

Review Article

Generative AI in Physiotherapy Education: Opportunities, Challenges and Future Directions – A Narrative Review

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ABSTRACT

Background: Generative Artificial Intelligence (GenAI) is becoming increasingly popular in healthcare education. Tools, notably ChatGPT, are being utilized by students and educators to support learning, find information, and improve understanding of deep and complex concepts. As the use of AI continues to grow, it is important to understand both its benefits and challenges.

Aims and objectives: This review aimed to explore the use of Generative Artificial Intelligence in healthcare education, with a focus on its applications, advantages, limitations, and future potential. A rigorous literature search was conducted using articles identified from PubMed, Google Scholar, Scopus Studies related to Artificial Intelligence and Generative AI in healthcare education were reviewed and analyzed for the purpose of this paper.

Methods: This narrative review was revised in alignment with the Scale for the Assessment of Narrative Review Articles (SANRA). The authors' original search covered PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar for English-language literature from January 2023 through June 2026. Of 816 records identified, 765 were screened and 57 were included. Targeted evidence updates using SciSpace and Scite on 14 August 2026 added recent, directly relevant physiotherapy studies and current guidance. Evidence was interpreted according to study design, directness to physiotherapy education, comparator, and outcome type no meta-analysis was undertaken.

Results: Physiotherapy specific evidence remains limited but expanding. The reviewed studies revealed that GenAI can support learning by helping students access information quickly, grasp complex concepts, prepare study materials, and improve clinical reasoning skills. Transfer evidence from medical education suggests potential for simulated patient encounters and structured feedback. However, concerns were also reported, including inaccurate information, hallucinations, plagiarism, privacy issues, and overreliance on AI tools, data fabrication.

Conclusions: Generative Artificial Intelligence has the potential to become a useful tool in healthcare education. While it offers many benefits for both students and educators, it should be used carefully and responsibly. Policymakers and educators need to critically analyze and set guidelines to ensure ethical use of GenAI. Further research is needed to better understand its long-term impact on teaching and learning.

Keywords: Generative Artificial Intelligence, Artificial Intelligence, ChatGPT, Healthcare Education, Physiotherapy Education, Medical Education. Use of AI, Limitation of GenAI

INTRODUCTION

Generative AI has gained rapid attention in the medical education and training field since the launch of ChatGPT 4.5 by OpenAI in November, 2022(1). Generative AI(GenAI) is defined as a class of machine learning systems that comprehend the statistical patterns of large-scale data patterns and when provided with an accurate prompt, they generate novel text, images, audio and video outputs. The development of Generative AI tools such as ChatGPT has especially changed the way students and educators access information, learn new concepts, and interact with educational content(2).Generative artificial intelligence (GenAI) produces novel high-quality content through basic algorithms which generate images as well audio along with synthetic datasets. Generative artificial intelligence uses

large language models (LLM's) and deep neural networks to analyze and generate data(3). These tools can generate human-like responses, summarize information, assist with academic tasks, and support problem-solving and clinical reasoning activities(4,5). A study suggested that with rapid integration of AI tools in healthcare and industrial settings, its infiltration into medical education seems imminent(6).Within healthcare and medical education, GenAI is rapidly evolving and beginning to reshape clinical practice, medical education and treatment planning(7).The growing use of AI in healthcare education has created both excitement and concern among educators and students(8). Clinical reasoning forms a core component of physiotherapy education and evidence-based practice(9). In physiotherapy education, GenAI

serves as a versatile teaching aid facilitating understanding via simplification and summarization of large complex texts into smaller and easy to understand points(10). Some studies also observe that however GenAI technologies are not new in the clinical and educational landscape, addition of newer and finer LLM technologies have made it feasible for learners and clinicians to access quality content(11). These tools help students to understand deep and complex concepts easily and grasp key concepts. GenAI can simulate patient interactions, answer complex biomedical questions and generate coherent, high-fidelity text with an accuracy that in some cases approaches human performance(12).

A number of recent studies have explored students' attitudes and acceptance of AI tools in healthcare education. Research conducted among undergraduate physiotherapy students in Turkey showed that most students had positive views toward ChatGPT and AI-based chatbots, although concerns regarding ethical use and accuracy were also reported(13). Kotsis et al.,(14) asserted that rising use of GenAI technologies in education tends to blur the thin line between human creativity and AI artistry. Lenderman et al.,(15) highlighted the ethical and practical considerations of integrating GenAI in healthcare education. Kung et al.,(16) evaluated the use of ChatGPT on the United States Licensing Exam(USLE) and concluded that it performed on a near passing threshold without any prior training or reinforcement. This highlights the emerging status of GenAI technology in education, particularly physiotherapy education. Similarly, narrative reviews on AI in healthcare have emphasized both the challenges and opportunities of integrating GenAI technologies with healthcare and physiotherapy education.

This narrative review was synthesized to examine the current literature on the use of Artificial Intelligence and Generative AI tools in health professionals' education, with a particular focus on physiotherapy education and exploring the opportunities and challenges on integrating GenAI in physiotherapy and medical education along with suggesting appropriate future recommendations. This review includes evidence from validation studies, qualitative studies, randomized controlled trials, systematic reviews, scoping reviews, rapid reviews and narrative reviews to provide an overall understanding of the growing role of AI in healthcare education.

RESEARCH GAP

While there have been number of studies including multiple RCT's, observational studies, cross-sectional surveys, systematic reviews, scoping reviews and narrative reviews which critically examine the role of AI and more specifically Generative AI in medical education and clinical training, healthcare delivery, clinical decision making and research domains, there are significantly less published articles which focus specifically on physiotherapy education domain which forms the basis of this review. Existing literature focuses significantly on the role of AI in clinical physiotherapy practice and patient rehabilitation outcomes, but limited studies focus on core application of

AI for physiotherapy students and educators. Moreover, there are limited studies which focus on the ethical concerns, guidelines and future directions specifically for physiotherapy education. So, this narrative review aims to synthesize evidence from relevant literature to help physiotherapy students and educators regarding the challenges, opportunities and future directions of GenAI in physiotherapy education.

