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The impact of ChatGPT on academic integrity in medical education: a developing nation perspective

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Introduction

The integration of artificial intelligence (AI) in education varies significantly across the globe, influenced by factors such as technological infrastructure, economic development, and policy frameworks. In developed nations, AI is increasingly utilized to personalize learning experiences, automate administrative tasks, and enhance educational outcomes. For instance, the global AI in education market was valued at approximately $2.5 billion in 2022 and is projected to reach $6 billion by 2025, reflecting substantial investments in AI-driven educational technologies (Khurshid et al., 2024). In contrast, developing countries face challenges in adopting AI in education due to limited resources (Wang et al., 2023), inadequate infrastructure, and a shortage of skilled personnel. Despite these obstacles, AI holds potential to address educational disparities by providing personalized learning and overcoming financial and technological divides. The World Economic Forum highlights AI's capacity to transform education systems globally, emphasizing its role in creating more inclusive and effective learning environments (Mikeladze et al., 2024).

Rapid innovation in digital technology has revolutionized the learning process not only in developed but also in developing countries. Teachers and supervisors now act as facilitators and mentors. While AI has positively impacted medical education—supporting clinical case development, course design, virtual patients, and assistance, it also challenges academic integrity, especially in developing countries (Khan et al., 2023). Ensuring adherence to ethical codes and principles, such as honesty, trust, fairness, respect, and responsibility, is increasingly difficult, threatening the credibility of educational institutions and the value of their credentials (Rane N. L. et al., 2024). The widespread use of ChatGPT by undergraduate and postgraduate students for seeking response to questions through ChatGPT rather using authentic sources like textbooks or journal articles has raised concerns about maintaining academic integrity in learning and writing (Rane N. et al., 2024). This presents a significant challenge for educators, who must design higher-order thinking questions and develop fair assessment methods in the digital era. Equally important is teaching students to use tools like ChatGPT constructively in their learning process. ChatGPT offer diverse applications in medical education, including generating clinical case studies, acting as virtual test subjects or patients, facilitating research, developing course plans, and providing personalized feedback (Abd-Alrazaq et al., 2023). However, their integration poses significant challenges, such as plagiarism, misinformation, overreliance, inequity, privacy concerns, and copyright issues. Transitioning medical education from an information-driven model to an AI-driven approach requires addressing these challenges. This study analyzes the opportunities and challenges faced by faculty and students in developing countries and outlines future directions for evidence-based best practices (Hadi et al., 2023).

In November 2024, we reviewed 30 studies in English language highlighting the use of ChatGPT in developing countries and extracted data from 18 peer reviewed studies that focused on opportunities and challenges related to AI in developing countries. Studies in English language from year 2023 and 2024 were included while those in language other than English and before 2023 were excluded. The data was extracted from sources like PubMed, Web of Science, Elsevier, and Google Scholar, with keywords such as academic integrity, opportunities, challenges, limitations, AI, ChatGPT, and language models. Data extraction was conducted by three independent reviewers, with consensus achieved through discussion to minimize bias. The extracted data was analyzed using NVIVO, which transcribed the information and identified key themes and subthemes (Table 1).

Opportunities of LLMs for faculty and students in developing countries

World bank classifies the low income and low middle income countries based on gross national income (GNI) of 1025$ or less and 1026 to 4135$ respectively. These both are included in developing countries (World Bank, 2025).

Accessibility

In developing countries, low literacy rates are often linked to the high cost of private education, which remains unaffordable for middle- and low-income citizens. Post-COVID-19 inflation has further strained economies, shifting national priorities toward economic survival over education and health (World Bank, 2025). As a result, many children remain out of school. ChatGPT and similar AI models offer a potential solution by enabling the development of digital education models, allowing students to access basic education from home through online courses. For educators, ChatGPT can assist in creating course frameworks, making educational content development more efficient. Additionally, the ease of access to information provided by these tools can foster greater awareness, enabling societies to pool resources and address community needs effectively.

