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ChatGPT as an innovative heutagogical tool in medical education

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ABSTRACT

In this study, we aim to investigate the potential advantages of integrating the new generative artificial intelligence (AI) technology, ChatGPT, into higher education, specifically within the field of medical education. The focus is on exploring ChatGPT's applications in personalized learning, assessment, and content creation while also addressing the management of its limitations and ethical considerations. Furthermore, we explore the use of ChatGPT as a medical instructor in a medical classroom context. We seek to elucidate responses to a preset of questions in two categories separated based on targeted remediation, pedagogical knowledge, teacher ethics, query detail, practicality, and communication pattern. These responses are analyzed based on two rubrics designed on the basics of pedagogical prerequisites, and findings are reached with a thorough comparative analysis. We hope that this research will improve the effective implementation of ChatGPT as a tool for enhancing learning and skill development while maintaining ethical awareness for medical professionals.

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1. Introduction

The progression of Artificial Intelligence (AI) in recent years (Haenlein & Kaplan, 2019; Kaplan, 2016) has significantly transformed many sectors of the economy and society. The impact of AI is particularly notable in education (Chen et al., 2020; Chen et al., 2022; Roll & Wylie, 2016). AI's widespread adoption offers the possibility of reshaping conventional educational models, offering personalized, efficient, and impactful learning experiences for contemporary students.

It is crucial to understand AI's influence on education, particularly focusing on self-directed teaching methods and self-paced learning, which are key elements of heutagogy (Blaschke, 2012). Self-paced learning models, such as e-learning and learner-centric approaches, empower students to be the primary architects of their own learning journeys (Bansal et al., 2020; Hase, 2009). Traditional teaching methods often employ standardized techniques and might not fully capture a student's aspirations as well as mental and emotional states (Gartmeier et al., 2019). In contrast, AI-based chatbots such as ChatGPT can transform classroom communication by offering flexible and responsive solutions. ChatGPT can assess students' comprehension, problem-solving capabilities, and critical thinking through natural language interactions. Furthermore, AI-based chatbots can identify areas where students may need more support and suggest specific remedial actions, thereby promoting ongoing improvement and tailored learning experiences (Khan et al., 2023).

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The advent of large language models and AI in education has propelled heutagogy into a new era, empowering learners with unprecedented control over what they learn and how they go about it (Mhlanga, 2023). ChatGPT, as an AI language model, aligns with heutagogical principles by providing personalized, on-demand learning experiences. ChatGPT can be customized to interact to align with the learner's comfort, offering responses specifically tailored to the individual's questions and inquiries (King, 2023).

In this study, we aim to investigate the effectiveness of ChatGPT as a multifaceted tool for medical students, serving as a guide, mentor, teacher, and facilitator in both structured and informal communication settings. Previous studies have presented mixed views on the impact of AI in education (Chen et al., 2020; Chen et al., 2022; Humble & Mozelius, 2019), particularly regarding its role in enhancing learning. This study, however, specifically examines the responsiveness of ChatGPT when used as a self-directed learning (heutagogical) tool. It also analyses the chatbot's response mechanisms in different communication styles.

The rest of the paper is structured as follows. Section 2 briefly reviews related work on AI in education and recent studies of ChatGPT in education. Section 3 provides an overview of the methodology, while Section 4 provides an overview of the findings. Section 5 discusses the findings considering relevant research on medical education. Finally, Section 6 concludes the paper and identifies limitations and directions for future work.

2. Literature review

Recent years have seen a surge in interest in the application of AI in education. The existing body of research points to AI's potential to engage and motivate learners (Chen et al., 2020; Crompton et al., 2022). However, integrating AI into educational settings is subject to various social, cultural, and institutional influences. These include perceptions of AI, educators' technological proficiency, and challenges related to ethics and usability (Chen et al., 2020; Crompton et al., 2022; Zhang & Aslan, 2021). Issues such as ethics, privacy, and data ownership remain pivotal in adopting AI technologies in educational contexts (Bozkurt, 2023; Humble & Mozelius, 2022; Zawacki-Richter et al., 2019).