AIMS AND OBJECTIVES

While there have been number of studies including multiple RCT's, observational studies, cross-sectional surveys, systematic reviews, scoping reviews and narrative reviews which critically examine the role of AI and more specifically Generative AI in medical education and clinical training, healthcare delivery, clinical decision making and research domains, there are significantly less published articles which focus specifically on physiotherapy education which forms the basis of this review. Existing literature focuses significantly on the role of AI in clinical physiotherapy practice and patient rehabilitation outcomes, but limited studies focus on core application of AI for physiotherapy students and educators. Moreover, there are limited studies which focus on the ethical concerns, guidelines and future directions specifically for physiotherapy education. Therefore, this narrative review aims to synthesize evidence from relevant literature to help physiotherapy students and educators regarding the opportunities, challenges and future directions of GenAI in physiotherapy education.

ETHICAL CONSIDERATIONS

This is a narrative review therefore neither informed consent nor approval by the institutional review board was obligatory.

METHODOLOGY

This narrative review is intended to integrate a broad, rapidly evolving and methodologically diverse literature. It was revised against SANRA which assesses justification, aims, description of literature, search, referencing and scientific reasoning. The review mainly focused on students' and educators' perceptions of AI, its role in improving learning and clinical reasoning skills, and the ethical and practical challenges associated with its use in education.

SEARCH STRATEGY

A comprehensive search was carried out using electronic databases including PubMed, Scopus and Web of Science. Academic search engine Google scholar was also used to retrieve relevant articles which were later critically evaluated. Google scholar was predominantly used to retrieve the majority of articles due to the ease of availability of high-quality literature. Articles published from 2023 were preferentially included to ensure inclusion of recent and high-quality literature evidence thereby reflecting most recent advancements regarding GenAI in

physiotherapy education. The original search identified 816 records. After 34 duplicates and 17 records removed for other reasons, 765 titles and abstracts were screened and 235 full text reports were assessed and finally 57 were included in this review. The full text exclusions comprised ineligible study types (n=127), unavailable English full texts (n=29) and unavailable full text (n=22). Figure one visually represents this selection criteria.

Due to rapid changes in this field, a targeted update was conducted on 14 August 2026 using scispace for semantic discovery and Scite for bibliographic verification, citation content review and editorial notice checking. The update prioritized physiotherapy specific empirical research and controlled educational studies.

Different keywords related to artificial intelligence and healthcare education were used during the search process. The medical search terms included were:

“Artificial Intelligence” , “Generative Artificial Intelligence” , “ChatGPT” , “Health Professions Education” , “Physiotherapy Education” , “Clinical Reasoning” , “AI-based Chatbots” , “Medical Education” , “Healthcare Students”

The keywords were combined using terms such as “AND” and “OR” to identify relevant studies. The search results were imported into the Zotero reference manager and duplicates were screened and removed.

ELIGIBILITY CRITERIA

Articles were thoroughly screened and critically appraised and were selected based on the exclusion and inclusion criteria.

INCLUSION CRITERIA

Studies were considered eligible for inclusion if they were 2023 onwards and focused on Artificial Intelligence and GenAI tools in healthcare and health professions education and having healthcare professionals and students as their primary sample constituents. Studies exploring perceptions, attitudes, acceptance, educational effectiveness, clinical reasoning, learning experiences and challenges related to GenAI integration in education. Qualitative studies, quantitative studies, randomized controlled trials, validation studies, systematic reviews, scoping reviews and narrative reviews were included in this study. Only articles published in the English language and those having full text articles available for detailed review were selectively included in this narrative review.

EXCLUSION CRITERIA

Studies unrelated to healthcare professions and physiotherapy were selectively excluded during screening. Moreover, studies describing the role and technical development of GenAI without discussing its educational impact or role were not included in this review. Editorials, opinion papers, conference abstracts, commentaries, letters to the editor, and unpublished studies were omitted to maintain and follow quality guidelines and enhance the quality of synthesized evidence in this review. Studies

published in languages other than English and articles where the full text was not available were omitted.

STUDY SELECTION

The titles and abstracts of the identified studies were screened to check their relevance to the topic. Full-text articles were then reviewed based on the inclusion and exclusion criteria.

A brief description of the article screening and selection procedure is illustrated by the following flowchart.

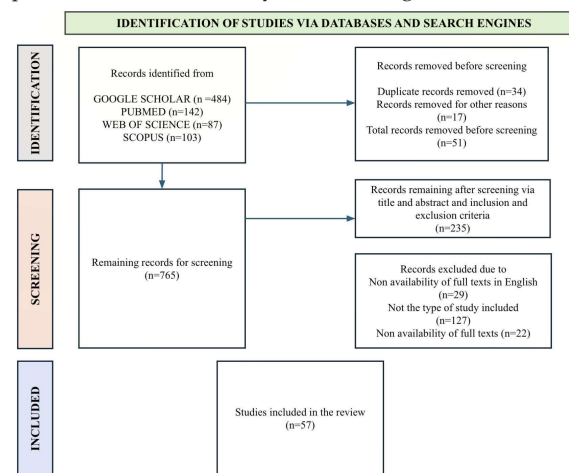


Figure1 illustrating screening and selection criteria of eligible articles included in the review to improve transparency

GEN-AI IN HEALTHCARE EDUCATION AND ITS TYPES

Generative Artificial Intelligence (GenAI) is a type of artificial intelligence that can create new content such as text, images, videos, audio, and computer code. Unlike traditional AI systems that mainly analyze information and make predictions, GenAI can generate original content based on user instructions. The development of tools such as ChatGPT has increased the use of AI in healthcare and education, making information more accessible and supporting learning in new ways(17). The use of GenAI in healthcare education has grown rapidly in recent years. Students use AI tools to understand complex topics, summarize research articles, prepare study materials, and answer academic questions. Educators are also exploring how these technologies can be used to improve teaching methods and support student learning. The ability of GenAI to provide quick responses and personalized assistance has made it increasingly popular among healthcare students and professionals(18).

