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**POSSIBILITIES OF ARTIFICIAL INTELLIGENCE AS A SUPPORT TOOL IN MEDICAL EDUCATION. MAIN DIRECTIONS AND CURRENT ISSUES REGARDING ITS USE IN THE TRAINING OF MEDICAL STUDENTS**

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**Abstract.** The integration of artificial intelligence into medical education has emerged as a transformative approach to support students in acquiring theoretical knowledge and developing clinical reasoning skills. Traditional medical training relies heavily on extensive study of foundational subjects such as biochemistry, anatomy, physiology, pathophysiology, and clinical disciplines, which are essential for building competencies and professional skills. However, the rapid expansion of digital resources, scientific publications, and clinical databases has created challenges for students who must navigate large volumes of information. AI technologies, including large language models and adaptive intelligent systems, offer the potential to assist learners by summarizing complex texts, organizing information, facilitating interactive simulations, and providing immediate feedback. These tools allow students to engage in self-directed learning, critical analysis, and clinical scenario modeling, which enhances situational awareness and decision-making without risking patient safety. Despite these benefits, AI integration requires careful planning, ethical consideration, and active supervision by educators to avoid academic integrity issues, ensure data privacy, and maintain student autonomy in learning. The current study systematically reviews recent international and regional literature on AI applications in medical education, identifying trends, benefits, limitations, and practical implications for students and teachers. Findings demonstrate that AI can effectively complement traditional pedagogical approaches, enhance learning efficiency, and foster critical thinking and clinical competence. This study contributes to the scientific understanding of AI's role in medical education, emphasizing its function as a supportive tool rather than a replacement for active student engagement.

**Keywords:** artificial intelligence, medical education, clinical reasoning, adaptive learning, large language models, interactive simulations.

**МОЖЛИВОСТІ ШТУЧНОГО ІНТЕЛЕКТУ ЯК ДОПОМІЖНОГО ІНСТРУМЕНТУ У  
МЕДИЧНІЙ ОСВІТІ. ОСНОВНІ НАПРЯМИ ТА АКТУАЛЬНІ ПИТАННЯ ВИКОРИСТАННЯ  
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Інтеграція штучного інтелекту (ШІ) в медичну освіту стала трансформаційним підходом до підтримки студентів у набутті теоретичних знань та розвитку навичок клінічного мислення. Традиційна медична підготовка значною мірою спирається на ретельне вивчення фундаментальних предметів, таких як біохімія, анатомія, фізіологія, патофізіологія та клінічні дисципліни, які є важливими для формування компетенцій та професійних навичок. Однак швидке розширення цифрових ресурсів, наукових публікацій та клінічних баз даних створило труднощі для студентів, які повинні орієнтуватися у великих обсягах інформації. Технології ШІ, включаючи моделі великих мов та адаптивні інтелектуальні системи, пропонують потенціал для допомоги учням, узагальнюючи складні тексти, організовуючи інформацію, сприяючи інтерактивному моделюванню та надаючи негайний зворотний зв'язок. Ці інструменти дозволяють студентам займатися самостійним навчанням, критичним аналізом та моделюванням

клінічних сценаріїв, що покращує ситуаційну обізнаність та прийняття рішень без ризику для безпеки пацієнтів. Незважаючи на ці переваги, інтеграція ШІ вимагає ретельного планування, етичного врахування та активного нагляду з боку викладачів, щоб уникнути проблем академічної доброчесності, забезпечити конфіденційність даних та зберегти автономію студентів у навчанні. У цьому дослідженні систематично розглядається остання міжнародна та регіональна література щодо застосування ШІ в медичній освіті, визначаючи тенденції, переваги, обмеження та практичні наслідки для студентів та викладачів. Результати дослідження демонструють, що штучний інтелект може ефективно доповнювати традиційні педагогічні підходи, підвищувати ефективність навчання та розвивати критичне мислення й клінічну компетентність. Це дослідження сприяє науковому розумінню ролі штучного інтелекту в медичній освіті, підкреслюючи його функцію як допоміжного інструменту, а не як заміни активної участі студентів.

**Ключові слова:** штучний інтелект, медична освіта, клінічне мислення, адаптивне навчання, моделі великих мов, інтерактивні симуляції.