Curriculum development and implementation

Advancements in AI technology have transformed the need for curriculum reform and implementation strategies, particularly in medical education. AI tools like ChatGPT facilitate curriculum development by streamlining tasks such as creating assessment tools (e.g., Multiple choice questions (MCQs) and Short essay questions (SEQs), designing Objective structured clinical examinations (OSCE), validating assessment methods, and simplifying curriculum implementation (Sengupta et al., 2024). To maximize the benefits of these tools, faculty should integrate them into academic sessions, enabling students to enhance their knowledge and skills more efficiently. This calls for a reorganization of teaching and learning strategies to align with technological advancements, ensuring students can fully leverage the potential of AI in their education.

Independent and self-paced learning

AI tools like ChatGPT enable students to learn at their own pace and according to their individual capabilities, addressing differences in learning styles without requiring significant financial investment (Hunaepi and Suharta, 2024). This approach promotes a culture of self-directed learning, as advocated by medical educationists globally (Figure 1). Medical schools can integrate hybrid teaching models—combining asynchronous and synchronous methods—to leverage digital technology for both learning and assessment. These models create a more conducive learning environment while simultaneously reducing the overall cost of education.

Healthcare

AI technology has revolutionized access to healthcare in underserved rural areas through telemedicine, bridging gaps where physical medical facilities are unavailable. Previously, patients in these areas faced high mortality rates from manageable illnesses due to lack of access to care. AI-driven digital technology now offers preventive measures and improved health outcomes. Additionally, telemedicine provides job opportunities for doctors who cannot operate physical clinics, allowing them to serve as a valuable resource for patients in remote areas (Mogavi et al., 2024).

Promoting research

The developing world lags behind developed countries in generating and pursuing novel research ideas, often replicating studies conducted in Western countries rather than fostering original research tailored to local populations. This occurs due to lack of technology and research driven policies, which is dependent on provision of resources. Resources depends on economy which cannot be afforded by these countries due to poverty. This limits capacity-building among youth and stifles innovation, which could otherwise contribute to economic growth. AI technology, such as ChatGPT, can help bridge this gap by facilitating the generation of innovative ideas. By promoting a culture of creativity and original research, AI empowers individuals, institutions, and societies to pursue projects that are both locally relevant and globally impactful (Thacharodi et al., 2024).

Challenges and possible solutions

Plagiarism and originality

The rising use of AI tools by students poses dual challenge to maintain academic integrity and originality. Although it aids

TABLE 1 Summary of the published studies from developing countries.