Type of Technology	Examples	Physiotherapy Education Applications	Advantages	Limitations
LLM's	1.GPT-4(OpenAI) 2.BLOOM Gemini (Google)	1.Case based discussions 2.Summarise difficult concepts 3.Prepare study notes	1.Personalised responses 2.Natural conversation 3.Easily Available	1.Lack of real time data 2.Hallucinations and Fabrication 3.No Clinical Judgement
Image Generation Models	1.DALL-E 3(OpenAI) Stable Diffusion	1.To study complex anatomical and clinical concepts via visual cues	1.Provides visual cues to understand complex cases 2.No patient consent needed 3.Personalised Experience	1.Requires proper validation 2.May Generate inaccurate details
Multimodal and Simulation Models	1.Virtual patient platforms 2.Integrated 3.Simulation environments	1.Interactive case discussions 2.Virtual consultancies (TeleRehabilitation) 3.Visual Learning Experiences	1.Immersive Experiences 2.Safe Clinical practice Environment	1.Technically Complex to Understand 2.Needs Advanced Devices to Function
LMS/EMR Integration	1.Performance analytics tool 2.Google Classroom 3.EMR integrated Assistants	1.Personalised Study Plans 2.To store clinical and patient records safely and effectively 3.Performance Tracking	1.Easy Progress Monitoring 2.Curriculum Alignment 3.Easy to understand and Employ	1.Privacy concerns related to patient data 2.Policy barriers

Table 1 illustrating the various types of GenAI models along with their applications, Advantages and limitations in physiotherapy education adopted from (12)

One of the most common types of GenAI is the Large Language Model (LLM). LLM's are trained on large amounts of text data and are designed to understand and generate human language. Examples include ChatGPT, Gemini, and Claude. These models can generate written content, answer questions, assist with problem solving tasks, and summaries information. In healthcare education, LLMs are often used to support learning, clinical reasoning, and knowledge acquisition(19).

Another type of GenAI is image-generation AI, which creates images based on written descriptions. These tools can be used to develop educational diagrams, and visual learning materials. In education, image-generation tools may help students, make them understand anatomical structures through colorful diagrams with labelling and explain clinical concepts more effectively by providing visual representations of information.

Video-generation AI is another emerging technology that can create videos and animations from text prompts. Although its use in healthcare education is still under development, it has the capacity to support simulation-based learning, clinical demonstrations, and patient education. Such tools make it easy to learn in a more interactive way and highly engaging for students.

A more advanced category is multimodal AI. These systems can work with different forms of information, including text, images, video, and audio. By combining multiple types of data, multimodal AI can provide more detailed and context-specific responses. This technology has the potential to support virtual patient simulations, case-based learning, and other interactive educational activities in health professions education(19).

Despite its many advantages, GenAI also has limitations. One of the main concerns is AI hallucination, where the system generates information that appears accurate but

sometimes it's incorrect. Other challenges include privacy concerns, bias, plagiarism, and overdependence on AI-generated content. For this reason, information produced by AI should always be reviewed critically and supported by reliable sources.

Overall, GenAI has the potential to improve healthcare education by making learning more accessible, flexible, and interactive. However, its successful use depends on responsible implementation, proper guidance, and continuous evaluation to ensure that educational quality and academic integrity are maintained(20).

POTENTIAL USES OF GENAI IN PHYSIOTHERAPY EDUCATION

GenAI is one of the fastest emerging and rapidly evolving tools used in medical and physiotherapy education. Large language models such as OpenAI's ChatGPT are seen as a tumultuous force that will fundamentally change the education sector. LLM's are capable of generating human-like text like almost any topic and writing style which is of immense importance in the education field and particularly medical and physiotherapy fields(21). These models without any prior training or fine tuning for medical education achieve near passing scores on all three exams of United States Medical Licensing Examination (USMLE) Step exams (22) suggesting that GenAI has a great scope in medical and physiotherapy education. GenAI plays a crucial role in brainstorming certain ideas and theories which helps both the students and educators to get major insights regarding topics and ideas. Moreover, there should be increased usage of transparent AI systems in education. By directly collaborating with instructors, GenAI can extensively generate clinical cases with detailed history, clinical notes, examination results and lab data perfectly tailored as per the need of the student, educator

or clinician. Furthermore, GenAI can integrate certain contextual factors such as ethnicity, race, occupation which can enhance the quality of teaching notes and clinical cases (23). GenAI is also rapidly evolving to provide interactive learning and provide a suitable learning environment to the students to help them grasp key concepts and ideas from grass root level. Systems such as DALL-E 3 (OpenAI) and stable diffusion can generate images and other visual cues to facilitate learning. They help to generate realistic anatomical illustrations, radiological findings, and dermatological presentations that may be integrated into medical teaching (12). These systems operate on stored dataset and respond appropriately based on the user's prompt to generate illustrative diagrams and figures which help in enhanced conceptual understanding.

OPPORTUNITIES OF GENAI IN PHYSIOTHERAPY EDUCATION

The distinctive ability of GenAI to competently formulate new content and simulate human creativity and produce realistic outputs has revolutionized many fields including physiotherapy (24). However, some studies claim that educators have not maximized the potential of AI in teaching and learning contexts (25). Image generation models and LLM's have a great scope in the field of physiotherapy education as they help prepare future clinicians, researchers and educators via providing in depth and detailed understanding of core physiotherapeutic concepts.

1. PERSONALIZED LEARNING AND TUTORING

GenAI is swiftly evolving and along with the integration of image generation models and LLM's, it is providing a stupendous platform for students to grasp concepts at their own varying pace. GenAI is currently seen as the future of physiotherapy education. Some studies(26) state that GenAI currently does not possess the capabilities to completely replace educators and is great as an adjunctive tool as it is unable to produce the experiences and social interactions necessary to develop empathetic and contextually aware learners. As suggested by other studies (27) that LLM's such as ChatGPT may lack complete clinical reasoning and critical thinking which justifies its status as a secondary reference rather than primary source of learning. Creely et al.(28) observe that excessive dependence of learners towards GenAI technologies hamper their critical thinking and analytical aspects of learning as if GenAI repeatedly resolves complex queries and rectifies mistakes, learners may bypass stages of critical thinking and deep learning. Other studies (29) state that LLM's generate interactive simulations that allow medical students to understand and grasp deep concepts via visual maps.

