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Using Innovative Technologies In Medical Education Of Ukraine Under Martial Law

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Abstract

Annotation. Reforming medical education, changing the paradigm towards ensuring the quality of professional training of future doctors, forming a modern educational space and harmonization with international standards on innovative technologies was interrupted by the Covid-19 pandemic and Russian military aggression. The relevance of the conducted research is called by determination of the directions of educational innovation, implemented by medical institutions of higher education in wartime conditions.

The methodological base of the research is the methods of scientific acknowledgement, structural and logical analysis. The scientific novelty of the issue lies in the comprehensive study of the peculiarities of organizing the training of higher medical education applicants through the prism of innovative educational technologies and interactive teaching methods use.

Based on the results of the research it is recommended to use a number of modern innovative technologies that are not yet sufficiently known to the general educational community. Among such we may note «flipped classroom», gamification, brainstorming, quest-task, training based education, STEM education. However, the implementation of the specified technologies and methods should be selected according to the individual capabilities and conditions for study of medical education applicants. The research also determines the peculiarities of knowledge assessment of higher medical education applicants in the conditions of innovative education and the change of the teacher's role in the educational process. The practical significance of the work lies in the possibility to organize the training of medical students in accordance with the tasks of training professionals of the new era.

Keywords: innovative technologies, interactive learning methods, educational webinars, brainstorming, quest tasks, workshops.

Introduction. The concept of reforming medical education in Ukraine foresees improving the effectiveness of professional training of healthcare professionals in accordance with the standards and recommendations of the European Higher Education Space: the introduction of Student-Centered

Learning (SCL) based on a competency-based approach and innovative technologies (Bodnar et al., 2022). However, the Covid-19 pandemic has forced almost all countries in the world to reconsider educational strategies and switch to distance learning (Newman, 2020; Roberts, 2020). Despite the fact that in Ukraine this transition caused some difficulties, as not all higher education institutions (HEIs) have high-tech equipment (telecommunication network, software, hardware), and users have the appropriate equipment, educators have successfully coped with this task (Bodnar et al., 2022). A new challenge for the national education system was the invasion of the Russian aggressor and the introduction of martial law. Among the most significant challenges are the complete or partial destruction of educational institutions, the destruction of their infrastructure, and the loss of qualified teaching staff and students. Higher education institutions, including medical ones, faced issues related to the organization of full-fledged educational activities during the period of hostilities.

The unique nature of medical education is due to the fact that the formation of clinical thinking and competencies of future doctors is integrally linked to practice-oriented forms and methods of education.

Even in the absence of unforeseen extreme situations, modern educational technologies should be focused on non-standardization, mobility, intensity of learning, laying the foundations of professional qualities in students, activating their cognitive needs, forming clinical thinking, making responsible decisions, which can be achieved through the introduction of the latest technologies, interactive learning in particular.

Interactive teaching and learning is a way of in-depth knowledge acquisition, conducted in close cooperation between the student and the teacher, who together outline and simulate various situations, think over the material, make decisions, analyze personal activities and the work of fellow students, and immerse themselves in scientific and educational cooperation.

The advantages of interactive methods are teamwork, involvement of all participants in the learning process, acquisition of skills to justify one's own opinion, respect for the existence of other views on the problem, and search for optimal options.

The remote format makes it much more difficult to acquire practical skills. In order to maintain continuity of education and reduce the gap between theory and clinical practice, a number of medical schools have introduced a Blended Learning model that integrates traditional and innovative educational technologies (Dziuban et al., 2018; Chen et al., 2020).

An analytical review of scientific and pedagogical publications on the organization of the educational process in wartime suggests that one of the leading trends in medical HEIs is the search for optimal models that would demonstrate their effectiveness in crises, testing innovative technologies and interactive teaching methods. This is evidenced by the presence of a significant number of articles that: cover the organization of the educational process of HEIs in times of war (Bodnar et al., 2022; Skrypnyk et al., 2022); review the experience of introducing information and communication technologies in medical education (Shapran et al., 2019); substantiate new approaches to the use of problem-based learning technologies and situational modeling (Phungsuk et al., 2022; Dushyk et al., 2021); present their own achievements in the context of the use of modern pedagogical technologies (Skrypnyk et al., 2022; Shapran et al., 2019; Khlamanova et al., 2019).