Author	Journal name	Title	Type of study	Aim of study	Opportunities	Challenges	Suggestions	Authors affiliation
Wang et al. (2023)	The Lancet Regional Health–Western Pacific	ChatGPT: promise and challenges for deployment in low-and middle-income countries	View point	To discuss the potential advantages and drawbacks of employing ChatGPT to advance healthcare in low- and middle-income countries	ChatGPT can enhance medicine and public health in LMICs by providing health literacy, remote healthcare, mental health support, multilingual capabilities, healthcare communication, medical training, and professional support.	ChatGPT's integration into medicine and public health settings requires holistic consideration of data accuracy, addressing misinformation, context relevance, ethical guidelines, overreliance, and equal access to technology.	The validation of ChatGPT-based interventions in community and clinical settings and the assessment of legal and infrastructure requirements for implementing ChatGPT and similar services in LMICs should be further explored.	Vietnam Combodia, Singapore, USA and UK
Piryani et al. (2023)	Journal of Integrative Medicine and Public Health	Medical schools of South Asian countries need to incorporate artificial intelligence-powered chatbots in existing undergraduate medical curricula	Editorial		ChatGPT, with its acceptable accuracy and relevance, has shown promise in various queries, but even minor errors in clinical judgment can lead to adverse outcomes.	The study discusses challenges in integrating chatbots into medical education, including training faculty, teaching students how to use chatbots, examining potential benefits and limitations, determining appropriate assessment methods, addressing ethical concerns, involving stakeholders, and developing strategies for integrating chatbots.	Chatbots have to play a vital role in transforming medical education and research and improving quality of healthcare and its delivery. These will become an integral part of medical curricula. Furthermore, AI-powered chatbots have to stay here and will have a long-lasting impact on medical education and healthcare.	Pakistan and France
Day (2023)	Journal of Technology in Counselor Education and Supervision	Toward ethical Artificial Intelligence in universities: ChatGPT, culture, and mental health stigmas in Asian Higher Education post COVID-19	Commentary	This article provides a conceptual interdisciplinary commentary	The study highlights how culture and sociolinguistic blend of power relations, sense-making, and cultural capital, shapes human-to-human dialogue in Asian higher education settings.	The study explores the sociolinguistic aspects of culture in Thailand and China using an ethnographic postmodernist perspective.	The article explores the potential of AI technologies like ChatGPT in enhancing university wellbeing strategies in Asia, considering cultural and ethical implications.	UK
Kosowicz et al. (2023)	J Med Internet Res	Lessons for Vietnam on the Use of Digital Technologies to Support Patient-Centered Care in Low- and Middle-Income Countries in the Asia-Pacific Region	Scoping review	To identify the application of DHTs to support the provision of patient-centered care in low- and middle-income countries in the Asia-Pacific region (APR) and to draw lessons for Vietnam.	Low user literacy and digital literacy, limited user access to DHT infrastructure, and a lack of policies and protocols to guide the implementation and use of DHTs.	DHTs enhance patient-centered outcomes by increasing efficiency, reducing healthcare resource strain, and supporting clinical practice. Enablers include user needs alignment, ease of use, direct support, technical support, privacy governance, and cross-sectorial collaboration.	The use of DHTs is a viable option to increase equitable access to quality, patient-centered care across Vietnam and simultaneously reduce pressures on the health care system.	South Australia

(Continued)

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TABLE 1 (Continued)

Author	Journal name	Title	Type of study	Aim of study	Opportunities	Challenges	Suggestions	Authors affiliation
Jiandani and Supe (2023)	International Journal of Transformative Health Professions Education	Priority Health Professions Education Research in 21st Century	Review	To review the research priority in health professional education.	Population health needs, health equity, social determinants, competency-driven curriculum, capacity building, cultural competence, and communication skills are all crucial aspects of addressing health equity.	The integration of Artificial Intelligence and ChatGPT in innovative methods and technological advances is a significant advancement.	Future educational research is expected to incorporate technology advancements, capacity building to address diverse competencies, and collaborative practice.	India
Sallam (2023)	Healthcare	ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns	Systematic review	to investigate the utility of ChatGPT in health care education, research, and practice	The study highlights the benefits of utilizing AI in healthcare research, practice, and education, including improved scientific writing, efficient data analysis, cost savings, personalized medicine, and improved health literacy.	ChatGPT's potential applications in healthcare education, research, and practice can revolutionize the field by addressing ethical, copyright, transparency, and legal issues.	AI chatbot should be conducted with extreme caution considering its potential limitations.	Jordan
Abd-Alrazaq et al. (2023)	JMIR Medical Education	A. Large language models in medical education: opportunities, challenges, and future directions	View point	Recommendations for future use of AI in curriculum transformation	LLMs have the potential to significantly enhance medical curriculum development, teaching methods, personalized study plans, learning materials, and student assessments.	The text addresses issues such as algorithmic bias, overreliance, plagiarism, misinformation, inequity, privacy, and copyright concerns in medical education.	The analysis will guide future recommendations and best practices in utilizing AI technologies responsibly and effectively in medical education.	Qatar, Jordan, UK
Arif et al. (2023)	Medical Education	The future of medical education and research: Is ChatGPT a blessing or blight in disguise?	Editorial	Future of ChatGPT	ChatGPT has been successfully used in healthcare for medical information and assistance, passing the United States Medical Licensing Exams, indicating its potential for medical education and clinical decision-making.	ChatGPT cheating in exams raises concerns about students' ability to generate original ideas and arguments, while its use in scientific papers raises ethical, legal, and copyright issues, lack of creative thinking, and inaccuracy concerns.	ChatGPT enhances constructive writing, material review, and text rephrasing, rather than providing a complete blueprint.	Qatar
Tangadulrat et al. (2023)	JMIR Medical Education	Using ChatGPT for clinical practice and medical education: cross-sectional survey of medical Students' and Physicians' perceptions	Cross sectional survey	To evaluate the perception of physicians and medical students toward using ChatGPT in the medical field.	Doctors find ChatGPT's superficial and general response cautious and suggest medical students should seek a deeper understanding of the disease.	Medical students generally have a positive perception of using ChatGPT for guiding treatment and medical education but cautious use of it is recommended.	Medical students and graduated doctors have shown a positive perception toward using ChatGPT for creating patient educational materials.	Thailand