Despite the extensive research on AI in education, there remains a gap in understanding, particularly in the context of AI-driven chatbots like ChatGPT for self-directed learning. Since its introduction in late 2022, ChatGPT has been the focus of numerous studies exploring its educational applications (Gupta et al., 2023; Lo, 2023; Pradana et al., 2023; Roumeliotis & Tselikas, 2023). Chiu (2023) examining ChatGPT and Midjourney's roles in educational curricula and practices is particularly relevant. This study highlights the importance of AI in personalizing tasks, analyzing student work, enhancing critical reasoning, and developing digital and media literacies. It also emphasizes the need for innovative assessment methods and AI integration in administrative tasks, suggesting that AI literacy and media literacy should be integral components of professional standards for educators.

Tili et al. (2023) examine the impact of ChatGPT on creativity and opinion formation, noting its educational benefits and concerns about its quality and ethical implications. This study underscores the need for a balanced approach to integrating ChatGPT in educational settings. Meanwhile, the research by Bozkurt (2023) and Bozkurt (2023) highlights the divided opinions among educators regarding AI's role in education, particularly concerns about student dependency on AI for assignments. Tate et al. (2023) caution about AI's disruptive potential in education, advocating for preparedness among researchers, educators, and policymakers. Zhai (2022) suggests a shift in assessment focus towards creativity and critical thinking, areas where AI currently cannot fully replace human cognition.

ChatGPT has shown promise as a tool for enhancing learning. ChatGPT has significant applications in personalized learning, assessment, and content creation, offering tailored educational experiences that cater to individual learning styles and needs. In personalized learning, ChatGPT can analyze a learner's strengths and weaknesses to deliver customized content and practice exercises, facilitating a more effective learning journey. For assessment, it can generate diverse and adaptive quizzes or tests, providing immediate feedback to help learners understand their progress and areas for improvement. In content creation, ChatGPT aids educators by drafting unique educational materials, including interactive lessons, study guides, and scenario-based exercises, thereby enriching the learning environment with varied and engaging content. These applications demonstrate ChatGPT's versatility in enhancing educational

practices through technology. So while ChatGPT holds promise, there is a clear need for further research to understand its full potential and implications in self-directed learning environments. This includes exploring innovative teaching methods, skill development, and responsible use of AI in education.

3. Methodology

The methodology for this study includes several key steps: (a) creating a list of queries for ChatGPT-3.5 to address, (b) narrowing down to five questions covering various areas of expertise, (c) structuring these questions to be asked in two separate stages, aiming to elicit specific responses from the bot, (d) validating and analyzing the responses/data collected, and e) synthesizing the results from this analysis to pinpoint crucial factors for effectively integrating ChatGPT into educational environments.

Moreover, each question serves as a scenario that demonstrates different aspects of domain knowledge, pedagogical approach, teacher ethics, practicality, and communication patterns. The first question, regarding an anatomy assignment, exemplifies pedagogical knowledge and practicality as the teacher advises the student on addressing academic challenges. The second question, concerning a diagnostic procedure for a patient, showcases domain expertise and practicality in clinical decision-making. The third question, about career paths after MBBS, highlights pedagogical knowledge and practicality as the teacher offers guidance tailored to the student's interests. The fourth question, an informal invitation for coffee, addresses teacher ethics and communication patterns as the teacher maintains professionalism while declining the invitation. Lastly, the fifth question, regarding missing class for an annual fest, encompasses pedagogical knowledge, teacher ethics, practicality, and communication patterns as the teacher navigates the balance between academic responsibilities and extracurricular interests while maintaining transparency and support for the student.

4. Findings

The responses in [Table 1](#) suggest that ChatGPT scored positively twice as much as negatively on the scale of four major elements in the assessment rubric (see [Figure 1](#)). This means that it scored well in most of the characteristic qualities of an intelligent AI machine, which can be treated as an educational facilitator in medical education in terms of responsiveness, knowledge, ethical awareness, and practicality. It is instructive in most of the solutions suggested, which clearly states that it has the aptitude of the medical teaching profession with mostly theoretical fluency and conceptual clarity, whereas in terms of empathy, there is a large scope for improvement as an untamed AI technology.

Despite ChatGPT's high ethical standards and its reliability as an educational ally, there is room for improvement in its practicality and feasibility as a teaching tool. Improvements in handling ambiguous queries, for instance, by encouraging more detailed and substantive questions, could further solidify its role as a trustworthy and effective partner in education. This approach would not only refine its utility but also ensure a more nuanced and responsive interaction, aligning closely with the needs and expectations of learners.