The main task of higher medical education institutions under the Medicine study program is to train doctors, who are committed to their professional duties, proactive, open to changing healthcare paradigms, able to diagnose, treat and prevent diseases at a high level, conduct innovative basic and applied research, implement their results in educational and clinical practice, and promote a healthy lifestyle in order to maintain and improve the health of individuals and society as a whole.

The purpose of the study is to analyze the principles and features of the use of innovative technologies in the professional training of higher medical education students based on existing domestic practices and own experience. The methodology of the study is based on the methods of scientific cognition and structural and logical analysis, which contributed to the determination of the role of innovative teaching technologies in the medical education system.

Without setting out to cover a wide range of issues related to the introduction of innovative technologies in one article, we will consider the most common national practices of their use in the educational process of medical institutions of higher education.

Research results and their discussion.

Innovations in education involve the introduction and dissemination of new ideas, tools, pedagogical and management technologies in educational practice, which result in the transition of the system to a qualitatively different level. Innovations in education include new teaching methods, ways of organizing classes, and methods of assessing learning outcomes. (Raza et al., 2022; Regmi et al., 2020).

As previous experience shows, one of the most effective ways of distance learning is to organize work through the Zoom system, which makes it possible to deliver lecture material in synchronous video conferencing mode and effectively conduct practical classes using personal gadgets. Control of the initial, final, current and final level of theoretical and practical training of students can be carried out through special service settings. The ability to use applications free of charge on both personal computers and smartphones directly from the link of the teacher-organizer of the Zoom conference is a significant advantage of this service (Skrypnyk et al., 2022). For effective use of additional educational material (electrocardiogram, results of visualization methods - radiographs, computed tomography, magnetic resonance imaging, scintigraphy and results of other examination methods), it is possible to use the appropriate settings of the service. For better learning, you can use video materials on the desktop (thematic videos) and interactive whiteboards. When working in the online system, it is possible to divide students into certain small groups for wider opportunities to form the basics of clinical thinking.

For those students who were unable to join the Zoom conference for objective reasons, the use of popular messengers such as WhatsApp, Telegram, and Viber provides direct communication with the teacher and is a worthy alternative to mastering the educational material.

Google Classroom provides great opportunities in the development of academic disciplines, where the teacher can quickly and accurately create different classes, clearly formulate tasks, objectively check them, adequately evaluate them, and reasonably comment on them. Students, in turn, have the opportunity to complete assignments independently of each other, and at the same time, communicate with each other and the teacher (Skrypnyk et al., 2022).

Class materials can be presented in text format, as well as in video and photo materials, PDF files, and links to information sites. The use of such services as Google Jamboard, Google Sheets, Google Docs, Google Meet, etc. helps to simplify communication. In unforeseen situations, the ability to save information on Google Drive if each student has a smartphone ensures the continuity of the educational process even if there is no access to a computer or laptop.

An integral condition for the formation of a modern educational environment based on innovative technologies is their integration with interactive learning technologies that implement a new type of learning interaction between teachers and students based on tolerance, cooperation and co-creation. Interactive technologies help to create conditions under which each student feels satisfied with his/her success and is intellectually capable (Xia, 2020). Thus, the choice of pedagogical technology is a choice of learning strategy, model of interaction between participants of the educational process, criteria for assessing the practical knowledge gained by students, and the style of work of the teacher.

Problem Based Learning (PBL), or PBL technology, is considered to be one of the components of student-centered learning. The technologies that combine the principles of problem-solving and modeling of professional activities also include team-based learning (TBL), case-based learning (CBL), simulation-based learning, and project-based learning (Khlamanova et al., 2019).

Problem-based learning has been used in education for several decades and is aimed at helping students acquire new knowledge through independent problem solving set by the teacher. The problematic nature is realized through setting tasks that are correlated with future professional activities and contain contradictory, redundant or incomplete data, implicitly presented alternatives to choice, and pre-planned mistakes (Phungsuk et al., 2017).

The introduction of problem-based learning (PBL) in medical universities involves the development of practice-oriented tasks based on thematic and diagnostically complex clinical cases using modern computer and multimedia technologies. Lecture material is presented mainly in the format of a presentation or video lecture. The variety of information based on multimedia facilitates its perception, forms an algorithm of thinking and action, and promotes learning that is more effective. As a result, cognitive interest is formed, which gives rise to a creative approach to mastering professional knowledge, develops critical thinking, intellectual and mental abilities. The process of acquiring knowledge from passive perception of lecture material is transformed into an active activity of students.