(Continued)

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TABLE 1 (Continued)

Author	Journal name	Title	Type of study	Aim of study	Opportunities	Challenges	Suggestions	Authors affiliation
Lower et al. (2023)	Indian Journal of Orthopedics	ChatGPT-4: transforming medical education and addressing clinical exposure challenges in the post-pandemic era	Observational study	What is the potential of AI large language models in delivering safe and coherent medical advice to junior doctors for clinical orthopedic scenarios?	Its intuitive interface, accessibility, and sophisticated algorithm render it an ideal supplementary tool for medical students and junior doctors	Its inability to fully address highly specialized areas.	Future research should concentrate on the practical application of ChatGPT-4 in real-world medical environments and its integration with other emerging technologies to optimize its influence on the education and training of healthcare professionals.	Australia
Ali et al. (2024)	Pakistan Journal Of Neurological Surgery	The ChatGPT Develops Multiple Choice Questions (MCQs) for Postgraduate Specialty Assessment–A Reality or a Myth?	Cross sectional study	This study compares faculty-made MCQs to ChatGPT-made ones for a post-grad program.	AI's impact on education is undeniable	Faculty performed better than AI	More research is necessary, but ChatGPT could potentially streamline assessment development, saving faculty substantial time.	Pakistan
Mitra and Chitra (2024)	NK, E. Education in Medicine Journal	Glimpses of the Use of Generative AI and ChatGPT in Medical Education	Commentary	In this review, the focus is on the potential applications	In healthcare, GANs can analyze vast datasets to assist in diagnosis, patient data management, and analysis. Students use ChatGPT to obtain factual answers, write papers and translate languages. It	Students need to use generative AI carefully so that it does not impede their ability to think critically and write effectively	This review could highlight the scope of incorporating ChatGPT into medical education	Malaysia
Indran et al. (2024)	Medical Teacher	Twelve tips to leverage AI for efficient and effective medical question generation: a guide for educators using ChatGPT	View point	The study investigates the use of ChatGPT in creating diverse, high-quality medical questions, specifically multiple-choice questions, to enhance educator productivity and facilitate self-directed learning for students.	We showcase the use of ChatGPT in generating assessment questions that align with Bloom's taxonomy and core knowledge domains, promoting best practices in assessment design.	Subject matter experts are responsible for ensuring quality and accuracy in artificial intelligence-driven education, emphasizing the importance of human involvement.	With continual instruction refinement, AI can produce high-standard questions.	Singapore

(Continued)

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TABLE 1 (Continued)