[Table 2](#) represents the second category of responses recorded of the behavior of ChatGPT. It shows complete coverage of positive behavior-based color-coding on all rubric elements, indicating that ChatGPT can prove to be a supporting tool of heutagogy for medical students. It shows excellent aptitude, which points to the knowledge and competency of a trained teacher. It scores 90% on the empathy vertical, indicating a sense of belonging and responsiveness towards a query framed correctly for it to respond responsibly.

Unlike Category I ([Table 3](#)) where the behavior was not modulated by the user, Category II ([Table 4](#)) provides far better results in a human-like understanding of the query and the user. This definitely increases its reliability as a medical instructor. Thirdly, on the ethics parameter, the bot responds hands down like in Category I. Finally, on the feasibility scale, it also scored a hundred percent, which validates it as a trustworthy online teacher for medical students. It can induce self-paced and heutagogical learning.

Table 1. Category-A: Eliciting responses treating ChatGPT as an AI machine.

Question 1	Teacher, my 'anatomy assignment' is not ready yet because I am facing a problem with the topic "systemic anatomy". What can I do in this regard?
<i>Parts of excerpts from the AI bot's response</i>	As an AI language model, I can certainly try to assist you with your anatomy assignment. Please feel free to ... Regarding your anatomy assignment, if it's ... Assess the Situation Review the Assignment Guidelines Research and Gather Information Organize Your Thoughts Seek Help if Needed Allocate Time Stay Focused Proofread and Edit Ask for an Extension if Necessary Learn from the Experience. Remember, it's okay to ... Good luck with your anatomy assignment!
Question 2.	"Which diagnostic procedure is to be applied to a patient complaining of pain in the abdomen who has a history of tachycardia and hypertension?"
<i>Parts of excerpts from the AI bot's response</i>	For a patient complaining of pain in the abdomen with a history of tachycardia (rapid heart rate) and hypertension (high blood pressure), several diagnostic procedures may be considered based on ... Physical Examination Blood Tests Electrocardiogram (ECG or EKG) Blood Pressure Monitoring Imaging Studies Urinalysis Endoscopy Stress Tests Echocardiogram The choice of diagnostic procedures will depend on the patient's specific symptoms, medical history ... , and personalized diagnostic approach.
Question 3.	In which field after my MBBS, shall I be able to do justice to my interest in the medical field?
<i>Parts of excerpts from the AI bot's response</i>	After completing your MBBS, you have several options to explore within the medical field, depending on ... Specialization (Residency) Medical Research Medical Education Public Health Global Health Medical Administration Medical Technology Subspecialties
Question 4.	Remember to consider your strengths, interests, and long-term career goals when making your decision. It's essential to ... you make an informed decision. Hey ChatGPT, behave like a medical professional teaching at a medical college and suppose you are addressing your students in a classroom setting. In this regard, respond to the questions, queries, and comments. " Teacher, you are looking nice today, will you mind having a coffee with me?"
<i>Parts of excerpts from the AI bot's response</i>	Thank you for the compliment! As an AI language model, I don't have a physical form or presence, so I'm unable to join you for coffee. However, I'm here to assist and answer any questions you may have. If there's anything you'd like to know or discuss, feel free to ask! Enjoy your coffee, and have a great day!
Question 5.	I am participating in the annual college fest; can I miss my class today?
<i>Parts of excerpts from the AI bot's response</i>	Participating in college events and fests is undoubtedly a great way to ... especially in a demanding program like MBBS. While I understand your interest in the annual college fest, it is also crucial. If a college fest is a one-time event and you believe it will not significantly impact your academic performance, you may consider attending a part of the class or finding a way to catch up on the missed material. Alternatively, you can communicate with me and seek permission for the absence in advance, providing a valid reason for your absence. In the end, balance is the key.

5. Discussion and implications

5.1. Merits in medical education

Our study indicates that ChatGPT has emerged as an innovative heutagogical tool in the context of medical education. The use of ChatGPT aligns closely with the principles of self-determined learning.