Our experience shows that a multimedia lecture is most effective when teaching generalized topics, as well as at the beginning of the course to increase students' interest in the discipline. A lecture with the use of feedback techniques involves an active dialog with the audience, so it is advisable to conduct it as a final lesson after students have formed basic knowledge and skills. The lecturer encourages students to actively participate in the discussion of the material, ask questions, express their opinions, and share their thoughts. Feedback helps the lecturer to understand whether the material has been learned deeply enough and to further improve the lecture delivery techniques.

In our opinion, an interactive lecture-analysis of a specific situation is promising, when a specific situation regarding clinical symptoms, differential diagnosis, or treatment approaches is not a general problem, but rather a specific situation. It is demonstrated in the form of a short but informative video, which is analyzed by all participants after viewing. The lecturer activates the dialog by asking questions, comparing or clashing different views. At the end of the lesson, based on correct and reasonable answers and judgments, the lecturer provides convincing evidence of misconceptions and leads the audience to a collective decision or conclusion. The use of problem-oriented situations that are interdisciplinary in nature is also effective. By integrating different clinical disciplines, we have the opportunity to activate the thinking of students, expand the scope of knowledge of the subject, deepen and generalize their previous knowledge.

However, learning that involves problem-solving does not always correlate with PBL technology. In this regard, it is important to define the differences between problem-based learning and PBL. The organization of the educational process using PBL technology changes the way information is transmitted, types of work, the structure of lectures and practical classes. It involves several basic principles, including: problematic nature, professional orientation, team implementation of the goal with personal responsibility for the final result, optimization of independence in performing tasks. However, it is often difficult for students to understand how to combine the acquired knowledge with the performance of real tasks in practice. This is where the advantage of problem-based learning lies, as it helps students not only find the answer or the right solution, but also identify their areas of ignorance, understand what knowledge or skills they lack to close existing gaps (Khlamanova et al., 2019).

The PBL technology has its own specifics in problem formulation. While in problem-based learning the problem is usually realized through the creation of problem situations, in PBL the problem is presented through a case in a professional context. Students work with key problems that reflect their future professional activities. The case always has a name and is interdisciplinary. In other words, the logic and content of the course of each academic discipline in PBL is based on the formulation and solution of case studies (Lopina, 2018). This gives grounds to interpret PBL as a practice of organizing self-study and preparing for lifelong learning, which is especially important for doctors.

There is a transformation of the model of organizing the interaction of participants. In PBL learning, the teacher is the organizer-participant of joint activities (dual position), and the student is a significant and influential partner, which indicates a partnership model. In problem-based learning, another model is implemented - the leadership model, in which the teacher is a leader who organizes the learning process according to the following scheme: creating a problem situation - forming and discussing different approaches to solving it -

choosing and justifying the correctness - analyzing the results of activities.

The PBL format changes the priorities in assessing students' learning outcomes. The success of each student is determined not only by the teacher, but also by those who study alongside him or her. Therefore, PBL technology requires adjusting the criteria for assessing the level of knowledge achieved during the study of the discipline. It is also necessary to pay attention to preventing the influence of personal relationships between students on the assessment of their work.

The overwhelming majority of academic staff positively assess the introduction of the **technology of situation analysis or "case-study"** based on solving situational tasks (cases).

The case method is based on a thorough analysis of a problem situation created by the teacher based on a specific clinical case, which helps to develop skills in making decisions on the tactics of managing a real patient. Each teacher is responsible for collecting and selecting educational material, choosing the type of case: video, text, audio, multimedia and organizing its effective use during the practical training. During the seminar, both typical and atypical clinical situations with in-depth differential diagnosis can be considered.

"Case-study" harmoniously combines theoretical and practical parts of the educational process.

The applicants for education must have a sufficient level of theoretical preparation for the class, effectively analyze and perform tasks from the case, independently draw conclusions and make decisions on establishing a clinical diagnosis, management tactics, medical and non-medical treatment, and development of preventive measures. In case of making an erroneous decision, the teacher should discuss the peculiarities of each clinical situation and reasonably explain the identified shortcomings to the student in order to make the student aware of the degree of responsibility for the wrong decision in future medical practice.