Author	Journal name	Title	Type of study	Aim of study	Opportunities	Challenges	Suggestions	Authors affiliation
Yu (2023)	Frontiers in Psychology 2023	Reflection on whether ChatGPT should be banned by academia from the perspective of education and teaching	Opinion	Opinion about use of ChatGPT and its academic integrity	ChatGPT enhances learning efficiency and communication through its large language model, displaying creative capacity previously unattainable by AI, marking a qualitative leap from quantitative change.	ChatGPT, a method aimed at improving interpersonal communication, has faced criticism for potential negative effects on relationships, academic dishonesty, and cheating, leading to opposition from universities, publications, and scholars.	ChatGPT technology must consider how to integrate with human thinking and judgment to achieve optimal results.	China
Shidiq (2023)	In Proceeding of international conference on education, society and humanity	The use of artificial intelligence-based ChatGPT and its challenges for the world of education; from the viewpoint of the development of creative writing skills	Opinion	Aims to explore the influence of the ChatGPT system on students' inability to exhibit creativity in their writing abilities.	ChatGPT's ease in processing text input reduces originality, making it uncreative. However, its ability to understand human language allows for creative writing, such as poems, short stories, and novels.	Using the study of creative writing theory, this article aims to discuss the ChatGPT system and its impact on students' lack of creativity in writing skills.	Teachers should implement strategies beyond internet-based learning to ensure students' assignments are properly completed, including using paper for process control and assessment in creative writing tasks.	Indonesia
Mhlanga (2023b)	Available at SSRN 4355758. 2023 Mar 25	ChatGPT in education: Exploring opportunities for emerging economies to improve education with ChatGPT		Purpose of this study is to offer a critical analysis of OpenAI, with a particular emphasis on ChatGPT, regarding the educational sector in developing economies.	AI use in education can provide insights and opportunities by educating students about potential social biases, criticalities, and risks early on in their academic careers.	ChatGPT's potential for academic dishonesty in online exams raises concerns about the honesty of essay submissions, especially in higher education.	In developing economies, it is crucial to approach technology with caution, thoroughly examining its advantages, disadvantages, and potential ethical implications.	South Africa
Sharma and Yadav (2022)	Global Journal of Enterprise Information System	ChatGPT–A technological remedy or challenge for education system	View point	Discuss the limitations and benefits of use of ChatGPT in education	The Chatbot offers numerous benefits, including human-like chats and essay writing, potentially impacting education.	The rapid use of AI in various industries, including education, has led to significant disruptions and potential costs for institutions.	However, we now need to understand how to use technology responsibly.	India
Aleksić-Maslać et al. (2024)	INTED2024 Proceedings	Perception and Usage of ChatGPT in the Education System	Conference proceedings Original paper	The study aims to analyze the usage and perception of ChatGPT among Croatian high school, college, lifelong learning, and educators from various educational institutions.	ChatGPT is a versatile tool that can benefit both educators and students, providing a personalized learning experience and a before/after-class assistant.	90% of educators and LLL professionals believe ChatGPT will not replace their jobs in 5-10 years, while 98% of students believe AI will predominantly or completely replace translators.	Responsible use of ChatGPT is recommended	Croatia

The above table shows the aim, opportunities and challenges in use of ChatGPT in developing countries in 18 published studies.

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A

B

FIGURE 1
Conceptual impact of digital technology. **(A)** Pre-ChatGPT use learning environment. **(B)** Post-ChatGPT use learning environment.

students to bridge the gap of under resource to education in these counties, however some institutes lack the facility to detect AI generated texts and the faculty is also not trained to detect plagiarism in assignments, exams, research, and data manipulation, posing serious threats to academic honesty and integrity. The solution is not to restrict AI usage but to integrate digital technology into curricula, along with robust implementation and assessment tools (Mhlanga, 2023a).

Critical thinking

Over-reliance on AI for simple tasks, such as drafting applications, or emails, is diminishing students' critical thinking skills. Many students have become adept at generating AI prompts and copying results without evaluation. This replaces active intellectual engagement to solve problems with quick pre-formulated outputs without logic and analysis by the students. This has led to proficiency over depth. This may cause students to by-pass the process of thinking, analysis and original constructs generation in developing countries where rote learning is already in place. This could undermine their ability to think independently, innovate and adapt to real world challenges. To address this issue the students and faculty should be trained to critically analyze and review AI outputs, ensuring they refine and validate the content before using it in their academic work (Almatrafi et al., 2024).

