

SURVEY

ChatGPT's Impact on Education and Healthcare: Insights, Challenges, and Ethical Consideration

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This work was supported in part by United Arab Emirates University under Grant UPAR-12T055.

ABSTRACT The integration of artificial intelligence and natural language processing technologies has facilitated the adoption of advanced systems, such as ChatGPT, across various sectors, particularly in education and healthcare. These innovative technologies promise to deliver rapid and personalized services to key stakeholders, including educators, healthcare professionals, students, and patients. This paper presents a rigorous scoping review of prior research on the application of ChatGPT in the education and healthcare sectors. The comprehensive review methodology involved a meticulous analysis of 71 articles from reputable digital databases. The outcomes of this review provide a comprehensive understanding of the existing body of research related to the applications of ChatGPT in education and healthcare, encompassing insights from previous studies, a discussion of encountered limitations and challenges, exploration of potential research directions for implementing ChatGPT technology, and a deeper analysis of the ethical implications of its use and how to address them. We discuss the implications of these findings and recommendations, contributing to a growing body of knowledge regarding the application of artificial intelligence in these vital and sensitive sectors.

INDEX TERMS ChatGPT, artificial intelligence, natural language processing, large language model, education, healthcare.

I. INTRODUCTION

In recent years, remarkable developments have been witnessed in natural language processing (NLP), enabling conversational discussions with humans using natural languages to engage computers. As a subfield of artificial intelligence (AI), NLP involves interpreting, generating, and incorporating natural language scripts and dialogues through various media, such as textbooks, lectures, reports, articles, and podcasts.

The widespread use of NLP extends across many AI applications in diverse fields, with a notable focus on education [1], [2] and healthcare [3], [4], two essential and complex sectors that demand effective communication and collaboration among diverse stakeholders.

The associate editor coordinating the review of this manuscript and approving it for publication was Derek Abbott¹.

A significant development in NLP has been the emergence of large language models (LLMs). Neural networks can learn from massive amounts of text data and generate coherent and fluent text on various topics and styles. These LLMs have applications in chatbots and computer programs designed to engage in natural language conversations with individuals or other agents. Through text or speech interfaces, chatbots facilitate the dissemination of information, amusement, assistance, and companionship.

ChatGPT, developed by OpenAI [5], a research organization dedicated to exploring and promoting friendly AI, is a prominent example of an LLM. Rooted in the GPT family of models, ChatGPT utilizes a transformer architecture to acquire knowledge from an extensive corpus of billions of words from the Internet. By leveraging its aptitude and creativity, ChatGPT harnesses its remarkable capability to generate realistic and diverse responses to text

inputs. The extensive deployment and evaluation conducted by researchers and developers have firmly established the versatility of ChatGPT across diverse contexts and applications. Fig. 1 presents the milestones of ChatGPT. The latest version of ChatGPT has sparked heated debates regarding its capabilities in many areas. Education and healthcare are two of the most vital and sensitive sectors where personalized, accurate, and empathetic interactions are paramount. Both sectors rely heavily on personalized interactions, where the ability of ChatGPT to provide tailored responses can significantly enhance user experience and outcomes. Additionally, education and healthcare are areas with stringent ethical and privacy considerations, making them ideal for examining the challenges and solutions associated with AI implementation. In education, the impressive performance of ChatGPT in producing coherent human-like responses has garnered considerable global attention [6]. Harnessing the power of NLP allows ChatGPT to engage in meaningful conversations with teachers and students, thereby providing relevant contextual information. Leveraging its ability to understand and analyze input, ChatGPT crafts responses with semantic coherence and academic and methodological depth. This exceptional efficiency has made ChatGPT a leading paradigm for teaching AI, leading to its widespread adoption and recognition in the education sector. Similarly, ChatGPT also plays a pivotal role in healthcare. The multifaceted applications of ChatGPT in the medical domain encompass diverse functions, ranging from its utility in medical writing and documentation to its effectiveness in facilitating medical education. Recently, it was reported that ChatGPT passed the US Gold standard medical exam, indicating its potential for essential medical applications [7]. The deployment of ChatGPT is expected to become widespread, catering to both healthcare professionals and consumers. Significant language paradigms such as ChatGPT fundamentally change how patients ask for information about their health status [8]. Furthermore, the integration of ChatGPT into electronic health records (EHRs) for health systems is envisioned to foster seamless assistance for healthcare researchers, medical students, and overall healthcare endeavors [9].