When teaching clinical disciplines, in particular, internal medicine, the case method makes it possible to choose the right decisions under conditions of uncertainty, develop an algorithm for managing patients in the clinic, master and improve practical skills, draw up a plan for additional examination, treatment, rehabilitation and preventive measures, use the knowledge gained in the study of theoretical disciplines to solve practical clinical problems, and, if necessary, work in a multidisciplinary team, taking into account the opinion of other specialists to make decisions.

Unlike PBL, where the problems are broader, case technology is based on specific examples. Structural components of a practice-oriented case method based on information web technologies may include: presentation of clinical cases, medical educational web quest, practical skills simulators (Lopina, 2018). Case studies are based on a set of clinical cases that require differential diagnosis, making certain diagnostic decisions, or choosing treatment tactics. They are usually based on case histories with a typical course of the disease and various variants of complications that have common pathogenetic links with the main nosological form in accordance with the curriculum of the discipline. Most often, cases contain a clinical case and its appendices in the form of a selection of laboratory and instrumental examination tests of the patient before and after treatment. The appendices may also include publications by domestic and foreign researchers, including the department's faculty on the topic of the class. In our opinion, the proposal of Lopina and Zhuravlyova (2019) to create an electronic database of clinical cases with high-quality visualization of educational and practical information (a kind of interactive archive of clinical cases) at both the departmental and university levels is reasonable.

Assessment of students' work can be focused on the quality of problem solving, methods of solving, or skills acquired in the learning process (Phungsuk et al., 2017). The value of case technology lies in the fact that it simultaneously reflects not only a practical problem, but also actualizes a certain set of knowledge that needs to be learned in solving it.

Project technology, as a component of PBL, involves individual or group independent activities of students aimed at the detailed development of a specific problem, which should result in a practical result. There are some differences between PBL technology and project-based learning: the former **focuses on the problem and the process of solving it**, while the latter aims to get the final result. This can be a multimedia presentation on medical topics,

a program plan for treatment and diagnostic measures for a virtual patient, etc. The introduction of project technology introduces students to different ways of processing information, promotes the development of the ability to construct their knowledge, present their work results, and develops self-organization skills. However, most teachers note that the issue of developing methodological support for educational projects in teaching clinical disciplines is urgent.

The "flipped learning" technology is widely used in foreign medical education, but in Ukraine, only some of its elements are still used. It consists of independent work of applicants at home, where they study the theoretical material of the course in the form of videos, podcasts, Power Point presentations, and further discussion in an academic group with the participation of a teacher. During the classroom sessions, students are assessed on the material they have learned, consolidate their theoretical knowledge and develop practical skills. The content of the information and test content is designed in such a way that, if necessary, the applicant can re-work it using online tools. According to V. Gillispie, an expert in the field of medical education in the United States, the technology demonstrates a new educational strategy that is more student-centered than traditional classroom teaching, as the teacher sets the learning vector and creates opportunities for extensive interaction between students (Shapran et al., 2019).

The strengthening of the practical aspect of medical training of future doctors increases the requirements for the development of professional skills and the ability to quickly navigate complex clinical situations. However, the periodic absence of case studies and the related impossibility of illustrating the diversity of the clinic complicates this process. In addition, in wartime, the emphasis shifts to mastering and improving students' relevant skills - providing emergency and urgent medical care, including during hostilities, resuscitation, mastery of methods of diagnosing and treating patients in conditions of increased danger, when coordinated teamwork and knowledge of new algorithms are required. These problems are solved by the introduction of simulation training technology and situational modeling technology, which are aimed at immersing students in a professional environment by reproducing real medical activities (Kudria et al., 2020).

Simulation technologies, using various mechanical, electronic and computer equipment in the form of phantoms, dummies, simulators and virtual simulators, make it possible to practice the algorithm of practical skills by repeating the same actions many times. Debriefing (post-task discussion) helps to evaluate one's own achievements and shortcomings in the process of work, analyze mistakes and make corrections during simulation training (Ayaz et al., 2022; Dushyk et al., 2021).

