Review Article

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Integrating Artificial Intelligence in Medical Education: A Meta-Synthesis of Potentials and Pitfalls of ChatGPT

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Introduction: ChatGPT serves as a double-edged sword in education, offering either constructive information or potential challenges. Its impact ranges from being a transformative tool to a disruptive force, making it difficult to evaluate its educational efficacy comprehensively. In light of this complexity, the primary aim of this research was to investigate the opportunities and challenges associated with the integration of ChatGPT into the domain of medical education.

Methods: The study utilized the Interaction Equivalency Theorem as its conceptual framework to guide the investigation. To achieve the research objectives, a meta-synthesis of the literature was conducted to systematically integrate the findings of selected studies. Data collection involved comprehensive searches across specialized academic databases, including Science Direct, Springer, ERIC, Emerald, SAGE, Wiley Online Library, PubMed, and Google Scholar, focusing on publications from 2022 to 2024. 88 articles were meticulously selected based on their relevance to the research topic. The data were then subjected to thematic analysis, facilitating the extraction of key insights and patterns to address the study objectives.

Results: The findings were organized into four primary sub-themes highlighting the opportunities presented by ChatGPT in medical education. These sub-themes encompassed benefits for educators, learners, curriculum development, and the learning process. Similarly, the challenges related to the integration of ChatGPT were categorized into four primary sub-themes: addressing the difficulties experienced by educators, learners, curriculum development, and the learning process. Together, these challenges were further delineated into 11 secondary sub-themes, offering a comprehensive analysis of the complexities involved.

Conclusion: The findings suggest that improving educational efficiency, assisting with self-development, enhancing communication skills, creating and expanding curriculum, and improving the learning environment are opportunities for utilizing ChatGPT. The study outcomes also reveal that lack of technological knowledge, negative attitudes, reduction in education quality, diminishing students' capabilities, reducing learning quality, flaws in learning development, difficulties in designing educational content, and bias in learning evaluation are challenges of applying ChatGPT in medical education.

Keywords: Artificial intelligence; Computer-assisted instruction; Educational technology; Medical education

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Introduction

The rapid development of machine learning-based language models, such as OpenAI's Generative Pretrained Transformer (GPT), has significantly advanced language generation capabilities in recent years. GPT, a cutting-edge text generation model, attracted considerable attention for its ability to produce high-quality written content in real time (1). This technology sparked both enthusiasm and concerns, particularly in education, where it could transform activities such as information retrieval, discussion facilitation, content creation, coding, multilingual translation, and statistical analysis (2). However, its adoption also raised challenges, including biases inherent in natural language processing, privacy concerns, risks of job displacement, a lack of creativity and critical thinking, inaccuracies, and potential plagiarism (3). These dualities necessitated a balanced approach to the ethical and practical use of ChatGPT in educational settings. Additionally, the rapid integration of ChatGPT in medical education highlights the need for strategic responses and addressing the associated risks (4, 5).

The theoretical foundation of the present study is built upon three fundamental theories, including Complexity Theory, Chaos Theory, and Open System Theory. According to Complexity theory, planning for development is not linear, predictive, or deterministic; instead, it requires an understanding and tracking of past conditions, assessing and interpreting the present, and considering the surrounding environment. Based on this theory, adapting to technological advancements, including ChatGPT, requires constant self-organization, adjustment, and alignment with the surrounding environment (6). Relatedly, Chaos Theory suggests that we are facing a chaotic future for which there is no definitive design or strategy. By knowing the structure of the system, minor alterations can have a significant impact on the future. Therefore, simply adjusting the usage of ChatGPT in even small-scale applications, we can generate huge impacts on using technology (7, 8). According to Open System Theory, educational systems are open systems made up of multiple elements, factors, and players whose interrelationships are complicated and interdependent. This system constantly interacts with its environment as well as reorganizes and modifies itself based on feedback from the environment, taking the dynamic character of its conditions into account.

Conceptual Framework

Interactions and actions among the educator, the student, and the content produce meaningful and profound learning (9). We classified the data derived from the content analysis of the articles included. The principle of Interactional Equivalence conceptual framework was used as a guide for our analysis (Figure 1). To illustrate it, we considered three major dimensions:

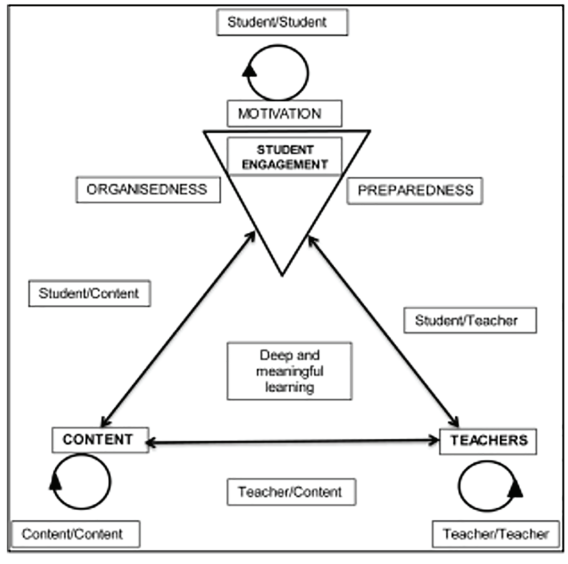

Figure 1: Conceptual framework

Methods

The analysis was conducted to synthesize qualitative interpretations of the opportunities and challenges of ChatGPT. A meta-synthesis method comprises four critical steps: [1] formulating research questions; [2] implementing a search strategy; [3] identifying and extracting key themes or concepts; and [4] synthesizing these themes or concepts into a cohesive framework (10-13). To follow the guideline, we posed these two questions: 1) What opportunities are created in medical education by utilizing ChatGPT? 2) What challenges are caused by applying ChatGPT in medical education?

Search Strategy

To examine the eligibility criteria of the articles, the three steps of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were applied. The review was in the stages of 1) title screening, 2) abstract screening, and 3) full-text screening. The following databases were selected to complete the search: Science Direct, Springer, ERIC, Emerald, Sage Journals, Wiley Online Library, PubMed, and Google Scholar. To include related articles, we used the following search strings:

"ChatGPT Opportunities in Education" OR "ChatGPT Opportunities in Medical Education" OR "ChatGPT Opportunities in Teaching" OR

"ChatGPT Opportunities in Medical Teaching" OR "ChatGPT Opportunities in Training" OR "ChatGPT Opportunities in Medical Training" OR "ChatGPT Opportunities in Learning" OR "ChatGPT Opportunities in Medical Learning" OR "ChatGPT Opportunities in Teaching-Learning Process" OR "ChatGPT Opportunities in Medical Teaching-Learning Process".