From scientific and academic perspectives, researchers and stakeholders are divided into supporters and opponents of the widespread adoption of ChatGPT. An evaluation of ChatGPT's educational performance by Lo [2] called for immediate action by schools and universities, training teachers to use ChatGPT effectively, and educating students about its limitations. Salam [10] found that appropriately implementing ChatGPT can accelerate research and innovation in healthcare and promote research equality by overcoming language barriers. Watson explored the meaning and communication of ChatGPT using social systems theory [11]. He revealed that ChatGPT presents new opportunities and complexities for many scenarios and suggested that we go beyond thinking only of misery or improvement. Mhlanga [12] emphasized the importance of responsibly and ethically using ChatGPT for lifelong learning. According to him,

ChatGPT should be used ethically and transparently regarding its educational implications. An analysis of the need for ChatGPT features in the educational system by Javaid et al. [13] recommended revising ChatGPT to empower students to effectively apply their knowledge and abilities to accomplish their tasks.

ChatGPT has received continuous updates and enhancements since it was publicly released in late 2022. Media reports shed light on their potential, but they may not always offer a comprehensive view of their capabilities.

In addition, a thorough examination of ethical considerations related to privacy, consent, and accountability, as well as technical aspects such as reliability, accuracy, and validity, is necessary. In addition, social factors, including trust, acceptance, responsibility, and influence, must be carefully considered. Thus, we pose the following set of unique research questions as guiding beacons for this review:

- **RQ1.** What are the potential applications of ChatGPT in education and healthcare, and what are the current limitations and challenges in their implementation?
- **RQ2.** What are the ethical implications of using ChatGPT in educational and healthcare applications, and how have they been addressed?

II. METHODOLOGY

A. RESEARCH QUESTIONS

This scoping review aims to conduct an extensive examination of the potential applications of ChatGPT in education and healthcare. It also addresses the associated limitations, challenges, and ethical implications. The research questions (RQs) guiding this SLR and their rationale are presented in Table 1.

B. SEARCH STRATEGY

This scoping review adheres to the Preferred Reporting Items for Systematic Reviews and Statements for Meta-Analyses (PRISMA), to ensure the highest level of quality and transparency in reporting [14]. An exhaustive online search was conducted using reputable digital databases, including Scopus, ScienceDirect, IEEEExplore, MDPI, and PubMed. The search was conducted between March 2023 and early July 2023, encompassing publications from late 2022 to 2023. By focusing on the last two years of publication, the study sought to capture the most current and up-to-date utilization of ChatGPT. The search was further refined by limiting the title of the documents, enhancing the precision of the results. The comprehensive review contributes to the existing body of knowledge on the cutting-edge applications of ChatGPT in the educational and healthcare sectors.

In pursuit of pertinent scholarly resources, the primary search strings employed were as follows: (ChatGPT AND (AI OR "artificial intelligence" OR NLP OR "natural language processing" OR LLM OR "large language model*")) AND ("education*" OR "healthcare*"). Each distinct database requires a modification of the search string. To ensure