## Introduction

**Topicality of the problem.** Medical student training has traditionally been carried out through a significant amount of theoretical research in core subjects such as biochemistry, biology, physiology and anatomy, as well as pathophysiology, pathological anatomy and clinical disciplines. This knowledge structure ensures the gradual development of competencies and skills and is important for the professional training of future doctors. The digital information age and the rapid development of technology have created new challenges for students, and the ability to read textbooks and absorb huge amounts of information is no longer enough to ensure effective learning [1, 2].

The development of the Internet expands access to scientific publications, international databases and current clinical guidelines. However, these resources can only be used effectively if the sources are critically analyzed, the information is systematized and its reliability is assessed [3]. With the support of artificial intelligence (AI) technologies such as Google Gemini, Claude or ChatGPT, students can speed up the process of reading scientific articles, clearly identify their main ideas, organize information and draw analytical conclusions. This is especially important when writing term papers and dissertations, which require critical thinking and independent analysis, and are an integral part of academic integrity [4].

Medical education is undergoing a transformation thanks to artificial intelligence (AI) technology, which opens the door to the ability to learn from vast amounts of information, clinical reasoning, and even diagnostic algorithms [5]. On the other hand, its application requires a thoughtful approach: not creating text without human analysis and synthesis of information can lead to plagiarism in academic work. AI should be understood as an assistive technology that supports learning and teaching effectiveness, but not as a replacement for the learning activity that the student must perform analytically and creatively-practically [6].

At a practical level, AI applications can include lecture notes, long scientific texts, flashcard preparation, clinical case modeling, and analysis of the medical literature in general. It can also help you prepare for exams and tests. Flash-card.ai, ChatPDF, NotebookLM, EvidenceHunt or OpenEvidence allow students to organize and structure what they have

learned, combine theoretical and practical elements, and quickly and easily access medical information.

Particular attention should be paid to the protection of personal data and the use of reliable clinical sources. The integration of artificial intelligence into the educational process should be systematic and carefully planned, supported by practical training and facilitated by teachers so that students can master and use artificial intelligence tools in their learning and professional development [7].

The significance of this study is revealed by defining the role and scope of application of artificial intelligence in medical education, the impact on the effectiveness of the educational process, the development of critical thinking and the preparation of students for clinical practice, which will form a new paradigm in medical education using integrated technological support [8].

**Literature review.** In recent years, the number of scientific publications reporting research in the field of AI technologies in medical education has been growing. Over the past few years, numerous research studies have been published in the scientific literature that share research on the use of Artificial Intelligence (AI) technologies in medical education. The studies include both descriptive reviews of practices and possible applications as well as quantitative evaluations of the impact artificial intelligence tools have on the learning process.

One of the main contributions is a review of the scope of research conducted by Morris Gordon et al. (2024) which is organised according to the recommendations of BEME Guide No. 84, systematising the research literature on the use of artificial intelligence in medical education (teaching, learning, assessment) and highlighting the main directions of research and gaps for future studies on this topic [9]. A total of 278 publications were analyzed, mostly from North America and Europe, covering various applications of AI: to support traditional teaching methods, to assess knowledge, to improve clinical thinking and to implement innovative practices. The findings indicate that AI can be a powerful tool to support conventional education, boost learning efficiency, and enable the incorporation of innovative pedagogical methods. The ethical spaces and the lack of ethical norms standardization were highlighted, and will need further investigation. FACETS is proposed as a framework to guide educators, policy makers and researchers to standardize reporting and systematic development of AI in medical education.

A systematic review by Tojsin et al. (2024) confirmed these findings, evaluating the existing literature on the use of AI tools in medical education, their validation and evidence quality. The authors highlight the importance of adopting the potential of AI to redefine the learning process; however, many of the studies currently carried out may have limited sample size and methodological diversity [10].

The Feigerlova et al. (2025) systematic review is a quantitative systematic review which tries to evaluate the effectiveness of the AI interventions on learning outcomes within the health care system. This work is a collection of works that measure changes in skills, knowledge and other evidence of learning outcomes using AI tools [11].

Z. Ahsan, Analysis of the incorporation of AI in education interventions, simulations, clinical scenario modelling and assessment (2025). The authors call for the potential of AI in clinical thinking and feedback automation, the need for standardization and consider the cultural and social context of implementing AI [12].

