Shiraz E-Med J. 2024 Dec; In Press(In Press): e144847. https://doi.org/10.5812/semj-144847.

Published online: 2024 April 9. **Letter**

The Role of Large Language Models in Modern Medical Education: Opportunities and Challenges

Abdollah Mahdavi [1], Masoud Amanzadeh [1,*], Mahnaz Hamedan [1]

[1] Department of Health Information Management, School of Medicine, Ardabil University of Medical Sciences, Ardabil, Iran

[*] *Corresponding author:* Department of Health Information Management, School of Medicine, Ardabil University of Medical Sciences, Ardabil, Iran. Email: m.amanzadeh@arums.ac.ir

Received 2024 January 9; **Revised** 2024 February 21; **Accepted** 2024 March 12.

1. Virtual Teaching Assistant

Large language models, like ChatGPT, can serve as virtual teaching assistants. Their capability to quickly provide information on a wide range of medical subjects around the clock makes them an invaluable resource for students (4). ChatGPT is adept at answering diverse questions related to medical topics, including anatomy and physiology, and can even suggest further study resources when necessary. Furthermore, this system has the ability to create a variety of exercises and assignments for students (5).

2. Interactive Learning and Knowledge Acquisition

Unlike conventional education methods, which often rely on passive delivery of information, LLMs promote an interactive learning experience. This approach facilitates active participation, enhances critical thinking, and ensures learners remain abreast of the latest medical developments and treatments (6).

3. Personalized Learning and Adaptive Teaching

Personalized learning and adaptive teaching accommodate the unique needs and preferences of each student. Large language models are capable of tailoring themselves to match the requirements and capabilities of individual learners by offering personalized learning paths. They can adjust the content, pace, and complexity based on the learner's knowledge and skills, providing explanations, guidance, and resources that are specifically suited to their needs (7). Through ongoing interaction, LLMs can track students' progress, pinpoint areas where knowledge is lacking, and supply targeted resources and exercises for additional learning. This adaptive method fosters personalized learning, boosts student engagement, and improves the learning experience.

4. Clinical Reasoning and Decision Support

For healthcare professionals, clinical reasoning is essential. Large language models can simulate patient scenarios, guiding learners through diagnostic processes and treatment decisions. By presenting complex cases, these models challenge students to apply their knowledge practically, thereby bridging the gap between theory and practice. The integration of LLMs into medical education presents a promising future, transforming learning experiences, personalizing education, and preparing students for real-world clinical challenges (8).

5. Continuous Assessment and Rapid Feedback

Assessment plays a crucial role in medical education by offering feedback on students' knowledge, skills, and abilities. Large language models-based tools deliver instant feedback on student performance, assessing their diagnostic and communication abilities. They also evaluate adherence to evidence-based guidelines and best practices, identifying knowledge gaps and weaknesses, thereby enhancing self-assessment skills and encouraging focused learning (4).

6. Research Assistant

As research assistants, LLMs support medical students in various research tasks, such as developing research plans, formulating research questions, conducting literature reviews, translating articles, summarizing scientific papers, and analyzing data. They also help in summarizing relevant articles and

identifying key findings, enabling efficient navigation of the vast amount of information available online (5).

While LLM-based tools in medical education offer promising opportunities, it's crucial to address potential ethical concerns and risks.

7. Privacy and Data Security

Integrating LLMs in medical education necessitates ensuring patient data privacy and security. It's imperative to implement robust data protection measures, including encryption, access controls, and secure storage, to safeguard patient confidentiality. When using patient data with LLM tools, obtaining explicit consent is essential (9).

8. Bias and Discrimination

AI systems, including LLMs, can inherit biases from their training data. These biases can perpetuate healthcare inequalities and exacerbate disparities. For instance, studies have shown that models like ChatGPT might reproduce gender and racial biases (10). In medical education, this issue could lead to inaccurate information or discriminatory experiences, limiting diverse perspectives. Addressing and mitigating bias in LLM outputs is critical for ensuring fairness and equality.

9. Ensuring Accuracy and Reliability

The accuracy and reliability of information provided by LLM-based tools are paramount in medical education, where inaccuracies can have serious implications. Despite being trained on vast datasets, errors and issues with the quality of training data can occur. Ensuring the use of high-quality, up-to-date medical data and implementing verification mechanisms are crucial for maintaining accuracy and preventing misinformation (11).

10. Maintaining Professionalism

The use of LLMs in medical education raises questions about maintaining professionalism. Although these tools can simulate patient interactions and provide diagnostic suggestions, the importance of real patient and healthcare professional interactions cannot be understated. It's vital for students to understand the limitations of LLMs and for machine-generated responses to be clearly identified as such to prevent confusion and misinformation (12).

11. Over-Reliance on Technology

Over-reliance on technology, particularly on LLMs, could detract from students' development of critical thinking and medical knowledge. Although LLMs offer an enriched learning experience, it's vital to maintain a balance between technological aids and human expertise. Excessive dependence on LLMs for information and decision-making may impede the cultivation of critical thinking abilities and clinical judgment. It's imperative for students to critically assess and verify information provided by LLMs (4).