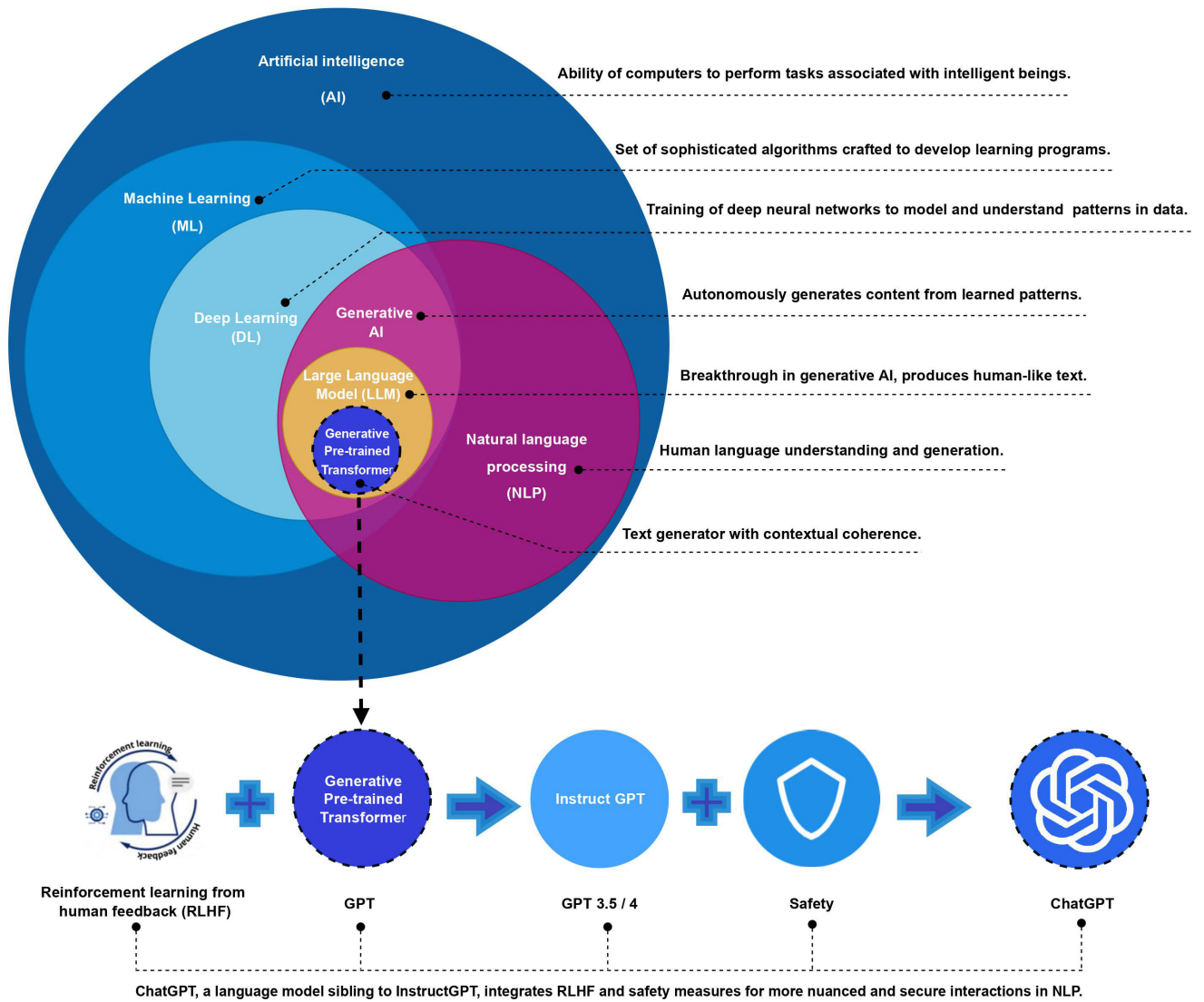


FIGURE 1. Key milestones of ChatGPT.

TABLE 1. Research Questions.

Research question	Rationale
RQ1: What are the potential applications of ChatGPT in education and healthcare, and what are the current limitations and challenges in their implementation?	To gain insights into the potential applications of ChatGPT in education and healthcare to effectively utilize ChatGPT and address any obstacles to its successful integration into these areas.
RQ2: What are the ethical implications of using ChatGPT in education and healthcare applications, and how have they been addressed?	Evaluate potential ethical considerations and identify challenges and concerns that must be addressed to ensure the responsible and ethical use of ChatGPT in education and healthcare.

the integrity of the findings, we meticulously excluded duplicate entries after a thorough examination of their titles. Subsequently, the titles and abstracts of all selected studies were meticulously scrutinized to identify relevant studies. Through the application of the inclusion criteria, we retrieved and evaluated the full content of relevant articles by employing a comprehensive author review method to ascertain their credibility and significance.

C. INCLUSION AND EXCLUSION CRITERIA

The present scoping review incorporated studies that conformed to the specified inclusion criteria (IC): (IC1) Studies that primarily focused on the applications of ChatGPT in the field of education or healthcare. (IC2) ChatGPT as a tool in education and healthcare; (IC3) Studies that assess the impact of ChatGPT on learning outcomes, student performance, or educational interventions; and (IC4) Studies

that explore the application of ChatGPT in improving patient care, diagnosis, treatment, and healthcare delivery.