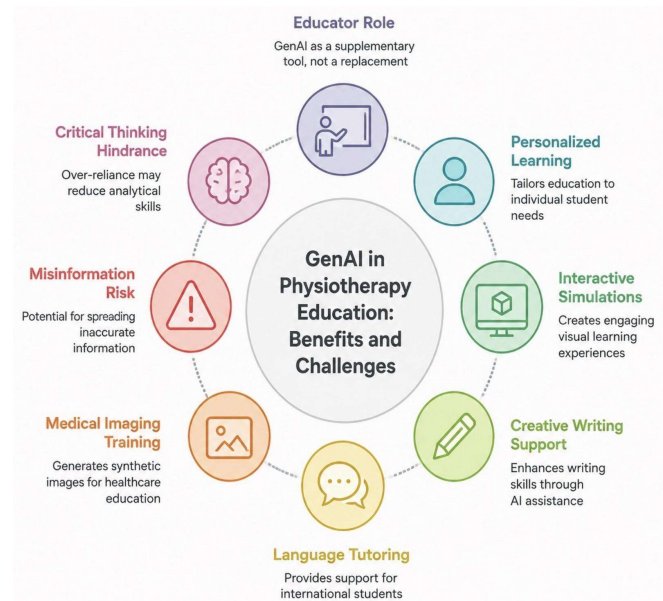


Figure 2 illustrating conceptual domains of opportunity and risk for GenAI in physiotherapy education generated by NapkinAI based on author generated prompt

This implies that GenAI can help students understand complex and multifaceted topics with relative ease. According to Iorliam et al.(30) ChatGPT is a great tool for creative writing and elucidating concepts and can help learners grasp concepts at their own pace. Moreover Farrelly et al.(31) observed that GenAI tools may potentially evolve into personal language tutors for international students going abroad to pursue higher education as these LLM's may be trained in local terminology and idioms so as to explain contextual information and greatly improve written and spoken English. Takale et al.(24) emphasize on the fact that image generation models have a stupendous role in training medical and physiotherapy students as they can generate synthetic medical imageries to simulate medical scenarios which is greatly utilized to train healthcare professionals. Moreover, some studies indicate an increased risk of spread of misinformation, lack of context and generalizability by GenAI chatbots which demand for critical appraisal skill and independent verification of sources (32). Lopez et al.(33) strongly emphasize that GenAI can improve overall collective construction of knowledge and it should not be seen as an automation tool but as a stepping stone which helps to cultivate creativity, critical thinking and problem-solving skills in students.

2. RESEARCH AND ACADEMIC WRITING

Research and academic writing are tedious tasks and many students struggle to balance studies with research activities. GenAI tools assist with literature summarization, manuscript drafting, brainstorming ideas (12). Janumpally et al.(22) emphasised that LLM's are powerful tools for academic research and they can readily summaries complex academic papers making it efficient and less cumbersome for students and educators. These tools have a great utility in assisting physiotherapy students to comprehend complicated researches and academic works. However, Faisal kalota et al.(34) observed that the current

version of ChatGPT is not functionally equipped to be the primary writing tool in research and academic writing and should be improved in functionality and most likely contains factual errors. Moreover, it has another limitation that it is unable to generate information specific to the needs of the students (34). It implies that GenAI tools are producing a paradigm shift in the research and academic field. LLM's such as ChatGPT are being extensively utilized amidst their evolution in understanding the dynamics of research and academic writing. Currently these LLM's are being widely used for summarizing and categorizing literature reviews and to quickly synthesize large quantities of information and to analyze them effectively(35)

Moreover, use of these LLM's in research activities has provided a huge push to manuscripts from non-native English-speaking countries as they can be easily translated making them highly publishable as scholarly work(36). This highlights a positive impact of these GenAI models to connect global scholars and educators and discourage any language barriers which have hindered medical and physiotherapy education in the past. Use of GenAI technology to assist research and academic writers is not inherently considered unethical (37). But we come across grievances of certain sections of medical education that consider use of GenAI in physiotherapy research as unethical. However, Wilcocks et al.(37) state an important assertion that use of AI cannot be considered unethical if it is used to perform legitimate and valid research and moreover the author should take full responsibility for their research and academic work.

3. EDUCATIONAL CONTENT CREATION AND CURRICULUM DESIGN

GenAI plays a monumental role in development of educational content and helping identify gaps and shortcomings of curriculum. Educators can utilize GenAI to draft lecture notes, PowerPoint presentations, design case-based scenarios and also generate material for problem-based discussion to facilitate clinical training and ensure substantial understanding of the concept (12). Image generation models such as DALL-E 3 by OpenAI can generate visual cues and images which are used by educators to facilitate learning. Apart from educational content creation, GenAI also plays an important role in designing curriculum and improving its structure to adapt changing educational policies and significantly improve its competency. The current state of physiotherapy curriculum is basically futile i.e. it is not capable of training students to cultivate essential skills such as critical thinking, critical analysis and appropriate clinical reasoning. Thus, with the assistance of GenAI, it can help to effectively identify gaps and various shortcomings of our current curriculum and help us suggest great alternatives and future subsequent pathways to produce better clinicians and researchers. However, currently strategies of integrating GenAI in medical and physiotherapy education curricula have not yet been established (38). This demands critical analysis and immediate integration of GenAI in medical curricula.

USE CASE SCENARIO	CURRENT EVIDENCE	POTENTIAL EDUCATIONAL VALUE
Formative Tutoring	Limited Controlled Physiotherapy Evidence	Adaptive Explanation, More Active and Personalised Learning Mechanisms
Virtual Patients and Case Management	Early Controlled Transfer Evidence from Medical Education Studies	Advanced and Hassle-Free History Taking, Expert Communication Practice
Research and Writing	Useful for High Process Support Along with High False Citation Risk	Outlining and editing the Manuscript, Aid in Image and Flow Chart Generation
Feedback Support	Physiotherapy Case Study Evidence	More Specific and Consistent Feedback
Assessment Support	Current Evidence Points out that Validity Concerns far outweigh its Effectiveness Evidence	Feedback Drafting, Low-Stakes Practice

Table 2 illustrating use cases of GenAI in physiotherapy education and clinical setup and its potential educational value.