Verification and authentication

Institutions face challenges in verifying the authenticity of students' work as AI becomes increasingly integrated into learning. Advanced tools like text generators, coding assistants and algorithms may mimic human originality which is difficult to detect. AI detection tolls also lack reliability as false negatives and biases against non-native English. This can be mitigated by establishing clear policies and guidelines for AI use in academics, applicable at both national and international levels. The faculty should be trained to detect the style of writing and encourage students to do more class work, flipped classrooms and viva examinations so as to verify what they have learnt. This can be mitigated by establishing clear policies and guidelines for AI use in academics, applicable at both national and international levels (Rane N. L. et al., 2024; Rane N. et al., 2024).

Cultural and socioeconomic factors

The introduction of AI bring trans formative changes in health, education and governance in developing countries but its adaption is restricted by multiple challenges regarding cultural attitudes and resource inequities. AI integration is limited in some countries due to language barrier as AI is mostly in English language limiting its use in these countries. Limited digital infrastructure, internet connectivity and limited data storage capacity also add to the challenges (Parker et al., 2024; Sozon et al., 2024). Limited resources and high publication costs often forces faculty and students to cover expenses themselves, leading to practices like gifted authorship to share resources,. Addressing these issues require systemic changes to foster equitable access to academic resources and support. Developing countries should focus on home ground AI development according to their cultural and socioeconomic needs (Figure 2).

FIGURE 2
Pictorial view in tabulated form of challenges and opportunities in use of AI digital technology (ChatGPT) in developing countries. This figure shows the pictorial representation and tabulated form of summary of opportunities and challenges of use of ChatGPT as discussed in 18 extracted studies on it.

Conclusion

Although AI tools like ChatGPT present significant opportunities for faculty and students, but also poses challenges to academic integrity in developing countries. The key lies in developing international policies and guidelines to ensure safe and effective use. Integrating digital technology into medical curricula and redesigning teaching sessions can help students leverage these tools responsibly. While concerns about plagiarism and over-reliance persist, strategic measures and responsible use can allow educational institutions to enhance learning while upholding academic integrity.

Recommendations

Establish Clear Guidelines: Educational institutions should create clear, internationally standardized policies outlining the permissible use of AI tools like ChatGPT. These guidelines should be binding and enforceable across institutions.

- *Redefine Authorship and Compliance*: Authorship standards for publications should be redefined, including legal implications for non-compliance. Institutions should also set limits on AI usage for manuscript writing.
- *Integrate AI into Learning Sessions*: Incorporate AI tools into student learning activities, such as small group discussions and project-based learning. Redesign teaching sessions to promote the effective and ethical use of AI technology.
- *Implement AI Plagiarism Detection Tools*: Make AI plagiarism detection software widely available, requiring all institutions to use it for assignments and academic writing.
- *Conduct Training Programs*: Organize seminars and workshops for faculty and students to promote the ethical use of AI tools and raise awareness about academic integrity.
- *Engage Stakeholders*: Involve all stakeholders in discussions about AI technology to address its challenges and benefits. This collective effort will enhance awareness and help maintain academic integrity.
- Clinical trial number: not applicable.

Author contributions

AJ: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. RA: Data curation, Formal analysis, Writing – original draft, Writing – review & editing. GF: Data curation, Formal analysis, Writing – original draft, Writing – review & editing. MZB: Resources, Supervision, Validation, Writing – original draft, Writing – review & editing.

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Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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References

Abd-Alrazaq, A., AlSaad, R., Alhuwail, D., Ahmed, A., Healy, P. M., Latifi, S., et al. (2023). Large language models in medical education: opportunities, challenges, and future directions. *JMIR Med. Educ.* 9:e48291. doi: 10.2196/48291

Aleksić-Maslać, K., Borović, F., and Biočina, Z. (2024). "Perception and usage of ChatGPT in the education system," in *INTED2024 Proceedings* (Valencia), 1842–1848. doi: 10.21125/inted.2024.0511

Ali, F. A., Sharif, S. Y., Ata, M., Patel, N., Rafay, M., Syed, H. R., et al. (2024). The ChatGPT develops multiple choice questions (MCQs) for postgraduate specialty assessment–a reality or a myth? *Pak. J. Neurol. Surg.* 28, 142–149. doi: 10.36552/pjns.v28i1.963