To ensure the inclusion of relevant studies encompassing both the education and healthcare domains, no restrictions were imposed on factors that could potentially influence education or healthcare outcomes.

Conversely, exclusion criteria (EC) were applied to maintain the quality and relevance of the selected studies: (EC1) Studies published before 2022; (EC2) Studies not written in English; (EC3) Studies that are incomplete or have not undergone peer review or review process; (EC4) Studies that focus solely on technical aspects or improvements of the ChatGPT model itself without educational or healthcare implications; and (EC5) Studies that primarily examine the ethical or legal considerations of ChatGPT without substantial analysis of its educational or healthcare applications. Fig. 2 illustrates the stages of the selection process.

D. DATA EXTRACTION

After retrieving full-text articles for each study that met the established inclusion criteria, we focused on the application of ChatGPT in education and healthcare. Pertinent characteristics were extracted by thoroughly examining selected articles to gain a comprehensive understanding of the research landscape. The following information was collected.

1) STUDY CHARACTERISTICS

- Type of participants involved in the study (e.g., students, teachers, and healthcare professionals).
- Specific focus on ChatGPT applications in education or healthcare.
- Description of interventions or tools utilizing ChatGPT in educational or healthcare settings.

2) APPLICATION FACTORS

The extracted data were analyzed to identify factors related to the application of ChatGPT in education and healthcare. This includes:

- **Educational Applications:** Factors associated with the utilization of ChatGPT in educational settings, such as personalized learning, intelligent tutoring, language learning, and instructional support.
- **Healthcare Applications:** Factors pertaining to the implementation of ChatGPT in healthcare settings, including patient communication, medical diagnosis, treatment recommendations, and healthcare information retrieval.

By extracting and analyzing relevant data, this scoping review aims to provide insights into the specific application areas of ChatGPT in education and healthcare, shedding light on its potential benefits and challenges within these domains.

III. RESULTS

The state of research on ChatGPT applications in education and healthcare was determined using the reviewed articles.

According to this review, the number of studies on the use of ChatGPT in both fields is rapidly increasing because of its use in several studies in several ways. This indicates that ChatGPT technology has seen widespread integration in the education and healthcare sectors. The usage percentages related to the current study regarding the aspects in question are shown in Fig. 3. The figure illustrates the degree of overlap in the utilization of ChatGPT technology within the realms of education and healthcare, registering at a rate of 40.85%. Furthermore, education surpasses healthcare with a percentage of 35.21%, while healthcare lags behind at 23.94%.

A. RQ1: WHAT ARE THE POTENTIAL APPLICATIONS OF CHATGPT IN EDUCATION AND HEALTHCARE, AND WHAT ARE THE CURRENT LIMITATIONS AND CHALLENGES IN THEIR IMPLEMENTATION?

1) APPLICATION OF CHATGPT IN EDUCATION AND HEALTHCARE

a) EDUCATION

As shown in Table 2, the review findings indicate that ChatGPT plays a pivotal role as a tool in education and is used in the areas of learning, teaching, evaluation, and feedback.

i) TEACHING

ChatGPT has been used in the field of teaching as an essential tool in several applications, such as providing suggestions, explanations, guidance, and preparing study materials.

a) Provide suggestions

ChatGPT's ability to generate personalized suggestions and feedback tailored to the specific inquiries and learning objectives of teachers and students offers significant potential in educational contexts. For instance, researchers like Su et al. [15] have highlighted the transformative impact of integrating ChatGPT into educational settings. By harnessing ChatGPT's capabilities, educators can streamline the process of providing suggestions and feedback, leading to more efficient and effective educational practices. Moreover, ChatGPT's involvement in education extends beyond simple assistance; it presents opportunities to enhance the overall quality of education. For example, ChatGPT can offer suggestions for optimizing lesson plans, developing instructional materials, or tailoring learning resources to individual student needs [13]. This not only enhances the educational experience for students but also supports teachers in delivering more personalized and engaging instruction. In practical terms, ChatGPT could be used to provide real-time feedback on student assignments, offer personalized study recommendations based on individual learning styles, or even assist educators in developing customized curriculum content. By leveraging ChatGPT's capabilities in this way, educational institutions can unlock new avenues for improving teaching and learning outcomes in the digital age.

