

Editorial

Integration of Artificial Intelligence Technology in Medical Education

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Artificial Intelligence (AI) originating in the mid-twentieth century, replicates human thought processes using computer systems, integrating elements from various disciplines. Since 1955, AI applications have expanded rapidly, addressing educational challenges in the past decade, notably in medical education. A Web of Science search indicates a growing interest, reflected in increasing publications and citations over the last two decades. The surge highlights a recent uptick in AI utilization for research and development in medical education, including virtual inquiry systems, medical distance learning, and teaching video creation in medical schools.¹

Medical education is a continuous learning process, spanning from undergraduate to postgraduate and specialty training, applicable to various healthcare professionals.^{2,3} Recognizing the need to build on existing knowledge amid rapidly advancing technology, AI in medical education becomes crucial. AI holds potential in enhancing the non-analytical, humanistic aspects of medicine, aiding healthcare professionals in processing vast amounts of information and improving diagnostic capabilities.³

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The current generation of learners, growing up in a digital world, values social connections, collaboration, and sharing activities through various software applications.³ Educators must adapt instructional tactics to engage these learners, utilizing approaches suggested by institutions like the Institute of Medicine. The evolving healthcare landscape, including digitalization and changing student demographics, necessitates an evolution in medical training.⁴

AI's application in curriculum development and analysis, learning, and assessment is significant. It can expedite curriculum reviews, solve complex problems, improve accuracy in classification, and assess relationships between parameters in curriculum assessment. AI contributes to personalized learning experiences, helping students identify knowledge gaps and offering accurate, rapid, and cost-effective assessments with detailed feedback.⁵

To reform medical education in an AI-driven world, emphasis should shift towards innovation and research, incorporating skills like statistical expertise and compassion. Students need to adapt to evolving technologies, and medical education must prepare them for a value-based payment system, where accountability for quality and cost becomes paramount.^{5,6} Wartman et al. stress the need for changes such as emphasizing invention

and research, developing skills beyond memorization, adapting to technological advancements, and transitioning to value-based healthcare systems.⁷

AI in Medical Teaching and Learning

AI in medical education can impact the learning process in three main ways: direct teaching, support teaching, and empowering the learner.⁸ Integration of AI tools, such as chatbots, intelligent tutoring systems (ITSs), virtual patients, gamification, and adaptive learning systems, enhances students' knowledge, skill development, and understanding of complex medical concepts.⁹⁻

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Chatbots, programmed with advanced natural language processing, can automate tasks like summarizing and evaluating research. While they offer quick access and assistance, caution is advised due to the potential for generating false references.⁹ Intelligent Tutoring Systems (ITSs) analyze student data to create personalized learning experiences, emulating one-on-one human tutoring. Virtual patients, interactive computer simulations of clinical scenarios, allow students to practice communication and clinical reasoning skills in immersive environments.¹⁰

The use of virtual reality (VR) and augmented reality (AR) with virtual patients makes learning more enjoyable and effective.^{11,12} Gamification, employing AI-driven games, enhances engagement and collaborative efforts, providing opportunities for risk-free clinical decision-making.¹³ Adaptive learning systems, integrated with learning management systems, personalize instruction to guide learners toward content mastery at their own pace.¹⁴

AI-based tools also show promise in diagnostic disciplines like radiology, pathology, and microbiology. Content-based image retrieval

(CBIR) aids in radiology teaching, while AI with machine learning contributes to diagnosing microbial infections. Advancements in deep learning technologies focused on cellular images can transform education in diagnostic pathology.¹⁵ In summary, AI reduces the burden of resource searching, offers personalized learning with immediate feedback, and provides simulation-based platforms for practical learning experiences.

AI in Medical Research

AI can be an asset for academic medical researchers by assisting in various aspects of their work. These tools can aid researchers in tasks such as collecting pertinent research articles, identifying knowledge gaps in the literature, formulating research questions, suggesting appropriate statistical methods for available data, creating graphical representations of data, and even supporting manuscript writing.¹⁶⁻¹⁷

One notable AI tool, ResearchRabbit, developed in 2021 by Human Intelligence Technologies Incorporated in Seattle, WA, USA, provides researchers in medical institutes with innovative ways to search for articles, find writers, monitor research landscapes, and collaborate with researchers from different institutes.¹⁶ This tool's strength lies in its extensive literature search capabilities, offering visualization maps based on network views and timelines.¹⁷

Moreover, AI can assist researchers in analyzing large datasets derived from patients' treatment charts, laboratory reports, and textual feedback from students. By extracting relevant information needed for research and structuring the data in an organized manner, AI streamlines the process for subsequent statistical analysis.¹⁸⁻¹⁹

Conclusion

Incorporating AI technology into medical

education is considered crucial to align with the changing expectations of learners and the growing digital environment. This integration presents various advantages, including the enhancement of diagnostic and problem-solving abilities, refinement of curriculum development and analysis, facilitation of personalized learning, and acceleration of evaluation processes. The article emphasizes the significance of prioritizing research, nurturing skills beyond memorization, embracing a value-based approach to medical practice, and equipping future healthcare professionals to embrace progress in AI and machine learning. However, a cautious approach is necessary, considering ethical implications, technical infrastructure, and faculty training to ensure responsible AI integration in medical education. To promote ethical considerations, medical education should include dedicated modules exploring the ethical aspects of AI, emphasizing transparency and comprehensibility in AI systems to build trust among students, faculty, and AI technologies.

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