CHALLENGES AND RISKS OF USING GENAI IN PHYSIOTHERAPY EDUCATION

Despite its enormous potential in influencing physiotherapy education and clinical practice, use of GenAI poses significant challenges and risks in various domains of education. GenAI majorly poses certain risks in legal, academic and ethical domains of medical and physiotherapy education which needs to be understood and critically analyzed by the educators and policymakers so as to promote ethical use of GenAI among learners.

HALLUCINATIONS, DATA FABRICATION AND INACCURACY

This is one of the major concerns of integrating GenAI in the academic and research landscape. GenAI models such as LLM's are highly prone to generate false and inaccurate information. Hallucinations are described as inaccurate and nonfactual information generated by LLM's due to inherent tendency of the model emphasizing certain parts of the prompt more than others seen in errors of training data (39). Moreover, Hallucinations and data fabrication are more commonly seen in the GPT-4 models due to the fact that these technologies are trained on pre-set data and are mostly unaware of the most recent guidelines or discoveries in the field of education and clinical practice (12). This majorly leads to the generation of fabricated data which is inherently incorrect and inaccurate.

GenAI also has a tendency to not understand which dataset fed is real or fake. So, it also utilizes fake dataset to produce inaccurate and fake information which leads to formation of fake, manipulated and fabricated data (40). Furthermore, Templin et al.(39) observed that most professionals and learners are not equipped with the inherent ability to identify hallucinations and fabricated data. Hence there is a major role of physiotherapy educators, instructors and clinicians in helping the students identify AI hallucinations, fabricated and fake datasets and inaccurate content and guide them to identify such data and critically appraise any dataset before utilizing it.

PLAGIARISM AND ACADEMIC INTEGRITY

Plagiarism as quoted by Aline Mille et al.(41) refers to the unethical act of copying and appropriating someone else's work, ideas and words without proper attribution or permission and quoting them as one's own. They further explained three forms of plagiarism i.e. paraphrasing an idea or sentence not originally belonging to the author, not properly acknowledging the original source and using someone else's work without proper citation. It is a serious academic offense and is appropriately punishable under law. However, with the rise of GenAI in the field of research and academics has made the tedious task of detecting plagiarized data more difficult. GenAI is capable of producing human like content which blurs the line between human creativity and AI generated text as LLM's such as ChatGPT are equally capable of generating human like content which has made plagiarism detection more gruesome than ever (42). For instance, GenAI can automate generation of a literature review and auto cite articles which are often incorrectly cited and data fabrication is observed but this easy process of content generation inadvertently promotes authors and learners to be overly relied on these technologies without critically analyzing its original source (14). Moreover these LLM's are being widely abused by students for assignment writing and other academic processes. This risks academic integrity and greatly hampers students' evaluation reasoning and critical thinking abilities (43). Moreover, since LLM models generate datasets on pre fed data, they cannot be held accountable for the data they synthesize.

These models lack critical thinking, reasoning and therefore the author who uses these tools without proper acknowledgement shall be held responsible for plagiarism (44). Moreover, students and authors try to use torture phrases in attempts to evade plagiarism checks in recent times (45). These phrases are bizarre rewording of established technical terminologies which students and researchers use to evade plagiarism accusations. These tactics are deemed unethical and unacceptable behavior in academia. Therefore, the use of GenAI technologies should be ethical and both its positive and critical aspects should be appropriately evaluated (46). There should be ethical and responsible use of GenAI technologies in research and scholarly work so as to avoid punishable offenses such as plagiarism. Authors and learners should properly acknowledge and cite the original source and use LLM technologies merely as a brainstorming and idea evolving tools and should not be abused and used inappropriately without proper acknowledgement.

ETHICAL CONCERNS AND DATA PRIVACY

In the era of rapidly evolving GenAI technologies there are certain ethical considerations and moral duties which are imperative and obligatory for AI developers. The major ethical dilemmas these developers need to operate are propagation of fake and harmful content, bias, misapplication and privacy and security breaches (47). Arar et al.'(48) observed that while these GenAI technologies are useful they still possess certain threats to mankind. They observed that while AI is evolving rapidly in education and other sectors, the lack of morality, emotions, contextualization and consciousness sets GenAI

technologies prone to ethical and legal consequences. Moreover, Osho base et al.,(49) observe that utilizing demographic inputs, GenAI is more susceptible to reproducing stereotypes and legitimizing inequalities. This further builds on the concept that as GenAI isn't conscious, logic driven and detached, it is more prone to propagate bias and inequality. Fui Hoon et al.,(50) observe that these GenAI technologies often possess bias as their training data is monolingual and these models are incompetent in managing and analyzing this data critically which causes bias generation in language models. Musalmagadu et al.,(51) devise a remedy for this particular situation. They propose that training data should be carefully curated and discriminatory outputs should be found and routinely audited and these models should be assessed on a regular basis. Moreover Sai et al.,(52) observe that the framework of GenAI produces output based on datasets, if the dataset is biased and of poor quality then the output generated too shall be shallow and biased.

LLM's are widely being used in medical education, clinical practice and medical data analysis and storage. However the data stored in GenAI systems is encrypted and strictly enforced access is limited, there remains a risk of data leak raising concerns of hampering patient confidentiality, identity theft and reputational damage to individuals and institutions (53). As GenAI is rapidly evolving, our understanding of its functioning and its role in student and faculty development is constrained (54). Therefore, as GenAI is evolving it is the inherent responsibility of policymakers and institutions to enforce strict protocols and properly evaluate GenAI technologies before implementing them in healthcare, medical and physiotherapy education and clinical scenarios to contain the bias, privacy concerns and data confidentiality effectively and uphold the true essence and value of integrating GenAI technologies in education and healthcare.