Almatrafi, O., Johri, A., and Lee, H. A. (2024). Systematic review of AI literacy conceptualization, constructs, and implementation and assessment efforts (2019–2023). *Comput. Educ. Open* 31:100173. doi: 10.1016/j.caeo.2024.100173

Arif, T. B., Munaf, U., and Ul-Haque, I. (2023). The future of medical education and research: is ChatGPT a blessing or blight in disguise? *Med. Educ. Online* 28:2181052. doi: 10.1080/10872981.2023.2181052

Day, M. J. (2023). Towards ethical Artificial Intelligence in universities: ChatGPT, culture, and mental health stigmas in Asian higher education post COVID-19. *J. Technol. Couns. Educ. Superv.* 4:7. doi: 10.61888/2692-4129.1097

Hadi, M. U., Qureshi, R., Shah, A., Irfan, M., Zafar, A., Shaikh, M. B., et al. (2023). A survey on large language models: Applications, challenges, limitations, and practical usage. *Authorea Preprints*. doi: 10.36227/techrxiv.23589741.v1

Hunaepi, H., and Suharta, I. (2024). Transforming education in Indonesia: the impact and challenges of the merdeka belajar curriculum. *Path Sci.* 10, 5026–5039. doi: 10.22178/pos.105-31

Indran, I. R., Paranthaman, P., Gupta, N., and Mustafa, N. (2024). Twelve tips to leverage AI for efficient and effective medical question generation: a guide for educators using ChatGPT. *Med. Teach.* 46, 1021–1026. doi: 10.1080/0142159X.2023.2294703

Jiandani, M., and Supe, A. (2023). Priority health professions education research in 21st century. Int. *J. Transform. Health Prof. Educ.* 1, 3–13. doi: 10.71354/ijthpe.01.01.05

Khan, R. A., Jawaid, M., Khan, A. R., and Sajjad, M. (2023). ChatGPT-reshaping medical education and clinical management. *Pak. J. Med. Sci.* 39:605. doi: 10.12669/pjms.39.2.7653

Khurshid, A., Tan, D. Y., and Tan, G. L. (2024). *Catalysing Growth: State of ASEAN University Innovation and Entrepreneurship: Report 2024*. Available online at: https://iie.smu.edu.sg/sites/iie.smu.edu.sg/files/2025-04/AUNWP_updated_22Apr25.pdf

Kosowicz, L., Tran, K., Khanh, T. T., Dang, T. H., Pham, V. A., Ta Thi Kim, H., et al. (2023). Lessons for Vietnam on the use of digital technologies to support patient-centered care in low-and middle-income countries in the Asia-Pacific region: scoping review. *J. Med. Internet Res.* 25:e43224. doi: 10.2196/43224

Lower, K., Seth, I., Lim, B., and Seth, N. (2023). ChatGPT-4: transforming medical education and addressing clinical exposure challenges in the post-pandemic era. *Indian J. Orthop.* 57, 1527–1544. doi: 10.1007/s43465-023-00967-7

Mhlanga, D. (2023a). Digital transformation education, opportunities, and challenges of the application of ChatGPT to emerging economies. *Educ. Res. Int.* 7:605075. doi: 10.1155/2023/7605075

Mhlanga, D. (2023b). *ChatGPT in Education: Exploring Opportunities for Emerging Economies to Improve Education With ChatGPT*. Available online at: https://ssrn.com/abstract=4355758

Mikeladze, T., Meijer, P. C., and Verhoeff, R. P. (2024). A comprehensive exploration of artificial intelligence competence frameworks for educators: a critical review. *Eur. J. Educ.* 14:e12663. doi: 10.1111/ejed.12663

Mitra, N. K., and Chitra, E. (2024). Glimpses of the use of generative AI and ChatGPT in medical education. *Educ. Med. J.* 16, 155–164. doi: 10.21315/eimj2024.16.2.11