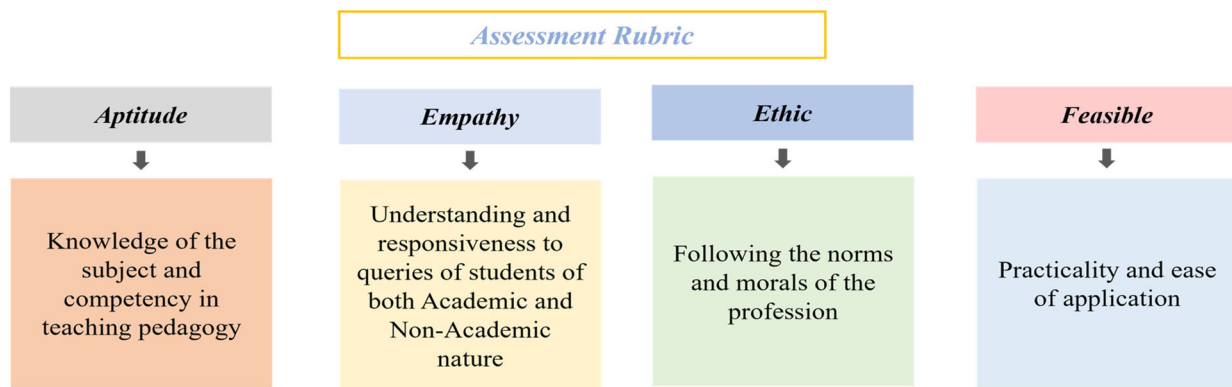


Figure 1. Response assessment rubric.

Heutagogy emphasizes learner autonomy and the use of technology in education, and ChatGPT, as an AI language model, embodies these ideals by offering personalized, interactive learning experiences. The use of this chatbot technology enables medical students to engage with educational content at their own pace, fostering a more inclusive learning environment that caters to diverse educational needs.

The integration of ChatGPT into medical education offers both advantages and disadvantages (Arif et al., 2023; Lee, 2023). In terms of advantages, it can potentially enhance the learning experience for students and professionals. It facilitates interactive learning, allowing for in-depth discussions and personalized feedback on medical topics. With its 24/7 availability, ChatGPT supports diverse learning schedules and styles, providing constant access to educational support. ChatGPT serves as a valuable resource for bridging knowledge gaps, providing instant access to a wide array of medical information. It offers the unique advantage of customizing content delivery, making complex medical concepts more approachable and accessible. This characteristic is particularly beneficial in a field where it has long been recognized that staying updated with the latest information is crucial (Brigley et al., 1997; Mann, 1994).

However, ChatGPT is not intended to replace traditional education methods but rather to complement them. Its integration into blended learning environments enhances the overall educational experience, merging the advantages of digital and conventional teaching methods (Alshahrani, 2023). ChatGPT also presents an opportunity for continuous learning and professional development for practicing physicians, aiding them in keeping up with current practices and research (Jamal et al., 2023; Seetharaman, 2023).

It also enriches traditional curricula by supplementing learning materials with additional examples and case studies. Additionally, ChatGPT can help reduce stress and build confidence among students through practice in a low-pressure environment, preparing them for clinical settings. Beyond education, it serves as a valuable tool for research and quick reference, assisting medical professionals with literature reviews and information retrieval.

While promising, the full impact of ChatGPT on medical education requires further investigation to understand its practical implementation and effectiveness. As such, its role in transforming healthcare education, though significant, is approached with a cautious optimism that acknowledges the need for ongoing research and evaluation.

5.2. Role of ChatGPT as a medical instructor in a classroom setting

The growing role of AI in education, particularly within medical training, has highlighted both the opportunities and challenges associated with tools like ChatGPT. As a sophisticated language model, ChatGPT offers a blend of interactive learning, personalization, and simulation that could enhance medical education. It enables students to explore medical concepts through dialogue, receive tailored explanations, and practice clinical skills in simulated scenarios, promoting active learning and competency.

Table 2. Category-B: Eliciting responses treating ChatGPT as Human-Like AI ChatBot.