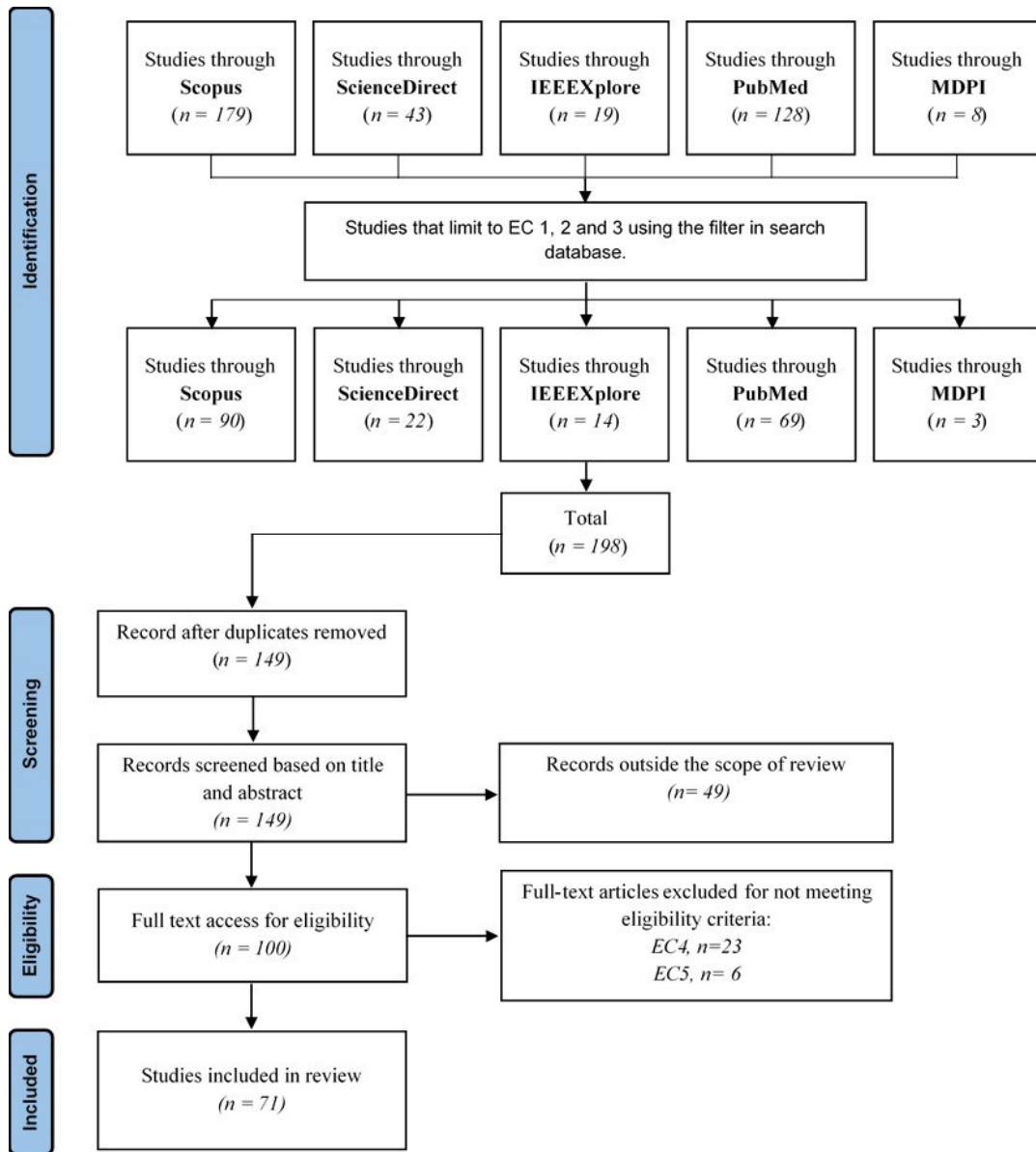


FIGURE 2. PRISMA flow diagram of article selection process.