The second string was designed as followed: "ChatGPT Challenges in Education" OR "ChatGPT Challenges in Medical Education" OR "ChatGPT Challenges in Teaching" OR "ChatGPT Challenges in Medical Teaching" OR "ChatGPT Challenges in Training" OR "ChatGPT Challenges in Medical Training" OR "ChatGPT Challenges in Learning" OR "ChatGPT Challenges in Medical Learning" OR "ChatGPT Challenges in Teaching-Learning Process" OR "ChatGPT Challenges in Medical Teaching-Learning Process".

Inclusion Criteria

To include studies, we defined the following eligibility criteria for finding the articles. 1) We sought full-text articles from 2022 to April 2024, as ChatGPT was launched in 2022, 2) Papers were included if they were relevant to the field of our study, 3) we checked for adherence to the given time limits.

Exclusion Criteria

The exclusion criteria were assessed using the ten-question Critical Appraisal Skills Program (CASP) questionnaire. This 10-question tool helps researchers analyze the correctness, credibility, and significance of studies, as well as establish links between study techniques and conclusions. Accordingly, researchers assigned a numerical score to each question and developed a form for accumulating article ratings. Articles with scores lower than 30 were eliminated based on the scoring provided by this tool. In this study, 25 research articles received less than 30 points and were, therefore, eliminated from the analysis. The final study involved 88 studies that passed the screening process (Figure 2).

Data Collection Process

To collect data, firstly, we extracted the key concepts from selected articles and transcribed them into a Word document. The concepts were reviewed multiple times by the research team. The paragraph was chosen as the unit of analysis. By using an inductive approach, the most significant key concepts, carrying the greatest interpretative value, were identified and extracted. To ensure the robustness and relevance of the extracted concepts, the process was repeated three times across all the key points. This iterative approach allowed the researchers to discern patterns and relationships among the concepts across different articles. Additionally, the research team employed a critical-analytical approach to uncover implicit concepts that underpinned the explicit concepts. Furthermore, the extracted concepts or initial codes were organized into thematic categories, facilitating their integration into the final stage of analysis.

Secondly, we focused on synthesizing the key concepts. To this aim, organization and integration of the concepts were undertaken. The key concepts were grouped into various clusters and placed into a single file. Subsequently, these concepts were categorized based on their similarities and differences. The research team were engaged in an iterative process of examining

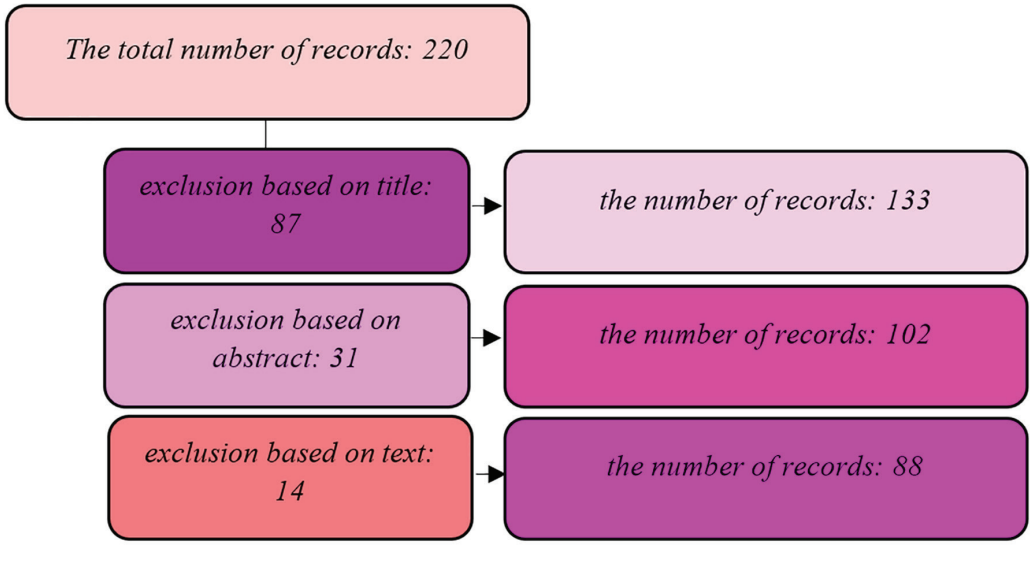

Figure 2: Flow diagram illustrating the screening process

and refining these categories to ensure the accurate placement and appropriate labeling of each category. This classification was conducted inductively, progressing from the individual concept level to more abstract and generalized levels of categorization. The process adhered to the principles of thematic analysis, providing a structured approach to identifying and organizing the data. Table 1 outlines the framework utilized in the thematic analysis process.

For validity, we focused on sources relevant to the topic, prepared a comprehensive representation of the findings, and employed two external scholarly reviewers in artificial intelligence as well as the medical education fields not affiliated with the research team. The reviewers' evaluation aligned with those of the researchers, reinforcing the reliability of the results. A dual-phase coding process was implemented at the stages of collaborative coding with co-researchers and independent coding by the leading researcher at two different times. In terms of ethical considerations, the current study adhered to the ethical principles of scientific integrity by applying primary sources of moral reference.

Results

As previously stated, essential themes were collected from the papers in response to the first study question, which was about the most significant opportunities of ChatGPT in medical education. At higher-level (more abstract) abstraction layers, these concepts were grouped based on their similarities and contrasts. Based on the conceptual model of the research, Table 2 details the findings of the most important opportunities of using ChatGPT.

In response to the second research question, the most major challenges of using ChatGPT in medical education, we extracted the most relevant key concepts (codes) from the papers using the methodology developed by Braun and Clark (14). We then categorized them based on their similarities and differences using the research conceptual model. Table 3 presents the conclusions of the most essential challenges of using ChatGPT in medical education.

Discussion

The aim of this study was to delineate the opportunities and challenges associated with the use of ChatGPT in medical education settings. We categorized the opportunities into four distinct groups: opportunities for educators, learners, curriculum development, and the learning process. Subsequently, we conducted a comprehensive analysis of each category.

Table 1: Thematic analysis process

Steps	Description	The method used to analyze the data in this study
Becoming acquainted with the data	To start analyzing any material, it's important to fully immerse oneself in it to gain a comprehensive understanding of its scope and depth. This initial stage enables a detailed examination of the content, paving the way for identifying patterns and extracting relevant insights during the analysis process.	This method was used to convert interview transcripts into texts, thoroughly read the interview text to become familiar with its content, then recognize and evaluate analytical patterns within the text to extract key insights and findings.
Creating initial code	This step efficiently organizes data and ensures impartial treatment of each item.	This method was utilized for taking into account the unit of text analysis in interviews (paragraphs) and extracting initial codes.
Developing preliminary themes	The resulting codes are sorted into preliminary themes in this step. Beyond sorting, the procedure includes determining the meaning of each code and investigating the links that exist among the initial codes.	This method was used for sorting and listing the retrieved initial codes based on study topics.
Reviewing the identified themes	The following stage entails identifying coherent patterns within the coded data. Researchers examine the complete dataset in its entirety, taking into account how the codes and motifs interrelate and contribute to the overall story.	This method was used to merge similar codes and ensure that there were a sufficient number of codes.
Defining and assigning names to the themes	The emphasis in this stage changes to identifying the narrative inside each of the highlighted themes. Researchers also try to integrate these particular theme narratives into the larger framework of the overall dataset, connecting them with the research issues at hand.	This method was used to review the categories generated based on similarities and differences, as well as organize the identified themes.
Creating the report	The main objective of this stage is to offer a concise yet captivating narrative that encapsulates the data's story. This narrative investigates not only the topics individually, but also the relationships and overall conclusions that arise throughout these themes.	This procedure was utilized to present the final findings report.