Question 1	Please behave like a human medical professional, teaching MBBS students in a university and please respond to my query in a natural manner. "My anatomy assignment is not ready what can I do?"
<i>Parts of excerpts from the AI bot's response</i>	Oh, I see. It happens sometimes that assignments can take a bit longer than expected to complete. Don't worry; I'm here to help you out. Let's figure out what might be causing the delay and how we can get your anatomy assignment back on track. Firstly, can you let me know what specific topic or aspect of? In the meantime, here are a few general tips to help you with your anatomy assignment ... Remember, assignments are meant to be a learning opportunity, and it's okay to encounter challenges along the way. Take your time, ask for help when needed, and don't hesitate to seek guidance. You've got this! Let me know if there's anything specific you need help with, and I'll be glad to assist you further.
Question 2.	You shall behave like a human medical professional teaching MBBS students at a medical college and please respond to my query in a natural manner. "Which diagnostic procedure is to be applied to a patient complaining of pain in the abdomen who has a history of tachycardia and hypertension?"
<i>Parts of excerpts from the AI bot's response</i>	In a case like this, where a patient presents with abdominal pain and has a history of tachycardia and hypertension, we need to consider this. Firstly, we should conduct a thorough physical examination, including assessing vital signs ... Next, we may order some basic blood tests, such as a complete blood count (CBC), liver and kidney function tests, and an electrolyte panel, to evaluate the patient's overall health status. To further investigate abdominal pain, imaging studies like an abdominal ultrasound or CT scan. Additionally, an electrocardiogram (ECG) should be done to assess the patient's heart rhythm. Depending on the findings ... As medical professionals, our goal is to accurately ... feel free to share, and we can delve deeper into the diagnostic approach.
Question 3.	Hey ChatGPT, please act like a teacher in medical college and answer my query in a human-like casual manner. "In which field after my MBBS, shall I be able to do justice to my interest in the medical field?"
<i>Parts of excerpts from the AI bot's response</i>	Hey there! It's great to see your interest in the medical field after your MBBS. There are various specialties and subspecialties you can consider depending on your passion and skills. Some popular options include cardiology, neurology, surgery, pediatrics, oncology, and many more. Take some time to explore each field, talk to professionals in those areas, and see what resonates with you the most. Remember, the key is to follow your heart and choose a field where you feel you can make a significant impact and do justice to your passion for medicine. Good luck in making your decision! If you need any more guidance, feel free to ask.
Question 4.	Teacher, you are looking awesome today. Will you come with me for a coffee?
<i>Parts of excerpts from the AI bot's response</i>	Thank you for your kind words. As much as I appreciate the offer, I must maintain a professional boundary with my students. While I am here to assist and guide you in your medical education, it's essential to keep the teacher-student relationship focused on academics and professional matters. If you have any questions related to the course or medical topics, feel free to ask, and I'll be more than happy to help. Let's continue with today's lesson on the topic at hand.
Question 5.	Give me a human teacher-like response to "I am participating in the annual fest. Can I miss today's class?"
<i>Parts of excerpts from the AI bot's response</i>	It's great to hear that you are participating in the annual fest! Participating in extracurricular activities like festivals can be a wonderful experience ... While I understand your enthusiasm for the fest, I encourage you to consider the significance of today's class. If there are any important lectures, discussions, or assignments scheduled for today, missing the class might impact your understanding of the subject. If possible, I recommend discussing your participation in the fest with your professors in advance. They might ... Ultimately, the decision is yours, but remember that striking a balance between academics and extracurricular activities is essential for ...

However, the utilization of ChatGPT in medical education is not straightforward. Its limitations, including concerns about data currency, inherent biases, and ethical issues related to AI in healthcare, require careful navigation. To ensure effectiveness and responsibility, ChatGPT should complement traditional educational methods, guided by experienced educators and transparent about its capabilities and limitations.

In essence, while ChatGPT holds the potential to make medical education more dynamic and accessible, its responsible integration demands attention to its shortcomings and ethical use. By balancing its

Table 3. Analysis of Category-A: Treating ChatGPT as AI machine.

Q No	Category – A Aptitude	YES Empathy	NO Ethics	N. A Feasibility
Q. 1				
Q. 2				
Q. 3				
Q. 4				
Q. 5				

Table 4. Analysis of category-B: Treating ChatGPT as human-like AI ChatBot.

Q No	Category – B Aptitude	YES Empathy	NO Ethics	N. A Feasibility
Q. 1				
Q. 2				
Q. 3				
Q. 4				
Q. 5				

innovative features with a cautious approach to its challenges, ChatGPT can support the development of skilled and ethical healthcare professionals.

5.3. Ethical considerations

While the integration of ChatGPT in medical education presents promising benefits, the use of ChatGPT in medical education comes with its share of ethical considerations and limitations. It is crucial to acknowledge and address the various inherent challenges and ethical considerations associated with the deployment of this emerging technological tool (Sidiropoulos & Anagnostopoulos, 2024; Stahl & Eke, 2024). In the context of medical education, ethical considerations are particularly pressing to ensure responsible implementation to safeguard patient well-being and learner integrity.

