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EFFECTIVENESS OF DIGITAL EDUCATIONAL TECHNOLOGIES IN TEACHING OFTALMOLOGY BASED ON PROBLEM CASES

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Abstract
This article provides a theoretical analysis of the effectiveness of using the case-based learning (CBL) approach and digital educational technologies in teaching ophthalmology. Modern medical education requires students to develop clinical reasoning, independent decision-making, and adaptability to real clinical scenarios. In particular, integrating digital tools such as virtual simulators, online cases, instructional videos, and distance learning platforms with traditional classroom instruction is becoming increasingly important in ophthalmology education. Based on a review of scientific literature and current practice, the article substantiates that the synergy of case-based learning and digital technologies enhances the quality and effectiveness of ophthalmology teaching. It also highlights the positive impact of these methods on students' academic performance, motivation, and acquisition of practical skills.

Keywords: Ophthalmology, case-based learning, digital education, distance learning, virtual simulation, clinical reasoning.

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Introduction

In modern medical education, the transformation of theoretical knowledge into practical skills and the formation of independent clinical thinking in students play an important role. This approach is especially important in teaching ophthalmology, which is one of the clinical sciences. Traditional classes are often aimed at providing general theoretical information on diseases and may not be effective enough in preparing students for complex clinical situations. Therefore, the quality of teaching can be significantly improved by introducing problem-based case studies into the educational process - that is, Case-Based Learning (CBL) - and integrating it with digital learning tools [1]. Today, digital technologies are actively entering the field of medical education. Online platforms, virtual simulators, video lessons, interactive tests, and remote monitoring systems provide students with the opportunity to model real clinical cases, make individual decisions, and analyze controversial cases. Especially in ophthalmology, due to the multifaceted nature of diagnostic and treatment stages, complex visual analysis, and cases requiring narrow specialization, the use of digital educational technologies is of great practical importance [2]. In this regard, this article analyzes the role of digital educational technologies in teaching ophthalmology based on problem cases, their effectiveness, and integration into the educational process on a scientific-theoretical and practical basis.

Materials and research methods. In the process of preparing this article, scientific articles, international experience reports, and case studies published between 2019 and 2024 were analyzed. Current sources on teaching ophthalmology based on problem cases and the use of digital technologies were identified through the scientific databases PubMed, Google Scholar, ScienceDirect, ResearchGate, and eLibrary, and a total of more than 20 scientific articles and meta-analyses were studied. The data obtained were analyzed in depth and their practical significance was studied.

Purpose of the study. To analyze the effectiveness of digital educational technologies in teaching ophthalmology based on problem cases based on

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scientific literature and to assess the impact of this approach on the level of knowledge, clinical thinking skills, and practical training of students.

Main part. Ophthalmology is one of the most clinically and practically complex medical disciplines, in which the formation of students' clinical thinking skills, visual analysis skills, and independent decision-making capacity is of great importance. While traditional forms of teaching usually prioritized theoretical classes in the classroom, today's educational approaches require interactive and practical methods that ensure the active participation of students. Case-Based Learning (CBL) is one of the pedagogical approaches that meets these requirements [3]. This method is highly effective in improving the professional and clinical training of students, especially in narrow areas of medicine such as ophthalmology [4].

The CBL methodology is organized in such a way that students analyze cases based on real clinical situations, review the patient's complaints, anamnesis, laboratory and instrumental examination results, independently make a diagnosis, conduct a differential analysis and develop treatment proposals. This process not only transforms their theoretical knowledge into practical skills, but also develops important professional competencies such as critical thinking, communication, clinical reasoning and teamwork [5].

In recent years, digital educational technologies have been widely used to further enhance the effectiveness of the CBL approach. One of the unique aspects of ophthalmology is that the diagnosis of diseases in this field is largely based on visual signs of the organ of vision. Therefore, teaching in this discipline based on visual materials, images, animations and simulations is extremely important [6]. With the help of digital educational tools, students are given the opportunity to realistically and accurately demonstrate the appearance of ophthalmological diseases, model complex clinical situations in a virtual environment and thereby gain practical experience [7,8].

For example, with the help of virtual simulation platforms such as EyeSim, Touch Surgery, Oculus Surgical and others, students can perform many clinical procedures, such as ophthalmoscopy, biomicroscopy, ultrasound examination, intraocular pressure measurement, and diagnosis of cataract and glaucoma, in a

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safe and interactive environment [9]. These tools adapt to the individual learning pace of the student, allowing them to work on analysis, errors and correct decisions at each step, as a result of which the quality of the learning process increases significantly. In addition, with the help of online cases, clinical case videos, interactive tests and webinars, students have the opportunity to study ophthalmological cases in depth, work independently and conduct group discussions even remotely [10]. For example, with the help of cases based on patient photographs, CT scans, fundus images, the student forms a diagnostic algorithm for himself and develops a decision-making mechanism. Especially during the COVID-19 pandemic, distance learning experiences have proven the relevance and effectiveness of such approaches [11,12]. During this period, trainers have developed various interactive methods, problem-solving cases, and problem-solving strategies to maintain and facilitate student engagement through distance learning. According to the results obtained at the end of the year, students who received training in this method mastered the topics better than students who participated in traditional lectures.

Analysis based on scientific sources shows that the combination of a case approach and digital tools increases students' mastery, professional motivation, and readiness for practical work [13]. An international study conducted in 2022 found that students who studied ophthalmology on a case-based basis acted with greater confidence and independence in working with patients in clinical practice compared to a group trained in traditional methods [14]. They also had an 18% higher accuracy rate in diagnosing diseases. In addition, such educational approaches form a culture of continuous self-improvement, innovation, and application of medical innovations in students [15]. In turn, for the effective implementation of digital education, it is also important to have appropriate technical infrastructure, quality content, methodological guides, and a sufficient level of digital literacy [16]. In places with limited technological capabilities, such approaches may not produce the expected results. Nevertheless, practical experience confirms that properly planned and methodologically based digital case-based education produces high results in teaching ophthalmology [17].

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Conclusion

The combination of a problem-based case approach and digital educational technologies in teaching ophthalmology is emerging as an innovative and effective approach in medical education today. The scientific analysis conducted in this article shows that in the educational process organized through the case approach, students not only acquire theoretical knowledge, but also acquire important skills such as analyzing real clinical cases, critical thinking, independent decision-making, and teamwork. In particular, cases enriched with digital platforms allow students to create more interactivity, visual imagination, and practical experience. At the same time, for the effective implementation of digital educational technologies, it is necessary to increase digital literacy among teachers and students, create high-quality educational materials, improve technical infrastructure, and strengthen the methodological training of teachers. These factors ensure successful integration and create the basis for the full use of digital educational tools. In the future, further developing these approaches and introducing them on a systematic basis in all clinical disciplines will further expand the opportunity to train highly qualified, independent-thinking, and practical specialists.

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