Mogavi, R. H., Deng, C., Kim, J. J., Zhou, P., Kwon, Y. D., Metwally, A. H., et al. (2024). ChatGPT in education: a blessing or a curse? A qualitative study exploring early adopters' utilization and perceptions. *Comput. Hum. Behav. Artif. Humans.* 2:100027. doi: 10.1016/j.chbah.2023.100027

Parker, L., Carter, C., Karakas, A., Loper, A. J., and Sokkar, A. (2024). Graduate instructors navigating the AI frontier: the role of ChatGPT in higher education. *Comput. Educ. Open* 6:100166. doi: 10.1016/j.caeo.2024.100166

Piryani, R. M., Piryani, S., and Piryani, R. (2023). Medical schools of South Asian countries need to incorporate artificial intelligence-powered chatbots in existing undergraduate medical curricula. *J. Integr. Med. Public Health* 2, 37–38. doi: 10.4103/JIMPH.JIMPH_19_23

Rane, N., Shirke, S., Choudhary, S. P., and Rane, J. (2024). Education strategies for promoting academic integrity in the era of artificial intelligence and ChatGPT: ethical considerations, challenges, policies, and future directions. *J. ELT Stud.* 1, 36–59. doi: 10.48185/jes.v1i1.1314

Rane, N. L., Paramesha, M., and Desai, P. (2024). Artificial intelligence, ChatGPT, and the new cheating dilemma: strategies for academic integrity. *Artif. Intell. Ind. Soc.* 5, 2–7. doi: 10.70593/978-81-981271-1-2_1

Sallam, M. (2023). ChatGPT utility in healthcare education, research, and practice: systematic review on the promising perspectives and valid concerns. *In-Healthcare* 11:887. doi: 10.3390/healthcare11060887

Sengupta, R., Saha, S., Patil, A., and Yadav, R. (2024). "Analysing the impact of China, Russia–Ukraine War and the global uncertainty post-COVID pandemic on the economy of Pakistan and Sri Lanka and possible recovery measures," in *Economic Uncertainty in the Post-Pandemic Era*. Routledge, 76–101. doi: 10.4324/9781003461074-5

Sharma, S., and Yadav, R. (2022). ChatGPT–a technological remedy or challenge for education system. *Glob. J. Enterp. Inf. Syst.* 14, 46–51.

Shidiq, M. (2023). "The use of artificial intelligence-based ChatGPT and its challenges for the world of education; from the viewpoint of the development of creative writing skills," in *Proceeding of International Conference on Education, Society and Humanity* 1, 353–357.

Sozon, M., Chuan, S. B., Fong, P. W., Alkharabsheh, O. H., and Rahman, M. A. (2024). Factors influencing academic dishonesty among undergraduate students in higher education institutions (HEIs) in Malaysia. *J. Manage. Info.* 11, 137–159. doi: 10.31580/jmi.v11i2.3039

Tangadulrat, P., Sono, S., and Tangtrakulwanich, B. (2023). Using ChatGPT for clinical practice and medical education: cross-sectional survey of medical students' and physicians' perceptions. *JMIR Med. Educ.* 9:e50658. doi: 10.2196/50658

Thacharodi, A., Singh, P., Meenatchi, R., Tawfeeq Ahmed, Z. H., Kumar, R. R., Kavish, V. N., et al. (2024). Revolutionizing healthcare and medicine: The impact of modern technologies for a healthier future—a comprehensive review. *Health Care Sci.* 3, 329–349. doi: 10.1002/hcs2.115

Wang, X., Sanders, H. M., Liu, Y., Seang, K., Tran, B. X., Atanasov, A. G., et al. (2023). ChatGPT: promise and challenges for deployment in low-and middle-income countries. *Lancet. Reg. Health West Pac.* 41:100905. doi: 10.1016/j.lanwpc.2023.100905

World Bank (2025). *World Bank country classifications by income level for 2024–2025*. Available online at: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed May 9, 2025).

Yu, H. (2023). Reflection on whether ChatGPT should be banned by academia from the perspective of education and teaching. *Front. Psychol.* 14:1181712. doi: 10.3389/fpsyg.2023.1181712