b) Providing explanation

ChatGPT plays a crucial role in clarifying the teaching context, which is paramount in modern educational settings. Researchers have extensively explored its potential as an educational tool, particularly in providing personalized explanations tailored to individual student needs, addressing queries, and elucidating complex concepts [16]. For example, Gill et al. [17] have underscored the transformative impact of integrating ChatGPT into educational environments. By leveraging ChatGPT's capabilities, educators can provide explanations that are not only easily accessible to students but also comprehensible, regardless of the complexity of the topic. In applied scenarios, ChatGPT could be deployed to offer real-time explanations during classroom lectures

or remote learning sessions, assisting students in grasping difficult concepts at their own pace. Additionally, it could serve as a valuable resource for educators, offering insights into students' areas of confusion or common misconceptions.

c) Providing guidance

In the educational landscape, providing guidance is crucial for students to navigate their educational paths effectively [18]. ChatGPT plays a pivotal role in guiding educators by offering insights into pedagogical approaches, curriculum development, and effective instructional methods. For instance, ChatGPT can analyze student performance data to identify areas where students struggle the most and suggest targeted instructional strategies to address these gaps. It can recommend diverse teaching methodologies tailored to

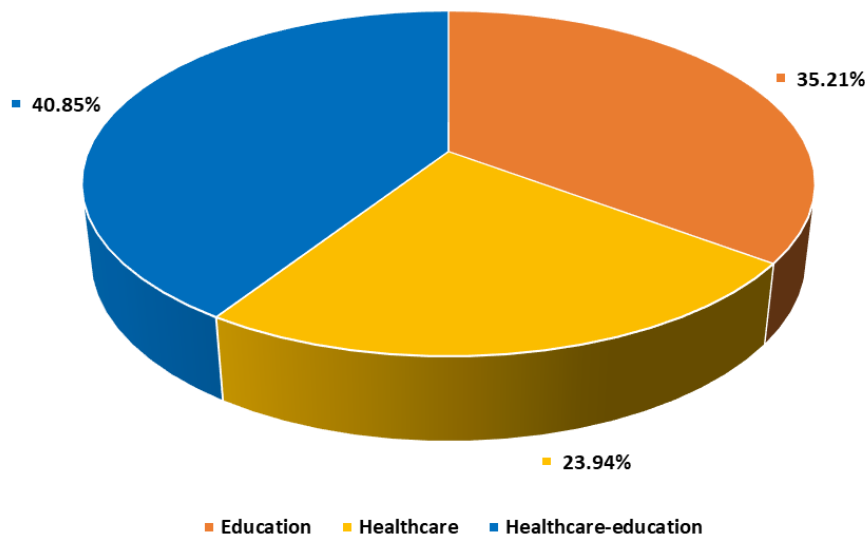


FIGURE 3. Proportion chart of published article research in education and healthcare.

specific subjects and student groups. AI-powered guidance can help instructors improve their teaching methods and adapt to the evolving needs of their students.

d) Preparing course material

ChatGPT has emerged as an innovative tool for creating educational materials [19], [20]. Its key strength lies in its ability to swiftly and effectively generate content. For example, teachers can draft detailed lecture notes and generate exam questions and assignments tailored to specific learning objectives. ChatGPT can also assist in creating up-to-date textbooks and supplemental materials like study guides and practice problems. Additionally, it can generate personalized resources, catering to individual students' needs and enhancing their learning experiences.

ii) LEARNING

ChatGPT has been used in learning as a key tool in many applications, such as facilitating collaboration and translation.

a) Facilitating collaboration

ChatGPT has demonstrated a remarkable potential for improving communication between students and teachers. ChatGPT serves as a beneficial collaborator in the context of blended learning approaches, as stated by Sanchez-Rui et al. [21], ChatGPT can serve as a beneficial collaborator. It may offer conversation prompts and assignments and even facilitate virtual group discussions, boosting active participation and collaboration among learners. Furthermore, Jeon and Lee [22] demonstrated the complementary nature of ChatGPT in the learning process. While human tutors provide invaluable instruction and guidance, ChatGPT may stimulate collaboration by aiding content development, developing course materials, and providing real-time support to students during collaborative tasks. A noteworthy implementation of ChatGPT for collaboration is presented in [23]. In pair-

programming settings, ChatGPT can act as a virtual companion, helping students solve problems, generate codes, and debug. This collaborative method not only promotes learning, but also prepares students for teamwork in a real-world context.