FUTURE DIRECTIONS

GenAI technologies are indubitably certain to have inevitable and everlasting effects on medical education and particularly physiotherapy education in the foreseen future. The integration of GenAI in education has a great scope in future to significantly improve problem solving skills, communication, critical thinking and research-oriented skills (55). Educators and instructors need to carefully evaluate these benefits of integrating GenAI in education and develop essential protocols and guidelines to ensure that benefits of using these technologies far outweigh its potential risks and harms. Batista et al.,(56) further highlighted that there are minimal quality studies which elaborate how to establish ethical guidelines and institutional policies for ethical use of GenAI in higher education and how to counteract the ethical challenges arising due to usage of GenAI in medical and physiotherapy education. Moreover Batista et al.,(56) emphasized on the fact that GenAI is influencing the skillset needed to secure future jobs and developing necessary skills to land a job in the evolving job market. For instance, in the physiotherapy domain, GenAI has assisted physiotherapists in providing clinical consultation and rehabilitation to patients across the globe via teleconsultation and virtual reality domains of GenAI. This has enabled physiotherapists to provide their services to remote areas where physical reach was restricted. Moreover, the use of virtual reality models helps to provide an immersive environment to students to

interact with AI generated clinical cases which furthermore helps in developing critical analytic and logistic reasoning skills. Raman et al.,(57) observed that when students perceive that GenAI tools promote autonomy, their engagement increases automatically. Moreover, they observed that learners who assume GenAI tools as enablers and guides and not substitutes for their cognitive processes exhibit greater academic confidence and integrity. This implies that GenAI should be potentially utilized as an aid for brainstorming ideas and concepts and not as a primary alternative. In physiotherapy education, there should be institutional policies which address critical aspects of AI assistance in assignments and coursework. Proper distinction between acceptable and prohibited AI usage should be upheld to maintain academic validity and integrity and prevent misconduct (12). Medical institutions need to establish structured programs and workshops to instill AI and deep machine learning fundamentals in both students and faculty. Moreover, students should be trained to identify AI generated outputs to maintain scholarly rigor and academic integrity. The physiotherapy curriculum should include AI and prompt engineering techniques for LLM's so that learners could effectively integrate GenAI with education and clinical practice (12). Furthermore, learners need to ethically use GenAI technologies and critically evaluate its outcomes and potential hazards which it brings along. Learners need to be trained in such a way so that they consider GenAI tools and LLM's as a secondary tool and understand how it functions, recognize its limits and apply them ethically and judiciously.

LIMITATIONS OF THIS REVIEW

This narrative review aimed to synthesize evidence from existing literature on the role and impact of integrating GenAI technologies in physiotherapy and medical education and exploring the opportunities and challenges associated with it and alongside mentioning some key future recommendations. Major limitation of this review includes the selection bias that may have invariably crept in which influences the conclusions drawn from this literature. This reduces the quality of evidence generated as compared to a systematic review but the robust methodology for literature search employed by the authors ensures that the review synthesizes accurate and reliable conclusions of the existing literature.

CONCLUSION

Generative Artificial Intelligence has many potential benefits in healthcare and physiotherapy education. Students utilize GenAI tools to understand difficult topics, make notes, summarize articles, and answer deep and conceptual questions. GenAI can also help students learn at their own pace and provide assistance whenever needed. For educators, GenAI can help in preparing teaching materials and learning activities and form assessment criteria. Overall, GenAI can make learning easier, faster, and more engaging. Even though GenAI has many advantages, it also has some major drawbacks. Sometimes GenAI can give incorrect or misleading information. The answers may look flawless, but they are not always accurate. GenAI is also not reliable as a sole research companion as it is prone to develop hallucinations and fabricate data which reduces its authenticity. There are also concerns about plagiarism, privacy, bias, and potential overuse of AI tools. If learners

depend too much on AI, they may not develop strong critical thinking and problem-solving skills.

This review establishes that Generative Artificial Intelligence is becoming more frequent in healthcare education. It can help students learn better, explore information easily, and improve their understanding of complex topics. However, GenAI possesses certain demerits and challenges. Hence GenAI can be used as an excellent assistant and brainstorming tool but it should not replace the critical thinking and decision-making aspects of learners and researchers. When used carefully and responsibly, GenAI can play a useful role in healthcare education.

AUTHOR CONTRIBUTIONS

All authors contributed equally and effectively in gathering relevant records, analyzing, synthesizing evidence, drafting and finalizing this manuscript.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest relevant to this review.

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REFERENCES

1. Rabbani SA, El-Tanani M, Sharma S, Rabbani SS, El-Tanani Y, Kumar R, et al. Generative Artificial Intelligence in Healthcare: Applications, Implementation Challenges, and Future Directions. *BioMedInformatics*. 2025 Jul 7;5(3):37. doi:10.3390/biomedinformatics5030037
2. Sallam M, Salim NA, Barakat M, Al-Mahzoum K, Al-Tammami AB, Malaeb D, et al. Assessing Health Students' Attitudes and Usage of ChatGPT in Jordan: Validation Study. *JMIR Med Educ*. 2023 Sep 5;9:e48254. doi:10.2196/48254
3. Dong C, Aw DCW, Lee DWC, Low SC, Yan CC. Generative AI in Healthcare: Insights from Health Professions Educators and Students. *Int Med Educ*. 2025 Apr 18;4(2):11. doi:10.3390/ime4020011
4. Kasneci E, Sessler K, Fischer F, Gasser U, Groh G. ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education.
5. Basil M, Ahmed W, Hajeomar R, Strawbridge J, Lynch M, Mukhalalati B. A scoping review of the use of generative artificial intelligence tools in health profession education. *BMC Med Educ*. 2026 Jan 23;26(1):291. doi:10.1186/s12909-025-08527-3
6. Preiksaitis C, Rose C. Opportunities, Challenges, and Future Directions of Generative Artificial Intelligence in Medical Education: Scoping Review. *JMIR Med Educ*. 2023 Oct 20;9:e48785. doi:10.2196/48785
7. Dekerlegand R, Bell A, Clancy MJ, Pletcher ER, Pollen T. Generative Artificial Intelligence in Education: Insights from Rehabilitation Sciences Students. *Educ Sci*. 2025 Mar 19;15(3):380. doi:10.3390/educsci15030380
8. Shisheghar S, Murray-Parahi P, Alsharaydeh E, Mills S, Liu X. Artificial Intelligence in Health Education and Practice: A Systematic Review of Health Students' and Academics'