12. Increase in Cheating

There's a concern that reliance on tools like ChatGPT might encourage academic dishonesty or "cheating," where a student might use ChatGPT for completing assignments without fully understanding the content or solutions. To mitigate this risk, educators should set clear guidelines and communicate the implications of academic dishonesty, alongside promoting assignments that demand critical thinking, creativity, and synthesis of information, and employing plagiarism detection tools (6).

13. Accountability and Transparency

As LLMs become increasingly integrated into medical education, establishing accountability and transparency is essential. Institutions should develop clear guidelines on the usage of LLM-based tools, delineating their limitations, risks, and appropriate applications. Mechanisms for reporting concerns about bias, inaccuracies, or ethical issues are also necessary (6).

While LLMs offer the potential to revamp clinical reasoning and assessment, they should complement rather than replace human expertise, critical thought, and compassionate patient care. Students are encouraged to scrutinize and appraise the information provided by these systems, viewing them as adjuncts to their learning. The implementation of LLMs promises to revolutionize the acquisition of knowledge, the development of clinical skills, and foster collaborative learning, preparing future healthcare professionals for evidence-based and empathetic care.

Footnotes

Authors' Contribution: Conception and design of the study were carried out by M.A., A.M., and M.H. M.A. and A.M. conducted the literature search and article acquisition. Article review and selection of studies were undertaken by M.A. and A.M. Data extraction was

performed by M.A., A.M., and M.H. Data analysis and/or interpretation were done by M.A., A.M., and M.H. The manuscript was drafted by M.A., A.M., and M.H., who also approved the version to be published.

Conflict of Interests: The authors listed below affirm their affiliation with Ardabil University of Medical Sciences and declare no financial (such as honoraria, educational grants, participation in speakers' bureaus, stock ownership, or patent-licensing arrangements) or non-financial interests (personal or professional relationships, affiliations) in the subject matter discussed in this manuscript.

Funding/Support: It was not declared by the authors.

References

1. Swanwick T. *Understanding Medical Education*. New Jersey, U.S: Wiley; 2018. https://doi.org/10.1002/9781119373780.ch1.
2. chatGBT. *OpenAI. ChatGP*. 2023, [cited 2023]. Available from: https://chat.openai.com.
3. Mahdavi A, Amanzadeh M, Hamedan M, Naemi R. Artificial Intelligence-Based Chatbots to Combat COVID-19 Pandemic: A Scoping Review. *Shiraz E-Medl J.* 2023;**24**(11). https://doi.org/10.5812/semj-139627.
4. Kung TH, Cheatham M, Medenilla A, Sillos C, De Leon L, Elepano C, et al. Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. *PLOS Digit Health*. 2023;**2**(2). e0000198. [PubMed ID: 36812645]. [PubMed Central ID: PMC9931230]. https://doi.org/10.1371/journal.pdig.0000198.
5. Gao CA, Howard FM, Markov NS, Dyer EC, Ramesh S, Luo Y, et al. Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers. *NPJ Digit Med*. 2022. https://doi.org/10.1101/2022.12.23.521610.
6. Ray PP. ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Int Thing Cyber-Physical Systems*. 2023;**3**:121-54. https://doi.org/10.1016/j.iotcps.2023.04.003.
7. Denny JC, Spickard A3, Speltz PJ, Porier R, Rosenstiel DE, Powers JS. Using natural language processing to provide personalized learning opportunities from trainee clinical notes. *J Biomed Inform*. 2015;**56**:292-9. [PubMed ID: 26070431]. https://doi.org/10.1016/j.jbi.2015.06.004.
8. Strong E, DiGiammarino A, Weng Y, Basaviah P, Hosamani P, Kumar A, et al. Performance of ChatGPT on free-response, clinical reasoning exams. *medRxiv*. 2023. https://doi.org/10.1101/2023.03.24.23287731.
9. Liebrenz M, Schleifer R, Buadze A, Bhugra D, Smith A. Generating scholarly content with ChatGPT: ethical challenges for medical publishing. *Lancet Digit Health*. 2023;**5**(3):e105-6. [PubMed ID: 36754725]. https://doi.org/10.1016/S2589-7500(23)00019-5.
10. Lippens L. Computer says 'no': Exploring systemic bias in ChatGPT using an audit approach. *Comput Hum Behav: Artificial Hum*. 2024;**2**(1):100054. https://doi.org/10.1016/j.chbah.2024.100054.
11. Haque MU, Dharmadasa I, Sworna ZT, Rajapakse RN, Ahmad H. I think this is the most disruptive technology: Exploring Sentiments of ChatGPT Early Adopters using Twitter Data. *arXiv preprint arXiv:2212.05856*. 2022.
12. Gunawan J. Current trends and issues in quality care and patient safety: A discussion with ChatGPT. *J Healthcare Adm*. 2023;**2**(1):1-9.