Title: ChatGPT in Medical Education: Promoting Learning or Killing Critical Thinking?

Authors: Rebecca Shin-Yee Wong

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Rebecca Shin-Yee Wong

Department of Medical Education, School of Medical and Life Sciences, Sunway University, Malaysia

ABSTRACT

Recent advancements in technology have transformed the landscape of medical education. The integration of new learning tools like ChatGPT has gained significant attention. This commentary discusses the opportunities and pitfalls of using ChatGPT in medical education. The interactive nature of ChatGPT renders it an invaluable tool for learning, as it allows medical students to seek clarification and receive immediate human-like responses. ChatGPT can also enhance subjective learning and writing skills and demonstrate potential in clinical decision support and differential diagnosis generation, which can benefit both educators and students. However, misuse of ChatGPT can lead to unintended consequences such as academic dishonesty, overreliance on technology, automation bias, and complacency, which hinder the development of critical thinking skills. Therefore, medical educators should encourage the ethical use of technology in medical education and address ethical considerations such as information accuracy, data security, confidentiality, and medico-legal issues related to technological integration..

Keywords: ChatGPT, medical education, opportunities, critical thinking, challenges

CORRESPONDING AUTHOR

Rebecca Shin-Yee Wong, Department of Medical Education, School of Medical and Life Sciences, Sunway University. No. 5, Jalan Universiti, Bandar Sunway, 47500 Petaling Jaya, Selangor, Malaysia
Email: rebeccaw@sunway.edu.my

INTRODUCTION

In recent years, medical education has undergone unprecedented changes, with stakeholders experiencing successive waves of technological advancements. Prior to the COVID-19 pandemic, the proliferation of social media, digital devices, and online resources was already reshaping the landscape of medical education. However, the COVID-19 pandemic itself has brought about the accelerated integration of newer technologies in teaching, learning, and assessment. As we gradually return to normalcy in the post-pandemic phase, the technology industry continues to introduce ground-breaking inventions such as

ChatGPT, which compels medical educators to re-think medical education in a technology-transformed world. It is noteworthy that concerns regarding the impact of social media and technology on students' critical thinking skills started before advanced tools like ChatGPT were introduced. For example, Wikipedia rapidly became a popular online encyclopaedia globally after its launch in 2001. Around the mid-2000s, students began to use Wikipedia extensively due to its wide coverage of various topics and user-friendly interface. However, the use of Wikipedia among students has sparked controversy as the accuracy and reliability of its information have been debated by educators. An earlier study by Giles compared the scientific entries of Wikipedia and Britannica reported that both contained errors, omissions, and misleading statements (1). Past research has also investigated the use of Wikipedia among college students in their academic research. The study concluded that such resources must be used cautiously, as there are concerns regarding the accuracy and reliability of the information (2). The release of ChatGPT, an advanced large language model (LLM) developed by OpenAI in November 2022 (1) (3), has captivated global attention. Operating on the principles of generative pre-trained transformers (GPT), ChatGPT is empowered to generate human-like text responses based on a large corpus of pre-trained text data. To date, there are many publications on the potentials and pitfalls of using ChatGPT in various industries, including medicine and medical education (4). As the utilisation of artificial intelligence (AI) models like ChatGPT continues to gain popularity among students, educators, and physicians, it is crucial to examine how these technologies impact medical education and patient care. Therefore, this commentary aims to shed light on the pedagogical advantages offered by ChatGPT while simultaneously scrutinising some potential drawbacks of its use.

USE OF CHATGPT TO PROMOTE LEARNING IN MEDICAL EDUCATION

LLMs are advanced AI systems trained on a large number of datasets consisting of texts and codes. These AI systems can handle language-related tasks in impressive ways, such as natural language translation and text summarisation, generating creative contents like scripts and poems. It is noteworthy that ChatGPT is