- Knowledge, Perceptions and Experiences. *Int Nurs Rev.* 2025 Jun;72(2):e70045. doi:10.1111/inr.70045
9. Hao J, Yao Z, Siu K. Artificial Intelligence in Physical Therapy Education: Evaluating Clinical Reasoning Performance in Musculoskeletal Care Using ChatGPT. *Musculoskeletal Care.* 2025 Sep;23(3):e70177. doi:10.1002/msc.70177
 10. Lindbäck Y, Schröder K, Engström T, Valeskog K, Sonesson S. Generative artificial intelligence in physiotherapy education: great potential amidst challenges- a qualitative interview study. *BMC Med Educ.* 2025 Apr 24;25(1):603. doi:10.1186/s12909-025-07106-w
 11. Blease C, Torous J, McMillan B, Häggglund M, Mandl KD. Generative Language Models and Open Notes: Exploring the Promise and Limitations. *JMIR Med Educ.* 2024 Jan 4;10:e51183. doi:10.2196/51183
 12. Kang J, Ahn J. Technologies, opportunities, challenges, and future directions for integrating generative artificial intelligence into medical education: a narrative review. *Ewha Med J.* 2025 Oct 31;48(4):e53. doi:10.12771/emj.2025.00787
 13. Güler MA, Dağ S, Kayal S, Can M, Şimşekkaya SN. Physiotherapy students' acceptance of AI-based chatbots (including ChatGPT) in education: a multi-institutional study from Turkey. *BMC Med Educ.* 2026 Jan 3;26(1):174. doi:10.1186/s12909-025-08535-3
 14. Kotsis KT. Artificial Intelligence Creates Plagiarism or Academic Research? *Eur J Arts Humanit Soc Sci.* 2024 Nov 1;1(6):169–79. doi:10.59324/ejahss.2024.1(6).18
 15. Lederman O, Llana A, Murray J, Stanton R, Chugh R, Haywood D, et al. Promises and perils of generative artificial intelligence: a narrative review informing its ethical and practical applications in clinical exercise physiology. *BMC Sports Sci Med Rehabil.* 2025 May 26;17(1):131. doi:10.1186/s13102-025-01182-7
 16. Kung TH, Cheatham M, Medenilla A, Sillos C, De Leon L, Elepaño C, et al. Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models. Dagan A, editor. *PLOS Digit Health.* 2023 Feb 9;2(2):e0000198. doi:10.1371/journal.pdig.0000198
 17. Oluwagbenro DrMB. Generative AI: Definition, Concepts, Applications, and Future Prospects [Internet]. 2024 [cited 2026 Jun 9]. Available from: <https://www.techrxiv.org/doi/full/10.36227/techrxiv.171746875.59016695/v1> doi:10.36227/techrxiv.171746875.59016695/v1
 18. Almansour M, Alfahid FM. Generative artificial intelligence and the personalization of health professional education: A narrative review. *Medicine (Baltimore).* 2024 Aug 2;103(31):e38955. doi:10.1097/MD.00000000000038955
 19. Dwivedi YK, Kshetri N, Hughes L, Slade EL, Jeyaraj A, Kar AK, et al. Opinion Paper: “So what if ChatGPT wrote it?” Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *Int J Inf Manag.* 2023 Aug;71:102642. doi:10.1016/j.ijinfomgt.2023.102642
 20. Anap DDB. The Role of Artificial Intelligence in Physiotherapy Education: A Systematic Review.
 21. Ahmad N, Murugesan S, Kshetri N. Generative Artificial Intelligence and the Education Sector. *Computer.* 2023 Jun;56(6):72–6. doi:10.1109/MC.2023.3263576
 22. Janumpally R, Nanua S, Ngo A, Youens K. Generative artificial intelligence in graduate medical education. *Front Med.* 2025 Jan 10;11:1525604. doi:10.3389/fmed.2024.1525604
 23. Lin Y, Luo Z, Ye Z, Zhong N, Zhao L, Zhang L, et al. Applications, Challenges, and Prospects of Generative Artificial Intelligence Empowering Medical Education: Scoping Review. *JMIR Med Educ.* 2025 Oct 23;11:e71125–e71125. doi:10.2196/71125
 24. Takale DG, Mahalle PN, Sule B. Advancements and Applications of Generative Artificial Intelligence. Vol. 10. 10(1).
 25. Cooper G. Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence. *J Sci Educ Technol.* 2023 Jun;32(3):444–52. doi:10.1007/s10956-023-10039-y
 26. Tran M, Balasooriya C, Jonnagaddala J, Leung GKK, Mahboobani N, Ramani S, et al. Situating governance and regulatory concerns for generative artificial intelligence and large language models in medical education. *Npj Digit Med.* 2025 May 27;8(1):315. doi:10.1038/s41746-025-01721-z
 27. Arif TB, Munaf U, Ul-Haque I. The future of medical education and research: Is ChatGPT a blessing or blight in disguise? *Med Educ Online.* 2023 Dec 31;28(1):2181052. doi:10.1080/10872981.2023.2181052
 28. Creely E. Exploring the Role of Generative AI in Enhancing Language Learning: Opportunities and Challenges. *Int J Chang Educ.* 2024 Apr 1;1(3):158–67. doi:10.47852/bonviewIJCE42022495
 29. Eysenbach G. The Role of ChatGPT, Generative Language Models, and Artificial Intelligence in Medical Education: A Conversation With ChatGPT and a Call for Papers. *JMIR Med Educ.* 2023 Mar 6;9:e46885. doi:10.2196/46885
 30. Iorliam A, Ingio JA. A Comparative Analysis of Generative Artificial Intelligence Tools for Natural Language Processing. *J Comput Theor Appl.* 2024 Feb 26;1(3):311–25. doi:10.62411/jcta.9447
 31. Farrelly T, Baker N. Generative Artificial Intelligence: Implications and Considerations for Higher Education Practice. *Educ Sci.* 2023 Nov 4;13(11):1109. doi:10.3390/educsci13111109
 32. Boscardin CK, Gin B, Golde PB, Hauer KE. ChatGPT and Generative Artificial Intelligence for Medical Education: Potential Impact and Opportunity. *Acad Med.* 2024 Jan 1;99(1):22–7. doi:10.1097/ACM.0000000000005439
 33. García-López IM, Trujillo-Liñán L. Ethical and regulatory challenges of Generative AI in education: a systematic review. *Front Educ.* 2025 Jun 30;10:1565938. doi:10.3389/feduc.2025.1565938
 34. Kalota F. A Primer on Generative Artificial Intelligence. *Educ Sci.* 2024 Feb 7;14(2):172. doi:10.3390/educsci14020172
 35. Human Biology Division, School of Medicine, IMU University, Kuala Lumpur, MALAYSIA, Mitra NK, Chitra E, School of Health Sciences, IMU University, Kuala Lumpur, MALAYSIA. Glimpses of the Use of Generative AI and ChatGPT in Medical Education. *Educ Med J.* 2024 Jun 28;16(2):155–64. doi:10.21315/eimj2024.16.2.11
 36. Human Biology Division, School of Medicine, IMU University, Kuala Lumpur, MALAYSIA, Mitra NK, Chitra E, School of Health Sciences, IMU University, Kuala Lumpur, MALAYSIA. Glimpses of the Use of Generative AI and ChatGPT in Medical Education. *Educ Med J.* 2024 Jun 28;16(2):155–64. doi:10.21315/eimj2024.16.2.11
 37. Schlagwein D, Willcocks L. ‘ChatGPT et al.’: The ethics of using (generative) artificial intelligence in research and science. *J Inf Technol.* 2023 Sep;38(3):232–8. doi:10.1177/02683962231200411
 38. Shimizu I, Kasai H, Shikino K, Araki N, Takahashi Z, Onodera M, et al. Developing Medical Education Curriculum Reform Strategies to Address the Impact of Generative AI: Qualitative Study. *JMIR Med Educ.* 2023 Nov 30;9:e53466. doi:10.2196/53466
 39. Templin T, Perez MW, Sylvia S, Leek J, Sinnott-Armstrong N. Addressing 6 challenges in generative AI for digital health: A scoping review. Silva JNA, editor. *PLOS Digit Health.* 2024 May 23;3(5):e0000503. doi:10.1371/journal.pdig.0000503
 40. Routray SK, Jha MK, Sharmila KP, Javali A, Pappa M, Singh M. Generative Artificial Intelligence: Principles, Potentials and Challenges. In. *Erode, India: IEEE; 2024 [cited 2026 Jun 4].* p. 211–6. Available from: <https://ieeexplore.ieee.org/document/10760992> doi:10.1109/ICSSAS64001.2024.10760992
 41. Mille A. Plagiarism in education and scientific integrity in the age of Generative IA.
 42. Hutson J. Rethinking Plagiarism in the Era of Generative AI. *J Intell Commun.* 2024 Apr 26;4(1). doi:10.54963/jic.v4i1.220