The task of the situational modeling technology is to develop a practical algorithm for the team's actions in choosing treatment tactics in various clinical situations as close to real ones as possible (Khlamanova et al., 2019). The scenarios of simulation games are based on computer modeling of different variants of the disease course; differential diagnosis and prescription of optimal treatment tactics. Researchers of the problem of game simulation believe that the situation that is the basis of each game should be relevant, typical, and provide for development options. They recommend that, in addition to information sufficient for diagnosis, the so-called "information noise" should include excessive information that most doctors always use (complex laboratory tests, instrumental studies, etc.).

The use of game practices and mechanisms in a non-game context to practice standard actions is based on gamification technology. It helps future doctors in cases where group interaction and efficiency in teamwork are required, and increases the effectiveness of compliance with emergency care protocols. Gaining practical skills through situational training and role-playing games significantly reduces medical errors by young professionals and reduces the potential risk to patients through clinical experience gained in a virtual environment. In addition to professional competencies, skills of interpersonal interaction, behavior in the medical community, and the ability to defend one's own point of view are also developed (Kudria et al., 2020). However, the use of **situational**

modeling technology is not without its drawbacks. In our opinion, such issues as the frequency of classes, the methodology for developing a simulation scenario, the parameters for evaluating students' work, etc. remain unresolved. We consider the large size of the training group and the limited time available for classes to be serious obstacles to the organization of simulation training.

The experience of conducting **educational webinars** in teaching internal medicine, which are conducted using the Microsoft Teams application in the format of a video conference, is worthy of attention. The applicant presents a clinical case in the form of a multimedia presentation, the head or professor of the department moderates the educational webinar, and expert teachers and students participate in the discussion of the clinical case and the formation of the conclusions of the conference.

Interactive **technologies of collective learning** are increasingly being used in the educational process, which allow students to acquire knowledge in cooperation with other students. One of these actively developing innovations is the workshop. This is a learning technology based on intensive group interaction and general discussion. Students gain knowledge and new skills by working not only with the teacher but also with each other. The methods of conducting the workshop usually include a mini-lecture with a presentation, problem tasks for group work, analysis and discussion of a clinical situation, conclusions and evaluation (self-assessment is possible). The peculiarity of the workshop is the individual work of each team member for the overall result and responsibility for its implementation. The debriefing element allows one group of participants to discuss the actions of another in an emergency clinical situation. The task of the teacher is to provide tactful guidance and help students to self-realize through action. Recently, there have been more and more studies of the structure of the workshop, the stages of its preparation and the specifics of its organization (Volosovets et al., 2021). The workshop is a certain indicator of the acquired knowledge and skills on the training topic and is best suited for brainstorming, interactive learning, and building teamwork in problem solving.

The use of the **brainstorming method**, which is considered to be an innovative learning technology, is relevant in the system of training a modern doctor. **Brainstorming** is a way to quickly solve a medical problem by generating new ideas or finding solutions to a particular medical problem through creative thinking and communication attack. Collective (group) work allows to generate as many ideas as possible by freeing discussion participants from inertia of thinking and stereotypes (Bodnar et al., 2022).

The success of brainstorming is ensured by meeting the following conditions: when forming a creative group, it should include only a few people who are well familiar with the problem to give full scope to the imagination of other participants; a clear statement of the purpose of brainstorming and selection of ideas; creating a comfortable and relaxed environment for discussing the problem.

The mechanism of brainstorming is that the discussion participants express their ideas in a free form, which are recorded. They also develop the criteria for evaluating the idea in terms of importance. The ideas put forward are grouped according to the content of the proposals. Upon completion of the work, the most effective ways of solving the problem that can be applied in practice are selected. The functions of the teacher (moderator) are to motivate brainstorming participants, regulate the process of generating ideas, stimulate the creative flow, and limit the time of each statement.

The teacher should lead the process. After explaining the problem, the group is given time to ask questions, which the teacher should answer as fully as possible. Each participant formulates his or her own ideas by writing them down rather than expressing them immediately. The floor is given in turn, and everyone expresses his or her ideas. The game form allows you to increase the level of enthusiasm for the learning process and generate interesting and non-standard ideas. At the end of the brainstorming session, the teacher can express his or her own informed opinion on the most successful ideas.