not the only LLM chatbot on the market. Other examples of LLM chatbots include Bard (powered by Google) and Bing (developed by Microsoft). However, the applications of LLMs are not limited to general applications. In the medical field, LLMs have many potential applications, such as analysing vast amounts of clinical data, identifying disease patterns, and supporting clinical decision-making (5). Therefore, there are plenty of opportunities for the use of ChatGPT in medical education. One of the advantages of ChatGPT is its interactive nature, which enables medical students to ask questions, seek clarification, and receive an immediate response. Research has shown that ChatGPT is capable of generating medically related information, as exemplified by its commendable performance in diverse medical exams such as the United States Medical Licensing Examination (USMLE) (6), the microbiology exam (7), the German medical progress test (8), the medical physiology exam (9), etc. These findings suggest that ChatGPT holds potential as a study aid and exam preparation resource. ChatGPT can serve as a writing tool to enhance students' subjective learning and expression skills, particularly for non-English-speaking students. Some potential applications include using ChatGPT as a language editing tool or getting the chatbot to provide feedback on language style and subjective expression of medical knowledge. Medical students can also utilise ChatGPT to conduct literature reviews and generate drafts for medical writing (10). On the other hand, by interacting with ChatGPT, medical students can refine their medical history-taking skills (11), while ChatGPT assumes the role of a simulated patient. Kao and colleagues demonstrated that ChatGPT has potential for enhancing workflow and serves as a clinical decision support tool in paediatrics (12). In breast cancer screening and assessment of breast pain, Rao and colleagues reported the feasibility of applying ChatGPT in radiologic clinical decision support (13). These findings suggest that ChatGPT has the ability to interpret clinical data and information and could potentially facilitate medical students in generating differential diagnoses and evidence-based decision-making. The integration of ChatGPT in medical education not only benefits medical students but also medical educators. For example, medical educators are able to access a large amount of information rapidly. They can utilise ChatGPT to generate case scenarios and problem-based learning materials or tap into ChatGPT's capabilities to generate teaching contents such as summaries, quizzes, and assignments, which saves time and increases work efficiency.

Furthermore, research has shown ChatGPT's high diagnostic accuracy using common chief complaints in clinical vignettes (14). These findings suggest that educators can utilise ChatGPT to enrich their teaching strategies and provide students with engaging experiences. Table 1 summarises examples of teaching and learning activities that can potentially utilise chatbots in medical education (15–20).

Table 1: Teaching and learning activities that can potentially utilise chatbots in medical education.

Teaching and learning activities	Key findings	Reference
Case-based learning	ChatGPT outperformed Bard and Bing in answering physiology case vignettes, with a high inter-observer agreement observed among physiologists in rating the responses by LLM.	(15)
Problem-based learning	ChatGPT was proposed to support students and facilitators in problem-based learning.	(16)
Self-learning	ChatGPT generated relevant and appropriate answers for multiple choice questions in medical biochemistry, demonstrating its suitability to be used as a self-learning tool.	(17)
Simulated patient interactions	Chatbots such as ChatGPT can be used to simulate patient interactions in a safe environment and are potentially useful in history taking, differential diagnosis and treatment planning.	(18)
Simulated patient interactions	ChatGPT exhibited the ability to generate clinical simulations for early clinical education, allowing students to make decisions on diagnosis and treatment independently throughout the entire patient encounter.	(19)
Virtual OSCE	A chatbot called OSCEBot ® was used to train medical students in an interview approach, which has the potential of simulating the OSCE environment.	(20)

DRAWBACKS FOR USE OF CHATGPT IN MEDICAL EDUCATION

The use of ChatGPT in medical education presents certain disadvantages. Information accuracy remains a

big challenge. As ChatGPT was trained up to September 2021, it may lack access to more recent information. The chatbot occasionally produces erroneous or non-existent information. The problem of artificial hallucinations has been reported by researchers (21) and has significant implications if medical students and medical educators were to depend on ChatGPT as their primary source of information for teaching, learning, or exam preparation. Applying ChatGPT to academic writing has sparked considerable controversy. Some premier journals like Science, Nature, and Journal of American Medical Association (JAMA) do not accept ChatGPT as an author, while some journals explicitly prohibit the inclusion of AI-generated text (22). The use of ChatGPT in academic writing may lead to a lack of originality as well as the potential for cheating and plagiarism (23). Therefore, it is important that medical students are educated regarding the responsible use of LLMs and the originality of their works. Additionally, any works that are submitted for medical publishing must clearly declare the use of LLMs for transparency (24). Notably, with the emergence of LLMs, researchers have also explored tools to detect AI-generated text (25). However, there is still room for improvement in these detection mechanisms. Furthermore, overreliance on technology may lead to other unintended consequences, such as hinderance to the development of critical thinking skills. Automated bias emerges as people tend to choose the pathway that requires less cognitive effort when making decisions. Therefore, there is a tendency to let technology dictate the path. Conversely, people may become less attentive or vigilant because they tend to trust the information provided by technology, with a lower suspicion of errors when they become complacent (26). These behavioral tendencies when interacting with technology have a negative impact on the attainment of critical thinking skills and may also kill medical students' creativity. Additionally, there are several ethical issues associated with the use of ChatGPT in healthcare and medical education; these include data protection, patient confidentiality, consent, medical errors, and medico-legal issues (27). In September 2023, a new vision feature was added to ChatGPT, which allows users to upload an image for the extraction of factual information or subjective interpretation of the image. Although this feature has many potential applications in basic medical sciences, such as medical image interpretation, there are limitations in clinical medical education. Some ethical considerations concerning the use of this new feature include patient privacy and data security, as

unauthorised or inappropriate image handling may lead to ethical breaches and legal repercussions (28). Therefore, medical educators should be cautious whenever the use of ChatGPT in teaching involves confidential patient information. The limitations of ChatGPT should also be explained to the students to encourage safe and responsible use of the technology.