Table 2: The most important opportunities of using ChatGPT in medical education

Main Theme	Primary Subtheme	Secondary Subtheme	Key Concepts (Code)
ChatGPT Opportunities in Medical Education	Opportunities for Educators	Improving Educational Efficiency	Enhancing Curriculum Creativity, Promoting Teaching Idea Exchange, and Providing Access to Comprehensive Teaching Resources, Facilitating Individual Learning Styles-Tailored Teaching, Assisting in the Development of New Teaching Topics, Using Novel Approaches to Problem-Solving, Operating as an Educational Tool for Problem Solving in Teaching, Assisting in the Development of Instructional Lesson Plans, Providing Exciting Instruction, Improving Teaching Methods, Making Classroom Project Suggestions, Making Discussion Questions for Class Meetings, Providing Additional Classroom Examples, Increasing the Variety of Practical Classroom Examples, Assisting educators with test question design, Assisting educators with assignment design, Assisting Educators with condensing textbooks and articles for instruction, Assisting in identifying learners who require additional support in the classroom ,Assisting in explaining complex concepts, Assisting Teachers in Better Analyzing Learners' Emotions, Assisting with the extraction of information from a variety of educational resources, Assisting with the Evaluation of Teaching Activities, Identifying Learners' Weaknesses and Strengths, Assisting in Designing Gamification Activities in Teaching, Assisting Educators with Curriculum Development, Contributing to the Development of Novel Teaching Methods, Improved Course Content Organization, Assisting in challenging Incorrect responses, Presenting Practical Concepts in the Classroom, Accelerating Learner Assignment Assessment, Creating Innovative Teaching Activities, Assisting Educators in Determining Learners' Favorite Content, Intelligent Teaching, Data analysis for accurate learner performance prediction, Enabling timely intervention for at-risk learners, Profiling learner performance Providing Learners with Targeted Educational Resources in a Specific Field, Creating Online Educational Conversations, Making Multimedia Assignments Available, Providing New Ideas in the Classroom, Assisting with Test Design, Creating Valuable Insights for Educational Improvement, Better Organizing Educational Objectives, Research-Based Teaching, Multidisciplinary Education, Designing Exercises Aligned with Learning Objectives, Identifying Knowledge Gaps, Assisting in Question Design Based on Course Difficulty Levels, Aiding in the Evaluation of Teaching Effectiveness, Creating Diverse Assessments, Diversifying Course Assignments, Using Real-Life Examples That Are Tailored to Each Learner's Specific Situation, Creating New Educational Theories, Helping to Teach Preparedness, Exam Question Variation, Improving Course Content, Assisting in the Design of Critical Thinking and Clinical Decision-Making Exercises, Simplifying the Teaching Process, Rapid Knowledge Retrieval and Organization, Contributing to the Advancement of International Education, Creating a New Educational Environment, Creating a Test Question Bank, Changing the Educator Roles, Creating an Educational Vision for Educators.
		Assistance with Self-Development	Providing Special Resources for Educator Professional Development, Encouraging Knowledge Sharing, contributing to Educator Job Satisfaction, Assisting Educators with Self-Evaluation, Assisting Educators with Identifying Their Strengths and Weaknesses, Assisting Educators in Identifying Their Subject Knowledge and Skills, Helping Educators Recognize Their Mistakes, Assisting Students in Developing New Job Market Skills, Improving Students' Reading Skills.
		Effective Educator Assistance	Prompt responses to educational questions from Educators, Adequate Specialized Education Support for Specific Groups (e.g., those with disabilities, the hearing impaired, etc.), Time Management for Educators, Increased Focus on Students in High-Capacity Classes, Assisting Educators in Making Better Adjustments, Improving Classroom Supervision Techniques, Improving the Monitoring Process for Assignments, Assisting with the creation of lecture notes, Assisting with the creation of educational slides to New Classroom Settings, Improved Tracking of Learners' Academic Progress, Helping Educators Manage Large Classes, Assisting Educators with Task Management, Assisting Educators with Goal Achievement, Assisting Educators in Meeting Learning Goals, Improved Coordination of Classroom Activities, Contributing to the Development of More Effective Educational Aids, Assisting in the Determination of Individual and Group Responsibilities, Assisting with Appropriate Classroom Scheduling, Enhancing Learner Monitoring and Progress Tracking, Assisting in the identification of causes for learner failures or declines in performance, Assisting in the Development of More Effective Teaching Methods, Assisting in the Identification of Educational Needs, Assisting with the Management of Learners' Academic Records.
	Opportunities for Students	Improving Students' Communication Skills	Increasing Interaction Among Students from Various Disciplines, Aiding in the Development of Students' Interactions with Educators, Assisting in the Promotion of Interaction Among Students, Facilitating Meaningful Interaction Between Students and Educators.