The technology of webquest in pedagogy is a problematic task with elements of role-playing game for which information resources of the Internet are used. The most common classification of web quests is the following:

1. In terms of duration, there are short-term (1-3 sessions), which are related to the acquisition of new knowledge; long-term (from 1 week to 1 month), aimed at clarifying and deepening the ideas and knowledge gained from information sources.
2. In terms of content - mono-project (including only one specific subject or topic), multi-project (interdisciplinary).
3. In terms of task type: self-educational, analytical, scientific, creative, etc.

An educational web quest site is an example of an interactive learning environment. It is dedicated to a specific topic and consists of several sections connected by a single storyline, full of links to other resources. Medical web quests are based on combining theoretical data with clinical cases, drawing up a plan for additional examination with a choice of diagnostic methods and determining treatment tactics and preventive measures. Their topics may be diverse, problem tasks may differ in complexity, but the name of the topics must necessarily indicate the problematic nature. The results of the web quest can be presented in the form of computer presentations, websites, flash videos. Teamwork under the guidance of a teacher creates responsibility for the research results published on the Internet. The algorithm for constructing a web quest and methods of its use in the training of medical professionals are presented by Kravets and Shevchyk (2018). Working with web quests enhances learning motivation, promotes the development of analytical and creative clinical thinking, forms the ability to analyze errors and prospects for finding ways to solve the problem and the task as a whole.

The role of the teacher is to encourage the search for the necessary information. He or she determines the format, outlines the boundaries of this activity in time, and helps to create conditions for individual or group tasks.

The use of Internet resources in the educational process allows to form and develop basic general competencies in students, in particular, the ability to apply theoretical knowledge in practical situations, make informed decisions; work in a team; improve skills in the use of communication technologies.

The special (professional, disciplinary) competencies for the discipline "Internal Medicine", which is compulsory in medical higher education institutions, include: skills of patient examination, ability to determine the necessary list of laboratory and instrumental studies with evaluation of their results, establishing preliminary and final clinical diagnosis of the disease, ability to determine the principles and nature of disease treatment, the necessary work and rest regimen, patient nutrition, ability to diagnose emergency conditions, chose the tactics of emergency medical care, skills of performing medical manipulations, ability to maintain medical records, define the tactics of managing persons subject to dispensary supervision and conducting an examination of their ability to work.

The introduction of innovative technologies requires new approaches to assessing students' learning activities. In modern education, one of the most widely used types of result-oriented technologies is a **"portfolio"** that reflects individual educational achievements and the level of general competence of a person. Unlike traditional assessment, a portfolio makes it possible to solve the following important tasks: to trace the dynamics of the educational progress of each applicant achieved in the process of implementing an individual educational trajectory and to form an authentic assessment and self-assessment of his or her educational achievements, which can be supplemented by traditional forms of assessment (credit, test, exam). The content of the portfolio demonstrates the potential of the applicant for further personal and professional development. The educational portfolio may consist of individual creative works, original assignments on a specific topic, essays on various topics and directions, photos, audio and video materials, a personal development program, etc. The main functions of an educational portfolio are self-organization of learning activities, tracking the success of the learning process, and its correction (Magrlamova, 2018).

The student-centered approach underlying innovative technologies changes the role of the teacher. Its task is to create organizational and

pedagogical conditions for the implementation of research activities, which allows, through the optimal combination of traditional and innovative teaching technologies, to significantly expand the boundaries of the educational environment.

The vector of activity shifts from the translator of information to the activation of students' learning, mentoring, and classes become not only a platform for gaining knowledge, but also a place to find like-minded people and answers to their internal questions (Skrypnyk et al., 2022). A teacher of a higher medical school should have an integrative approach to education, an up-to-date level of knowledge in related key disciplines, and have variable conceptual and social competence.

Conclusions. Given the challenges faced by medical HEIs, it can be concluded that the war has made adjustments and determined the specifics of training medical professionals at all levels. Nevertheless, the educational activities of medical universities are determined not only by the search for optimal training models that would demonstrate their effectiveness in crisis situations of limited practical training and dependence on the security situation, but also aimed at adapting to key international standards. The use of innovative technologies provides and expands the space for self-realization of students in learning, promotes the comprehensive development of the individual and the formation of professional competencies important for the future activities of a doctor, in particular, clinical thinking, diagnostic skills, improvement of practical skills, etc. Prospects for further research in this area, we believe, will consist in a detailed study of the algorithm for implementing educational innovations for students of higher medical education.

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