Peng, J. et al. (2025) review the effectiveness of AI curricula in medical students. This review underscores the importance of AI tools like virtual patients and adaptive platforms, both for comprehending and utilizing educational materials, and for their potential in enhancing teaching and learning. The study by Moldt et al. (2024) explores how aware key stakeholders in medical education are about AI and the skills required for its effective utilization in medical education. A total of 38 participants were interviewed, including teachers, clinicians, students, and AI experts and persons from the administration of the TüKITZMed project in Germany. Six main categories and 24 subcategories of technologies were identified: digital and information literacy, ethics and morality, opportunity and risk assessment, practical application of software, analysis of medical test results and additional programming skills. Courses should be delivered in the form of lectures, seminars and practical work which is suitable for the students and also have some level of specialization for the students who wish to further their studies. This emphasizes the need for an interdisciplinary approach and a shared understanding of the role of AI among all stakeholders involved in the educational process, which will allow future medical professionals to acquire the practical, ethical and technical skills necessary to work with AI in clinical settings [14].

Evidence and results also show promise, but the evidence is also full of important literature about the pitfalls of employing AI in medical education, ranging from data quality to the ethical implications of using AI and its potential for negatively influencing student independence. Recent studies emphasize the importance of establishing ethical guidelines and providing students with the ability to critically evaluate the results of AI systems, taking into account their possible “hallucinations” and errors [15].

Current scientific publications provide a comprehensive overview of the prospects and challenges of using AI in medical education, combining empirical assessments of effectiveness, analysis of practical case studies, evaluation of stakeholder readiness, and consideration of ethical aspects. This multidimensional approach serves as a basis for further research and practical recommendations for integrating AI into the training of future medical professionals.

**Clarification of unresolved issues in this problem.** Although there is a large number of works devoted to the use of artificial intelligence in medical education, the impact of specific artificial intelligence tools on students' assimilation of theoretical information and clinical thinking has not been sufficiently studied. In particular, there is no systematic analysis that could collect information on the application of LLM methods and neural networks in clinical case modeling and generalization of scientific publications.

**The aim of the article.** This article aims to summarize current scientific knowledge on the use of artificial intelligence in medical education in order to see how it can be used and what its limitations are in medical education.

**Scientific novelty.** The scientific novelty lies in the systematic review of current research on the use of artificial intelligence in medical education, which allows integrating international and regional data to obtain an idea of its practical possibilities and risks.

**Practical significance.** The practical value of the results lies in the development of an objective information base for students and teachers of medical faculties, which will allow them to assess the potential of artificial intelligence in the educational process and make decisions on the rational and intelligent use of artificial intelligence.

### **Methodology.**

**Research methods.** Content analysis and comparative analysis of scientific publications were used for a systematic review of the literature. The research results were summarized based on key criteria: type of artificial intelligence tool, learning objectives, learning outcomes and limitations of use, using content analysis and comparative analysis.

**Data sources.** The empirical basis of the study was scientific articles and reviews from open databases from 2018 to 2026, PubMed, Scopus, Web of Science and Google Scholar. The following search terms for publications were used: “artificial intelligence”, “medical education”, “artificial intelligence tools”, “medical students”, “clinical thinking” and others.

**Study limitations.** The study findings are relevant to the context of medical education in higher education institutions (HEIs) that have access to modern AI technologies. They may need to be adapted to other educational systems or institutions that may have fewer resources to access digital content.

### **Results**

The literature search identified a diverse array of practices and approaches to using AI in medical education, demonstrating the current landscape of medical education support with digital technologies. A study of published material during the past few years has revealed a number of fields of scientific interest, that is, fields of active scientific research and of practical application.

The ability of the large language models and adaptive intelligent systems to assist in the teaching of theoretical knowledge is a significant part of scientific research. Some of these methods include automatic summarisation of huge quantities of text, the development of thematic notes and creation of interactive questions and explanations to help pupils learn basic subjects more effectively [16, 17]. The use of the automated generative tools described in these studies can be used to promote independent study because the systems can present information in a manner that matches the interest of the user's query, thereby providing yet another way to build up cognitive skills.