Main Theme	Primary Subtheme	Secondary Subtheme	Key Concepts (Code)
		Students' Effective Support	Improved Translation Accuracy, Providing Support for Multiple Languages, Quick and timely responses to inquiries, Accessibility at any time and from any location, Facilitating Active Student Engagement, Serving as a Learning Assistant, Assisting Students with Limited English Proficiency in Writing, Correcting Students' mistakes, Assisting Students in Better Understanding Class Topics, Making it possible for students to complete additional exercises, Providing more explanation on Course Assignments, Assisting Students in Summarizing Specific Subjects, Assisting Students with Creative Writing, Guiding Students Identify Study Resources, Assisting Students in Creating Flashcards for Exam Preparation, Assisting Students in Recognizing Their Weaknesses, Creating Practice Questions and Answers to Assist Learners in Exam Preparation, Assisting Students with Interview Preparation, Helping Students Determine Their Educational Needs, Receiving Immediate Personal Feedback, Assists Students in Meeting Educational Objectives, Individualized Learning, Reduces Anxiety and Stress in Students, Simplifying the Assignment Completion Process, Providing Self-Assessment Tools for Students, Providing Self-Study Resources, Helping Students Accelerate Their Learning, Using it as a Writing Aid, Helping with Better Career Path Exploration, Reducing class preparation time, providing personal guidance to students, Laying the groundwork for better course material retention, Improving Material Analysis Comprehension, Increasing Time Efficiency in Activities, Assisting Students in Achieving Educational Goals, Using it as a Mentoring Tool for Individual Students, Assisting Students in Adapting to Heavier Workloads, Academic Grade Improvement and Enhancement, Helping Students Choose Better Content, Analyzing Learning Patterns with Students, Providing Academic Guidance, Reducing Cognitive Overload from Task Completion, Developing a Sense of Competence in Students, Being able to meet the needs of multiple students, Assisting Students in Applying Knowledge, Creating Personal Study Plans, Increasing Study Time, Assisting Students with Oral Presentations, Providing Career Guidance to Students, Helping Students Discover New Concepts on Their Own, Assisting in Sharing Prior Knowledge, Increasing Students' Chances of Success, Developing Students' New Thinking Methods, Assisting Students in Identifying Mistakes Quickly, Helping to Improve Alignment with Individual Needs and Preferences, Assisting with Learning Prioritization, Providing Individualized Reporting, Developing Students' Educational Pathways, Assisting Students in Preparing for Classes, Making Exam Preparation Easier, Answering Questions in an Acceptable Manner, Capability for Self-Improvement, Assisting with the Writing of Appropriately Toned Emails, Assisting with Academic Stress Management, Helping to Balance Study and Rest Time, Assisting Students in Asking More Difficult Questions in Class, Assisting Students with Administrative Tasks in Education, Assisting in the Development of Engaging Visual Presentations.
		Personal Skills Improvement	Improving Language Skills, Improving Critical Thinking Capabilities, Encouragement of Reflection, Developing Students' Reasoning Skills, Improving Digital Skills, Improving Collaborative Capabilities, Assisting with Learning Self-Regulation, Enhancing Students' Self-Motivation, Advancing Problem-Solving Skills, Improving Students' Cognitive Abilities, Assisting in the Development of Argumentation Skills in Students, Helping Students Improve Their Analytical Skills, Advancing Students' Planning Capabilities, Developing Learners' Self-Efficacy, Increasing Learners' Self-Confidence, Helping to Advance Thinking Analytically, Assisting in Professional Learning Advancement, Developing Planning Skills, Improving Project Management Capabilities.
	Curriculum Development Opportunities	Creating New Curriculum Materials	Contributing to the creation of high-quality content, Contributing to the creation of graphic material, Creating instructional content in the student's native language, Creating interactive course materials, Customizing educational content, Participating in brainstorming sessions to develop new curriculum content, Designing unique educational content, Adapting content to match educational goals, Creating material in a variety of novel formats, Providing innovative curricular content design concepts, Creating educational content with a purpose, Creating a variety of content.
		Current Curriculum Content Revision and Expansion	Increasing the variety of educational content, Helping to provide practical content, Editing curriculum materials, Making it easier to compare different text formats and writing styles, Assisting in the identification of gaps in current curricular content, Assuring that existing content is complete, Updating current curriculum content, Assisting in curriculum content review.

Main Theme	Primary Subtheme	Secondary Subtheme	Key Concepts (Code)
	Opportunities in the Learning Process	Development of Learning Patterns	Multimodal learning; Personalized learning, Adaptive learning, Analytical learning, More meaningful learning, Technology-enhanced learning, Learning how to learn, Continuous learning, Flexible learning, Customized learning, Collaborative learning, Flexible learning; Dynamic learning, Exciting learning, Interactive learning, Independent learning, Exploratory learning, Experiential learning, Self-directed learning, Lifelong learning, Smart learning, Active learning, Interdisciplinary learning Distance learning, group learning, goal-oriented learning, self-regulated learning, and ownership of the learning process are all examples of effective learning strategies. Problem-based learning is a type of blended learning, Simulating real-life dialogues for students, Learning through simulation, Learning through reflection, Learning self-regulation, Project-based learning, Research-based learning, Question-based lessons, Developing a learning scaffold Experiential learning that is integrated, Open learning.
		Improvement of Learning Environment	Enhancing the peer learning process, Increasing learning possibilities, Improving the effectiveness of learning experiences, Creating a welcoming learning environment, Enhancing the learning experience, Creating learning group dialogues, Learning Resources for New Reforms, Providing a variety of learning resources, Improving the quality of learning experiences, Developing a conversational learning environment, Increasing the competitiveness of the learning environment, Improving the Learning Quality Improvement Process, Assisting with the understanding of complicated concepts, Creating more precise learning challenges, Recognizing and establishing learning patterns, Making learning more enjoyable, Aiding home-based schooling, Making recommendations for new learning paths, Increasing the variety of learning approaches, Increasing the effectiveness of learning, Assisting with the revision of learning objectives, Increasing interest in learning, Providing responses in a variety of formats, Capability to communicate in multiple languages, Providing step-by-step educational solutions, Answering questions by breaking them down into smaller components, Presenting findings in both text and visual formats, Providing useful study resources, Recommending articles and books to students, Making learning environments more responsive, Promoting a culture of constructive criticism, Creating new learning pathways, Assisting in directing the flow of learning toward the development of learners, Directing learning activities, Assisting with the revision of learning objectives, Improving Learning Results, Providing more instructional resources for learning, Creating measurable learning objectives, Creating personalized learning paths, Striking a balance in the learning process between learner-centric and teacher-centric approaches, Creating a good and encouraging environment in the classroom, Creating a welcoming educational atmosphere, Individual learning styles can be improved, Opportunities for low-cost learning, Creating text answers that are human-like, Increasing learners' eagerness to learn more, Creating interest with the first inquiry and responding to future inquiries, Advancing complicated learning processes.
		Learning Assessment	Assisting with learning evaluation, Automating evaluation procedures, Feedback delivery grading, Giving learners timely feedback on their assignments, Increasing the effectiveness of Assessment activities, Assessment should be tailored to the level of each student, Streamlining the evaluation procedure, Accelerating student activity assessments, Improving the efficiency of assessment activities, Assessments that are interactive, Observing and evaluating the progress of students throughout time, Assisting in the complete evaluation of students' activities, Reasonable evaluation, Managing Assessment Feedback Mechanisms, Analyzing the progress of students throughout time, Evaluation of educational advancements, Assessment grading method that is automated, Comparative analysis, Formative evaluation, Methods of assessment are being innovated, Student-centered assessment, Creating new assessment methods, Assessment that is interactive, Assisting in the execution of various assessments, Grading learners in assessment, Comparison feedback, Assisting Educators with qualitative student evaluation, Online evaluation, Improving the Evaluation Process, Increasing the variety of assessment methods, Human-free evaluation, Improving Assessment Efficiency and Accuracy, Automating assessment tasks, Providing suggestions for new curriculum design, Assisting Educators with assessment planning, Providing targeted feedback in the creation of intervention methods for improving learning, Assisting with the revision of evaluation strategies, Adapting evaluation to individual needs, Enhancing evaluation procedures, Process-based evaluation, Summarizing student projects for evaluation, Making assessment checklists for students' self-evaluation, Assisting with the creation of assessment tasks, Assessment criteria must be aligned with learning objectives, Facilitating the evaluation of complicated activities, Performance-based evaluation, Creating standardized evaluation tools, Reducing the time constraints for student evaluations, Creating oral assessments, Changing grading systems, Making practical assessments, Assisting in the preparation of peer evaluations, Assessment in small-group settings.