Figure 1 summarises the opportunities and drawbacks of using ChatGPT in medical education.

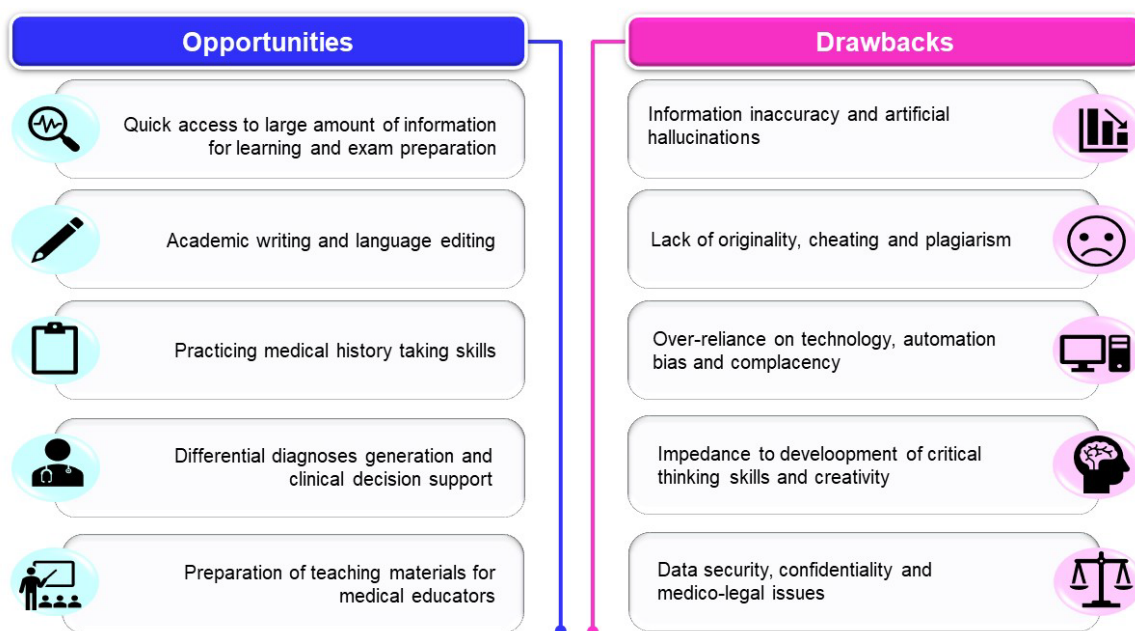| Opportunities	Drawbacks
Quick access to large amount of information for learning and exam preparation	Information inaccuracy and artificial hallucinations
Academic writing and language editing	Lack of originality, cheating and plagiarism
Practicing medical history taking skills	Over-reliance on technology, automation bias and complacency
Differential diagnoses generation and clinical decision support	Impedance to develoopment of critical thinking skills and creativity
Preparation of teaching materials for medical educators	Data security, confidentiality and medico-legal issues

Figure 1 Opportunities and drawbacks for using ChatGPT in medical education

FUTURE DIRECTIONS

Despite the drawbacks of using ChatGPT in medical education, its future directions are still promising. The ongoing advancements in LLMs offer opportunities to improve ChatGPT and other chatbots for more tailored applications in medical education. For example, future research should focus on addressing the complexity of medical scenarios and ensuring the accuracy of medical information generated by ChatGPT. Research should also focus on developing adaptive learning features based on individual student learning

needs and learning preferences. If used appropriately, ChatGPT and other chatbots can be used as an intelligent virtual tutor and self-learning tool. Further explorations into the use of ChatGPT in various teaching and learning activities and as an assessment tool are also warranted. Particularly, there should be long-term studies to investigate the impact of ChatGPT on learning outcomes, knowledge retention, and clinical decision-making skills in medical education. More importantly, AI experts, medical educators, and policymakers should work collaboratively to develop guidelines for the responsible and ethical use of AI in medicine and medical education.

CONCLUSIONS

The integration of technology in medical education can act as a double-edged sword. When used appropriately, ChatGPT can be a useful tool in medical education. However, misuse of ChatGPT can also lead to pitfalls. As we embrace new technologies in medical education, we should also implement guidelines to encourage the ethical use of ChatGPT. Medical schools should have a clear policy on its use, and users are encouraged to validate the information with reliable sources, such as practice guidelines, to ensure the accuracy of the information. While ChatGPT can be used as a supporting tool, it cannot replace critical thinking skills and clinical reasoning. Medical schools should also incorporate ethical issues related to the use of AI in the curriculum, such as data security, confidentiality, and medico-legal issues.

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