The integration of ChatGPT into medical education and practice presents promising benefits, yet it necessitates careful navigation of challenges and ethical considerations to ensure its responsible use and to safeguard patient well-being and learner integrity. Concerns about real-time information accuracy, potential biases, and the need for continuous updates highlight the importance of using ChatGPT as a supplemental tool rather than a replacement for professional expertise. Transparency in model training, data sourcing, and explicit disclosure of limitations is essential for fostering user trust and critical evaluation of information.

Healthcare institutions and practitioners play a critical role in promoting responsible ChatGPT use, advocating for it as a complementary educational tool, and establishing guidelines for ethical practices. By addressing these ethical challenges and prioritizing patient care, ChatGPT can enhance medical education and practice. Ongoing research and collaboration are key to realizing ChatGPT's potential within a responsible and ethical medical education ecosystem, complementing human expertise and enriching the healthcare landscape.

6. Conclusion

6.1. Concluding comments

Incorporating ChatGPT across various educational sectors, including medicine, holds remarkable potential to revolutionize learning and teaching methodologies. Its capabilities in crafting tailored learning experiences, conducting dynamic assessments, and generating innovative content promise a more engaging and effective approach to education. Emphasizing the enhancement of learning and skill development, effective implementation of ChatGPT can significantly contribute to the advancement of educational practices, benefiting both educators and learners.

To fully harness AI's advantages while addressing its limitations and ethical concerns, careful implementation, coupled with ongoing system refinements, is crucial. Continuous updates to ChatGPT will

help address challenges related to content relevance and accuracy. Furthermore, ethical considerations, particularly in the realms of data privacy and security, are paramount. Ensuring the protection of student data and adhering to ethical data practices are essential to maintaining trust and integrity within the educational framework.

Our study underscores the importance of guiding educators, academics, and policymakers through the technological transformations in the education sector. By showcasing ChatGPT as a heutagogical (self-determined learning) tool in medical education, we aim to inspire a transformative shift in teaching methodologies. This shift is envisioned to not only enrich the educational landscape but also to equip learners with the skills and knowledge required for success in an increasingly complex world. Through thoughtful integration and ethical usage of AI tools like ChatGPT, the future of education can be shaped to offer more personalized, accessible, and effective learning experiences.

6.2. Limitations and future research directions

The current study has been explorative and, therefore, has several limitations that should be considered carefully.

First, the study's scope is confined to examining one aspect of heutagogy: the interaction between humans and AI, acknowledging that other elements of heutagogy could be explored in similar contexts. A further limitation is the study's focus on just one educational field (medical education), whereas a similar approach could be applied to other disciplines. Therefore, this study underscores the need for further investigation in various professional fields like law, accounting, engineering, and architecture, advocating for the advancement of AI into a comprehensive model of self-determined learning (heutagogy), fostering a robust integration of education and technology.

Second, future studies focusing on ChatGPT as a medical instructor could significantly enhance understanding of its effectiveness and areas for improvement. By analyzing ChatGPT-generated responses against rubrics designed based on pedagogical prerequisites, researchers can perform more comprehensive comparative analyses. These types of approaches could allow for a detailed assessment of ChatGPT's ability to meet educational objectives, convey complex medical knowledge accurately, and adapt to different learning styles. Such studies could explore how well ChatGPT facilitates critical thinking, problem-solving, and clinical reasoning among medical students. Additionally, comparing ChatGPT's instructional capabilities with traditional teaching methods could shed light on its potential to complement or even enhance current educational practices. By identifying strengths and limitations through rigorous analysis, future research can guide the development of more sophisticated AI-driven pedagogical tools, ultimately aiming to enrich the medical education landscape.

Third, while ChatGPT offers notable advantages, it is important to recognize and address its limitations (Tlili et al., 2023). The responses it generates are derived from patterns in its training data, which may result in inaccuracies and biases in its outputs (Bozkurt et al., 2023; Farhat et al., 2023; Sohail et al., 2023). In the current study we used ChatGPT-3.5. However, it is likely that the results would be different if we had used ChatGPT-4, which is a more powerful model. In the future, researchers could perform a comparative study of the performance of different chatbots as heutagogical tools (e.g. ChatGPT-4, Google Bard) (cf. Farhat et al., 2024).

Looking forward, the evolving capabilities of AI promise to further revolutionize medical education. Nevertheless, balancing this optimism with a cautious recognition of ChatGPT's limitations and the need for responsible usage is crucial. Future research could explore the long-term impact of AI tools such as ChatGPT on learning outcomes in medical education, providing deeper insights into this emerging educational paradigm.

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