43. Huang C, Alhur AA, Azam M, Naeem SB. The Challenge of Academic Integrity in the Age of Generative Artificial Intelligence. *Libri*. 2025 Dec 17;75(4):339–54. doi:10.1515/libri-2025-0024
44. Chauhan C. The Impact of Generative Artificial Intelligence in Scientific Content Synthesis for Authors. *Am J Pathol*. 2024 Aug;194(8):1406–8. doi:10.1016/j.ajpath.2024.06.002
45. Chauhan C, Currie G. The Impact of Generative Artificial Intelligence on Research Integrity in Scholarly Publishing. *Am J Pathol*. 2024 Dec;194(12):2234–8. doi:10.1016/j.ajpath.2024.10.001
46. Giannakos M, Azevedo R, Brusilovsky P, Cukurova M, Dimitriadis Y, Hernandez-Leo D, et al. The promise and challenges of generative AI in education. *Behav Inf Technol*. 2025 Jul 3;44(11):2518–44. doi:10.1080/0144929X.2024.2394886
47. Uddin M, Arfeen SU, Alanazi F, Hussain S, Mazhar T, Arafatur Rahman Md. A Critical Analysis of Generative AI: Challenges, Opportunities, and Future Research Directions. *Arch Comput Methods Eng*. 2026 Mar;33(2):1763–93. doi:10.1007/s11831-025-10355-z
48. Arar KH, Özen H, Polat G, Turan S. Artificial intelligence, generative artificial intelligence and research integrity: a hybrid systemic review. *Smart Learn Environ*. 2025 Jul 22;12(1):44. doi:10.1186/s40561-025-00403-3
49. Osobase KO, Olawale Akadiri O, Davison Dirisu C, Asolo E, Adewara DE, Ekechi CC. ChatGPT and the Future of Generative AI: Architecture, Limitations, and Advancements in Large Language Models. *Asian J Basic Sci Res*. 2025;07(03):175–200. doi:10.38177/AJBSR.2025.7312
50. Fui-Hoon Nah F, Zheng R, Cai J, Siau K, Chen L. Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration. *J Inf Technol Case Appl Res*. 2023 Jul 3;25(3):277–304. doi:10.1080/15228053.2023.2233814
51. Musalamadugu TS, Kannan H. Generative AI for medical imaging analysis and applications. *Future Med AI*. 2023 Sep 6;FMAI5. doi:10.2217/fmai-2023-0004
52. Sai S, Gaur A, Sai R, Chamola V, Guizani M, Rodrigues JJPC. Generative AI for Transformative Healthcare: A Comprehensive Study of Emerging Models, Applications, Case Studies, and Limitations. *IEEE Access*. 2024;12:31078–106. doi:10.1109/ACCESS.2024.3367715
53. Al-kfairy M, Mustafa D, Kshetri N, Insiew M, Alfandi O. Ethical Challenges and Solutions of Generative AI: An Interdisciplinary Perspective. *Informatics*. 2024 Aug 9;11(3):58. doi:10.3390/informatics11030058
54. Diaz V. Exploring the Opportunities and Challenges with Generative AI.
55. Monib WK, Qazi A, Apong RA, Azizan MT, De Silva L, Yassin H. Generative AI and future education: a review, theoretical validation, and authors' perspective on challenges and solutions. *PeerJ Comput Sci*. 2024 Dec 3;10:e2105. doi:10.7717/peerj-cs.2105
56. Batista J, Mesquita A, Carnaz G. Generative AI and Higher Education: Trends, Challenges, and Future Directions from a Systematic Literature Review. *Information*. 2024 Oct 28;15(11):676. doi:10.3390/info15110676
57. Raman R, Achuthan K, Nedungadi P. Generative AI Integration in Education: Theoretical Review and Future Directions Informed by the ADO Framework. *Information*. 2026 Mar 2;17(3):241. doi:10.3390/info17030241