The other set of publications is related to the application of the intelligent technologies in the modelling of clinical scenarios and training of clinical judgement of students. In this context, artificial intelligence is employed to develop dynamic simulation environments that simulate clinical cases, which vary in parameters [18, 19]. These simulations can be used to change symptom sets, diagnostic testing choices, therapeutic interventions, etc. and have students make their diagnoses and treatment plans like in real life, but without risk to anyone. The cases reported here illustrate that interactive simulations can not only teach specific procedures, but also develop situational thinking, the ability to apply knowledge in a complex clinical context.

There are also several publications that discuss the preparedness and skills of the people who are part of the education system with regards to the use of AI in the modern education system. The findings of such research point to an awareness gap between students and teachers, as well as learning competencies that need to be acquired: understanding the

potential limitations and risks of AI systems; being able to critically evaluate their responses; integrating the data they have gained with the clinical decision-making process [20, 21].

Considerable attention is being paid to the ethical and academic aspects of the use of artificial intelligence. Recent literature reviews suggest that there is increasing concern about academic integrity, as students may employ generative tools to auto-generate text which they may not verify and interpret adequately. Academic pieces of work highlight the necessity to build moral structures and requirements for the usage of AI in the academic setting, which would limit how such technologies could be used, guarantee transparency in algorithms, and defend pupil information [22, 23].

Literature shows a lack of empirical evidence to draw conclusions about the long-term consequences of AI integration on particular learning outcomes, competence assessment, and graduates' preparedness for clinical practice. The majority of studies that are discussed are narrowly focused on specific examples of implementation, qualitative evaluations of effectiveness, or prospective models that need to be tested in large-scale studies using open and well-specified measures of effectiveness [24, 25].

This systematic literature review shows that the research on the use of artificial intelligence in medical education is an emerging field, not only regarding the technological aspects of what artificial intelligence can offer, but also the pedagogical, ethical and organisational aspects. The results reveal the promise of AI tools for enhancing the learning experience and lend opportunities for more empirical and methodological studies that evaluate the real-world outcomes of using such tools to build a learner's skills and capabilities as future health care practitioners [26, 27, 28].

### Discussion

**Interpretation of results.** The results obtained indicate that modern artificial intelligence tools are an auxiliary tool in medical education, where students can better process large amounts of theoretical information, develop cognitive skills and practice clinical thinking. The advantages of artificial intelligence are that it can personalize learning, provide quick and easy access to generalized information, and enable interaction with clinical cases. The effects are explained by mechanisms of adaptive content generation, presentation of dynamic situations and provision of immediate feedback, which allows students to edit their own thoughts and decisions in a safe space. At the same time, the effectiveness of these technologies largely depends on the course structure, pedagogical approaches and the active role of the teacher in the learning process.

**Scientific novelty.** The scientific novelty of the study is based on a comprehensive and systematic synthesis of recent publications on the use of artificial intelligence in medical education, which provides a comprehensive overview of the potential, limitations and practical aspects of use. Data from international and regional sources were aggregated for the first time, which allows illustrating the direction of the use of artificial intelligence in application areas and raising the pedagogical, technological and ethical issues that arise. The study also helped to better understand the role of AI as a tool, rather than a replacement for traditional student learning.

**Practical significance.** Even given a brief overview of the topic, the results obtained as a result of a systematic review allow students and teachers of the Faculty of Medicine to identify the potential of AI tools and subsequently use them for informed integration into curricula.

### Conclusions

The use of modern AI tools in medical education is a way to support the educational process, helping students better understand the theoretical basis of their research and develop clinical thinking. Adaptive intelligence systems and LLMs can provide personalized learning, engage students in self-directed use of learning resources, and develop their ability to analyze and integrate medical information. Incorporating AI into these clinical case

simulation and clinical simulation environments allows for the development of real-world skills, teaching decision-making, and shaping situational thinking without risk to the patient. Ethical and academic implications of AI use are highlighted, such as concerns about academic integrity and privacy, and the need to develop guidelines for implementing generative systems in the education sector. Currently, there is limited empirical evidence on the potential long-term impact of integrating AI on learning outcomes and graduate readiness for clinical application, and more controlled studies are needed, as well as the development of standardized assessment methods. Future research opportunities include further experimental studies of the effectiveness of AI tools in educational settings, the integration of AI tools into medical school education, and the development of ethical and methodological guidelines for the use of AI tools.

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