Table 3: The most important challenges of using ChatGPT in medical education

Main Theme	Primary Subtheme	Secondary Subtheme	Key Concepts (Code)
The Challenges of ChatGPT in Medical Education	Challenges for Educators	Educators' Lack of Technological Knowledge	Some Educators lack expertise in artificial intelligence technology, Certain Educators have limited abilities to examine outcomes for spotting specialized topic domains. Some Educators lack a basic comprehension of technology, Insufficient understanding among Educators in discerning generated information.
		Educators' Negative Attitudes	Resistance to change among Educators, Fear of job displacement among Educators, Negative attitudes and lack of acceptance of technology, Fear of using ChatGPT, Concerns about job security, Potentially negative consequences for workforce displacement, Existence of stereotypes and negative attitudes, Lack of interest among some Educators in using ChatGPT, Educators' skepticism in using ChatGPT, Concerns among some Educators about their roles and obligations.
		Decline in Education Quality	Lowering University education standards, Giving responses that do not correspond to educational aims, Difficulty in integration with current teaching methods, Ignoring each institution's and the educational ecosystem's existing contexts, Increase in academic dishonesty in the academic world, Risk to educational quality, Diminishment of the value of education, Erosion of ethical values in education, decreased accountability for Educators, Difficulty discerning genuine knowledge, Incompatibility of some large language models with the diverse needs of Educators, Reduced significance of actual labor in educational contexts, Reduced effectiveness of the educational process, Failure to meet genuine educational goals, Presenting incomplete data in education, Lack of acceptance in all educational fields, Weakening of educational values.
	Challenges for Students	Lack of Technological Skills among Students	Some students' inability to use ChatGPT, Some students' low level of AI literacy, Technology access gap among learners due to technical knowledge deficiencies, Some students' incorrect grasp of technology, Students' inability to evaluate generated information.
		Diminished Capabilities of Students	Reduced work discipline as a result of dependency on ChatGPT, Suppression of critical thinking development, Communication skills suppression, Reduced problem-solving abilities, Reduced socialization, Reduced student accountability, Independent thinking skills deterioration.
		Reduced Learning Quality	Some responses are not aligned with individual needs. Reduced the capacity of students to deal with difficult situations, Use of content without critical thinking, Students' tendency to search for answers to their questions rather than engage in true exploration, Decrease in students' motivation to learn, Reduced human interactions between students and Educators, Creation of cognitive biases among learners, Formation of a lazy habit among students, Negative impact on students' emotions, Incompatibility of some large language models with various learner demands, Formation of unfavorable ties between students and their Educators, Unawareness of students' learning habits, Reduced motivation among students to complete assignments, Academic integrity concerns, Erosion of creativity in learning, Lack of understanding of legal issues in responses.
	Curriculum Development Challenges	Difficulties in Properly Designing Educational Content	Impaired capacity to create detailed content, Failure to create new content in favor of just categorizing current materials, Low quality of generated content, Creating fictitious instructional content.
		Shortcomings in Reviewing and Developing Present Curriculum Content	Shifting away from human knowledge and moving toward technical and machine competence in content reproduction, Inadequate screening tools for ChatGPT-generated content, Difficulty identifying authentic content from ChatGPT content, Using repeated patterns in content creation.
	Challenges in the Learning Process	Learning Development Flaws	Students as passive recipients, Learning process deterioration, Difficulty in monitoring learning issues, Overreliance on answers in education, Students' limitations in developing specific abilities for task fulfillment, Lack of effort by students to provide fresh learning ideas, Inability to grasp nuance points in each specialized field in learning, Lack of knowledge in the ethical use of technology in learning, Destruction of learning ethics, Promotion of academic dishonesty culture in learning, Diminished value of hard work in learning, lowering the importance of effort in learning, Reducing students' eagerness to learn, Incorrect learning, Continued educational discrimination, Lack of transparency in the learning process, Failure to instill emotional values in students, Learning process oversimplification, Students' lack of significant engagement in the learning process, Adoption of a uniform approach to learning, Superficial learning, Neglect of cultural differences in learning, Academic Plagiarism Democratization in Education and Learning.

Main Theme	Primary Subtheme	Secondary Subtheme	Key Concepts (Code)
		Reduced Attraction of the Learning Environment	Concerns about developing authentic learning experiences, Inaccurate educational information dissemination, Presentation of contradictory information, Existence of logical errors in responses, Answering questions without referencing the original source, Bias in response algorithms (e.g., gender bias, racial bias, etc.), Increased academic dishonesty, Responses based on current data patterns, Copying and pasting tasks, Some comments lack interpretability, Concerns regarding the caliber of responses, Access to new data is limited because the algorithm is fixed for a set length of time, Giving out-of-date responses, Incomplete responses, Lack of critical thinking in responses, Responses that are too brief, Inability to provide complicated mathematical and statistical answers, Inability to answer problems that require logic, ChatGPT's limited knowledge and understanding, Insufficient detail in responses, Copyright and intellectual property rights issues, Lack of expertise in responses, Insufficient emotional and sympathetic intelligence, Producing low-quality information, Question misinterpretation and delivering irrelevant answers, Responses lacked depth of understanding, Errors in the network, Uncertain legal liability in answers, Challenges regarding freedom of expression in responses, Lack of imaginative capability in responses, Predicting based on probable algorithms rather than conducting independent, impartial, and source-based investigation, Lack of a thorough comprehension of the meanings of the words used, Future inaccessibility to free versions, Absence of innovation in responses, Lack of information transparency, Providing hazy information from unidentified sources, Providing unjustified incorrect responses, Failure to use reason and logic in responses, Some comments are irrelevant to the nature of specific subjects of research, Data collection from rogue databases is a possibility, Inability to use specialized terminology in responses, Reduced capacity to answer properly after a few words, Inability to evaluate the quality of used sources, Grammatical errors in writing (adjectives and adverbs), Generating misleading responses, Constant updates are required, Complex sentence comprehension is limited, Lack of awareness of culture and regional context, Responses lack basic reasoning and logic, Creating culturally unacceptable reactions, Preferring to use simplistic concepts in response to complex questions, Writing differences between humans and robots, Cursory comprehension of the subject, Responses that lack a true mindset and real-world experience, Limited capacity for critical thinking, inability to answer questions requiring reasoning, providing excessive and illogical information.
		Bias in Learning Evaluation	Biased evaluation and prejudiced conclusions, Difficulty in accurately judging the performance of students, Educators' unfamiliarity with new assessment methods, The challenge of accurately assessing how students are learning, Inconsistency with existing assessment techniques, Cheating in examinations, Cheating on homework assignments, Cheating on homework assignments, Lack of alignment of grades with learners' assignments, Providing students with unrealistic grades (grade inflation), Group evaluation, Educators' inability to adapt to new assessment techniques, Ineffectiveness of assessing assignments, Difficulty differentiating between actual and robot-generated information, Problems with evaluating outcomes, Concerns concerning examination credibility, Inadequate evaluation of students' efforts, Lack of clear and accurate techniques for checking the legitimacy of answers, Due to certain students' lack of access, some assessments are unrealistic, Reluctance to adopt new assessment methodologies, Machine-based evaluation, Inadequate evaluation of complicated jobs.

Opportunities for Educators

ChatGPT is a great tool in the learning process, but it should not be viewed as a replacement for the job of an educator (14). While ChatGPT can greatly assist educators by simplifying chores and assisting students in their learning path, it does not eliminate the need for them to provide advice, mentorship, and a more thorough assessment of students' abilities. ChatGPT can be a valuable resource in the classroom, but technology cannot totally replace educators' important roles as mentors and role models. As a result, ChatGPT should be used as a supplement to education, with its implementation carefully tailored to the educational context (15). It has a wide range of potential uses in education, including reducing workload of educators by automating numerous duties. These tasks may entail, among other things, creating lesson plans, drafting syllabuses for classes, developing quiz and exam questions,

measuring student performance, creating rubrics, and guiding learning activities (16). Reduced workload allows educators to focus on developing better, more effective methods of teaching various subjects, which can lead to improved learning outcomes. As a result, careful implementation of ChatGPT in education should prioritize retaining the valuable human element that educators bring to students' lives, while also ensuring that it complements and enhances the educational process. The principal sub-theme findings are consistent with the studies chosen (17-30).

ChatGPT's lasting impact on education can be transformative if it is used as a supportive tool for educators rather than replacing them. By taking over the repetitive tasks such as designing a lesson plan, drafting the syllabus, creating assessment, and tracking the students' performance, ChatGPT can enhance the efficiency of the learning process by reducing administrative strain. By doing so, educators can devote more attention to essential aspects of education, such as enhancing instructional practices, nurturing creativity, and mentoring students on a personal level. It is important to note that the educators' fundamental roles as mentors, role models, and critical thinkers remain crucial to the educational process. The implementation of ChatGPT in a long run should be carefully controlled to ensure that its use enriches human interaction rather than diminishing it. Education systems can benefit from ChatGPT to enhance productivity and learning, all while preserving the indispensable relational and developmental roles that educators fulfill in their students' learning journeys. This careful strategy will be essential for ChatGPT to achieve its full potential in promoting meaningful, effective education.

Opportunities for Students

Chat GPT can liberate the students' creativity, provide personalized tutoring, and improve their preparation for future encounters with AI systems. It can better accommodate the students' learning requirements, boosting their effectiveness and academic success. Furthermore, ChatGPT can help educators with student management and assessment, which leads to better course changes and instructional quality (31). Furthermore, ChatGPT can provide personalized feedback to students, identifying areas for improvement and making recommendations for improving their work (32). The ability to provide personalized and interactive help adjusted to each learner's specific needs and preferences can not only develop independence but also enrich the entire learning experience (33). This technology offers a practical way to connect classroom learning to real-world circumstances, ensuring that students are appropriately prepared to deal with the complexity and opportunities that arise in an increasingly technologically advanced society. The outcomes in this primary sub-theme align with the collection of studies (34-49).

With its ability to give customized feedback and tutoring, ChatGPT can help students enhance their creativity, address individual learning needs, and prepare for future interactions with AI systems. As a result, it is set to revolutionize learning and teaching methods. Not only does this adaptability boost academic performance but also nurtures independence in learners, empowering them to guide their educational pursuit. As for educators, ChatGPT simplifies student monitoring and assessment, resulting in improved course modifications and higher educational quality. ChatGPT helps close the gap between classroom learning and practical applications, preparing students for the complexities of an increasingly tech-centered world. These advantages highlight the potential of ChatGPT to ameliorate educational outcomes, improve teaching methods, and equip students with the skills necessary for success in a rapidly evolving environment. The findings align with existing research, confirming ChatGPT's role as a driver of personalized and progressive education.

Curriculum Development Opportunities

Advanced instructional aids offer quick assistance, resources, and advice. Lessons that are more engaging and efficient can arise from the system's awareness of lesson plans, content production, and instructional layout. Since ChatGPT may provide feedback and recommendations for a particular text, this feature can help create individual content. It has the ability to generate written content on a specific subject, allowing content providers to save time and energy when generating articles, blog posts, and other written resources (17). By bridging the gaps in numerous parts of education and content development, this technology improves efficiency and productivity. ChatGPT also helps create a more dynamic and productive educational environment, which benefits everyone involved. The findings within this key sub-theme align with the chosen studies (50-59). Using ChatGPT as an advanced educational tool has the potential to dramatically improve educational efficiency and quality. Through quick assistance, resource provision, and guidance, as well as its understanding of lesson planning, content development, and instructional layout, it helps create more engaging and effective

lessons. Furthermore, its capacity to offer personalized feedback and recommendations on specific texts helps to create personalized content; therefore, educators and content creators can save more time.

Opportunities in the Learning Process

Personalized education is an instructional technique that aims to tailor training to the unique needs, interests, and abilities of individual students. By analyzing the students' language usage, feedback, and performance, NLP models can enable personalized education by allowing the design of individualized learning plans that include content, exercises, and evaluations tailored to each student's specific needs. Personalized education has proven to be beneficial in improving student results. Indeed, personalized education has been shown in studies to improve academic achievement, engagement, and self-confidence. Students are more likely to interact with the content and have a deeper understanding of the subject matter when it pertains to their interests and competencies. NLP models can provide students with personalized educational experiences by creating a content that is specifically tuned to their individual learning needs (60). This allows both students and educators to access instructional resources from any location and at any time, overcoming geographical and temporal constraints. Technology has altered traditional teaching methods in our day and age. We now have digital educational resources such as multimedia presentations, interactive simulations, and educational apps. These technology advancements make the learning experience more engaging, dynamic, and adaptive, enabling increased comprehension and active participation of students. Educational institutions may establish more efficient and individualized learning environments that allow students to perform well academically while also developing important life skills by successfully exploiting ChatGPT's capabilities. The outcomes in this specific sub-theme correspond with the studies incorporated in the sample (61-72). Utilizing ChatGPT in personalized education creates opportunities to radically improve learning experiences and outcomes. With the help of natural language processing (NLP) models, ChatGPT crafts individualized learning plans based on each student's unique needs, interests, and abilities. By aligning the content with students' interests and strengths, this approach has been shown to improve academic achievement, engagement, and self-confidence. Additionally, ChatGPT provides flexible access to learning materials for students and educators, ensuring that resources are available anytime and anywhere.

Opportunities in Assessment

Using ChatGPT, educators can provide timely and continuous feedback on students' written tasks, enhancing the formative assessment process. ChatGPT can be used for self-evaluation and introspection. It can be employed by students to assess their progress and learning, identifying areas where they may require further support or advice. This technique for self-assessment and reflection can enable students to take responsibility for their learning and growth while also nurturing the skills and tactics required for success as self-directed learners (34). ChatGPT can evaluate and provide feedback on a given text, as well as provide automatic scoring and evaluation for student assignments and various forms of writing (19). ChatGPT can help educators create new evaluation methods to better understand their students' skills and learning processes. It can also help enhance teaching practices by assessing student performance and feedback data. Overall, ChatGPT has the potential to significantly improve student evaluation, resulting in enhanced efficiency and higher-quality feedback in education. This principal sub-theme's findings are compatible with the study sample (73-81).

Over time, applying ChatGPT in education is expected to have a substantial influence on both student learning and teaching methods. With timely and continuous feedback on written assignments, ChatGPT improves the formative assessment process, helping students refine their work and improve their academic achievements. By enabling self-reflection and evaluation, ChatGPT helps students in assessing their progress, identifying areas for further support, and becoming more accountable for their learning, nurturing critical self-directed learning abilities necessary for lifelong achievement. ChatGPT's automated assignment scoring not only streamlines grading but also assists educators in creating more efficient and tailored evaluation methods. Further, ChatGPT can examine student performance data, as well as offer educators valuable feedback to refine teaching methods and customize instruction to better address the unique requirements of each learner. With time, this technology could eventually pave the way to a more dynamic and data-driven approach to education, significantly enhancing feedback quality, instructional effectiveness, and student engagement. All of the results indicated are

consistent with prior studies, emphasizing the potential for ChatGPT to boost both instructional efficiency and learning outcomes.

In our study, we categorized the challenges into four distinct groups: challenges pertaining to educators, learners, curriculum development, and the learning process. Subsequently, we will delved into the analysis of each of these categories.

Challenges for educators

AI literacy entails having the knowledge and competencies required to interact with AI systems effectively, critically assess their results, and address the ethical, social, and practical consequences associated with their use (50). ChatGPT has also been trained on material written by people from all across the world, including both historical and contemporary sources. As a result, the model may exhibit the same biases as the data on which it was trained. It is crucial to highlight, however, that the accountability for these biases does not rest exclusively with the data; rather, it rests with the decisions made by OpenAI researchers and engineers when picking training data. OpenAI has aggressively solicited user feedback in order to resolve instances of "biased behavior." Given the risk of personal damage, some argue that Chat GPT should not have been made public until these concerns had been thoroughly examined and remedied (22). While ChatGPT offers exciting new prospects for educators, it also poses new challenges and obstacles. Educators should use extreme caution when evaluating assignments that may contain AI-generated information, as there is a greater risk of academic dishonesty. They must also be aware of any biases associated with the usage of AI-generated content in their teaching. The findings of this primary sub-theme are consistent with the sample of studies (82, 83). Long-term challenges surrounding AI literacy and the use of AI tools such as ChatGPT are intricate, encompassing ethical, educational, and practical dimensions. With AI systems reflecting biases embedded within their training data, reducing such problems requires developers to prioritize thoughtful design and informed decisions. Although user feedback has been crucial in addressing bias, the early deployment of these technologies without fully resolving such issues poses serious ethical challenges. The rise of AI-generated content introduces complications in academic settings, creating new challenges, requiring educators to protect academic integrity and critically address the biases and implications of AI in pedagogy; it is an effective framework which includes ethical monitoring, broad AI literacy education, and ongoing AI system modification to guarantee responsible and fair use.

Challenges for students

There are concerns regarding the fact that students may become overly reliant on ChatGPT and similar AI tools, potentially resulting in a lower capacity for critical thinking and a weaker sense of self-directed learning. Rather than developing their critical thinking and problem-solving skills, individuals may rely on the model for answers and solutions. Such reliance may impair their ability to think independently and creatively, both of which are essential for academic success and personal growth (49). It is important to highlight that academic integrity involves commitment to six core principles: honesty, trust, fairness, respect, accountability, and courage. As a result, when someone uses ChatGPT to create essays or other written work and presents it as their own, they violate the core precepts of academic honesty (84). Students may be frustrated if ChatGPT fails to correctly understand complex enquiries or give personalized assistance. While AI technologies are beneficial, they are not without flaws and may struggle with complicated questions. This can lead to frustration and increased reliance on educators for clarification, emphasizing the significance of a balanced strategy that values both AI assistance and instructor expertise. The sampled studies show that the conclusions of this key sub-theme correspond with the corpus of research in this field (85-91).

Some challenges of using AI tools, such as ChatGPT, in education for a long time surround nurturing critical thinking, protecting academic integrity, and managing expectations of AI abilities. Relying too heavily on such tools can weaken the students' independence, problem-solving skills, and creativity, both crucial for their intellectual development and future learning. This reliance can jeopardize the core principles of academic integrity, such as honesty and accountability, as students might falsely claim AI-generated content as their own. Furthermore, the inability of AI to handle complex or nuanced issues could result in frustration, shifting the responsibility for deeper support onto educators. For overcoming these challenges, it is necessary to have a balanced strategy that positions AI as a complementary resource rather than a replacement for human expertise, alongside a commitment to ethical practices and cultivation of key cognitive skills among learners.

Challenges in curriculum development

These duties have not become obsolete just because text generation technologies have improved to the point where it is difficult to distinguish whether a text was generated by a human or intelligent software. The difficulty is determining the accuracy of the content, especially when it comes from biased databases. The resulting knowledge, whether composite or misinformation, contains intrinsic biases reflecting the viewpoints of people who build and manipulate AI (92). Due to inadequate experience, educators may have difficulty integrating AI into curriculum construction, thereby impacting learning quality. Because of ChatGPT's static knowledge, curriculum modifications are required on a regular basis. Collaboration with AI professionals, adherence to ethical principles, and investment in training and resources are all necessary for maximizing AI's advantages in education. The findings of this primary sub-theme are concordant with the sample of studies (93-95).

When used in education, advanced text generation tools, such as ChatGPT, pose challenges that lie in leveraging their benefits while addressing their limitations. Although these tools can improve learning experiences, their dependence on biased datasets and static knowledge highlights the importance of critical evaluation of their outputs. This challenge gets even more complicated by the difficulty in identifying AI-generated misinformation from reliable information, casting doubt on the accuracy and objectivity of AI outputs. Another issue is the educators' lack of expertise in leveraging AI for curriculum design, which could constrain both the quality and creativity of education. The solution to these challenges lies in frequent curriculum revisions, collaboration with AI experts, strict ethical guidelines, and comprehensive educator training. Such initiatives will help establish AI as a reliable and dynamic support for human expertise, minimizing the risks of confusion or misuse.

Challenges in the learning process

A component of this debate concerns the negative repercussions of ChatGPT for students who use the system for assignments (96). The training data for ChatGPT is big but limited, only going up to 2021. The model has the potential to deliver erroneous information and consequences in 2023. When ChatGPT is employed, ensuring the quality and dependability of the responses generated remains a primary difficulty (51). Furthermore, allowing learners to use ChatGPT in assessments may give them an unfair advantage over peers who do not have access to it. Importantly, while using ChatGPT, educators may find it more difficult to effectively assess student performance, making monitoring students' learning progress more challenging (18). It is also worth mentioning that the use of these tools can encourage students to think less critically and stop analyzing their assignments properly since they start relying on the tool. This key sub-theme's findings are consistent with the sample of studies (96-103).

Equity, reliability and safeguarding critical thinking skills are the key long-term challenges of incorporating tools such as ChatGPT into education. Its reliance on static training data, limited to 2021, creates a risk of outdated or inaccurate responses, reducing the credibility of its outputs. The use of ChatGPT in assessments risks foster inequities, benefiting those with access while disadvantaging others. Moreover, dependence on AI-generated content may diminish critical thinking and analytical skills, by discouraging in-depth search and exploration of assignments. The educators' ability to assess the student performance and accurately track the learning progress is further complicated by these challenges. Resolving them demand creation of equitable policies, widespread access, and strategies to encourage meaningful engagement with both AI tools and academic subjects.

Limitations and Suggestions for Future Studies

This research had certain limitations. Firstly, it focused exclusively on studies published in English, thus excluding articles published in other languages. Additionally, this study solely concentrated on articles, overlooking books and research projects within this subject area, which are collectively referred to as gray literature in review studies.

Future researchers are encouraged to employ the phenomenological method to delve into the firsthand experiences of educators and students when utilizing ChatGPT in an educational context. Furthermore, it is recommended for subsequent researchers to craft a questionnaire founded on the central themes unearthed in this study. This would enable them to assess the most significant challenges and opportunities by employing weighting and hierarchical models, with input from experts. Additionally, future researchers should consider examining the impact of interventions, such as ChatGPT usage, on subject learning and teaching through experimental techniques that involve dividing students into experimental and control groups.

Conclusion

To critically evaluate ethical considerations of ChatGPT, educators and students require to know how to evaluate its outputs and explain them. For comparing the interpretation of AI vs. human, some of the values can be defined as cause ability, verifiability, contestability, and (in) compatibility. These values highlight the need for AI systems such as ChatGPT to not only generate results, but also explain the reasoning behind them. By cause ability, we mean to ensure that their algorithms and outputs are verified (certifiability), to allow their decisions to be challenged (contestability), and to align with human logic and reasoning (compatibility). The integration of these moral values within a bioethics framework reduces concerns regarding trust, responsibility, transparency, and the impact of generative AI in the healthcare landscape.

Policy and Implementation Suggestions

Further, the focus on operational solutions equips decision-makers with actionable strategies to maximize the utility of ChatGPT while mitigating its challenges. By addressing these complexities, this article not only deepens the current understanding of ChatGPT's impact on medical education but also provides a roadmap for its responsible and effective integration into educational systems.

▪ *Supporting Educators with Content Development*

Educators can utilize ChatGPT to draft lecture outlines, create exam questions, and generate teaching materials tailored to specific medical topics. This would allow instructors to allocate more time to interactive and hands-on teaching activities. To implement ChatGPT in education, administrators, teachers, and policy-makers should develop guidelines for using it in their context. There is positive tendency among educators toward ChatGPT as a source of content; however, to implement it in education, administrators, teachers, and policy-makers should develop guidelines for their context (104).

▪ *Enhancing Administrative Efficiency*

ChatGPT can assist educators by automating repetitive administrative tasks, such as creating assessments, creating questions for both formative and summative assessments across formal and informal settings, using it to test responses to questions, creating syllabi for a course based on existing syllabi or new based on specifications from the instructor, generating rubrics, grading assignments, compiling reports on student performance, and summarizing information in long documents for broad overview or for specific topics. This streamlining can improve efficiency while enabling educators to focus on mentoring and curriculum refinement (105).

▪ *Personalized Student Tutoring*

Students can use ChatGPT as a personalized tutor to clarify complex concepts, review foundational medical knowledge, or simulate real-life patient scenarios. This adaptive interaction accommodates diverse learning paces and styles. Students can use ChatGPT to write schematic essays; it is not as original or creative as human writers or replicate students papers (104).

▪ *Developing Simulated Clinical Scenarios*

ChatGPT can be incorporated to create realistic clinical vignettes for problem-based learning (PBL) sessions. These scenarios can be dynamically adjusted based on student performance and learning needs.

▪ *Providing Real-Time Feedback*

Feedback is an essential feature in supporting learners. ChatGPT can be perceived as a learning partner or teaching assistant that gives feedback (104). ChatGPT can deliver instantaneous feedback on student essays, case reports, or research summaries, highlighting areas of improvement and offering suggestions for refinement. This supports iterative learning and skill development (106).

▪ *Facilitating Self-Directed Learning*

ChatGPT is a useful tool for self-learning due to its ability to provide concise and customized feedback. Educators could encourage students to use ChatGPT as a source of independent learning (107). Students could query ChatGPT for explanations, practice with diagnostic questions, or explore hypothetical clinical scenarios, and foster autonomy and critical thinking.

▪ *Enhancing Multimodal Learning Resources*

Educators can integrate ChatGPT into multimedia platforms to generate content for instructional videos, interactive quizzes, or augmented reality (AR) applications, making medical education more engaging and comprehensive.

▪ *Supporting Curriculum Adaptation*

Today, big medical data is analyzed using AI-based algorithms. ChatGPT can help with the interpretation of vast amounts of data, ensuring that interventions align with practices. Additionally, ChatGPT provides insights and recommendations for revising medical curricula and helps identify areas that require more attention. ChatGPT also allows educators to adjust their teaching methods in the curriculum, resulting in better learning outcomes (108, 109).

▪ *Addressing Disparities in Learning*

Use of ChatGPT to bridge the gaps in

educational resources by providing accessible tools for students in under-resourced settings would ensure equitable learning opportunities in medical education.

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Conflict of Interest

The authors declare no conflicts of interest.

Authors' Contribution

BF participated in the collection of articles, ZF in qualitative data analysis, SB in writing the article and AK review and rewrite the entire article process.

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