b) Language translation

ChatGPT plays a pivotal role in enhancing the learning experience. As shown in [24], ChatGPT is a valuable tool for language learners, particularly in classrooms for speakers of other languages. For example, ChatGPT can provide real-time feedback on language exercises, helping students to correct their grammar, improve their vocabulary, and refine their pronunciation. It can simulate conversations in various languages, allowing students to practice speaking and listening skills in a safe and supportive environment. Additionally, ChatGPT can generate personalized study materials and practice exercises based on the learner's proficiency level and learning goals, making language acquisition more tailored and effective. These capabilities make ChatGPT an essential resource in language education, supporting both teachers and students in achieving better learning outcomes.

iii) EVALUATION AND FEEDBACK

ChatGPT is used in the field of evaluation and feedback as an essential tool in several applications, such as checking concepts and providing feedback.

a) Concept checking

Using ChatGPT as a tool for assessment and feedback, particularly in concept validation, introduces an innovative method to augment the learning process. Karaali [25] underscores the versatility of ChatGPT in delivering assessments and feedback that are valuable to students' comprehension and progress. For instance, in mathematics education, ChatGPT can assess students' understanding of mathematical concepts by evaluating their problem-solving responses

TABLE 2. Potential applications of ChatGPT in education.

Domain	Application	References
Teaching	Providing suggestions	[13] [15]
	Providing explanations	[16] [17]
	Offering guidance	[18]
	preparing course material	[19] [20]
Learning	Facilitating collaboration	[21] [22] [23]
	Language translation	[24]
Evaluation and feedback	Concept checking	[25]
	Providing feedback	[26]

and providing tailored feedback. This approach not only aids in identifying areas of strength and weakness but also promotes active engagement and self-directed learning. Additionally, ChatGPT's ability to generate personalized feedback enhances the educational experience by offering insights tailored to individual learning styles and preferences. By incorporating ChatGPT into assessment practices, educators can create more dynamic and effective learning environments that support students' academic growth and development.

b) Providing feedback

ChatGPT's capacity to deliver immediate feedback to students based on their responses holds immense value in educational settings. By swiftly identifying misconceptions and offering detailed explanations, ChatGPT empowers students to rectify errors and gain a clearer grasp of concepts. This real-time guidance fosters active learning, enabling students to take control of their educational journey and make continuous improvements [26]. For instance, when a student submits an incorrect answer, ChatGPT can pinpoint the underlying misconception, provide relevant explanations, and suggest alternative approaches to problem-solving. This dynamic interaction not only enhances student comprehension but also cultivates a culture of self-directed learning and ongoing improvement.

b: HEALTHCARE

As shown in Table 3, ChatGPT holds great potential in healthcare, where it can play a crucial role in many applications, such as medical education, patient care, healthcare professionals' support, learning, and medical research.

i) MEDICAL EDUCATION

ChatGPT has been used in the field of medical education as an essential tool in several applications, such as answering questions, providing explanations, feedback, and suggestions.

a) Answering questions

Answering questions is a fundamental aspect of learning, especially in fields as complex as medicine. Researchers such as Sinha et al. [27] have highlighted how ChatGPT can revolutionize medical education by assisting students in addressing intricate pathological problems. By leveraging

ChatGPT's capabilities, medical students can access instant, AI-driven support to tackle higher-order questions, thereby enhancing their understanding and retention of crucial medical concepts. Furthermore, ChatGPT proves invaluable in addressing knowledge-based queries in specific medical domains. Ghosh and Bir [28], for instance, explored the use of ChatGPT in a competency-based medical education curriculum, focusing on its efficacy in answering questions related to microbiology. This demonstrates ChatGPT's versatility in providing accurate and comprehensive responses tailored to the unique requirements of medical education. Moreover, researchers like Hoc et al. [29] have investigated ChatGPT's potential to aid in the preparation for otolaryngology board certification exams. By utilizing ChatGPT to generate exam content and practice questions in specialized medical fields, medical professionals can benefit from targeted and relevant study materials, thereby improving their chances of success in certification exams. In the real world, medical students and professionals can leverage ChatGPT to obtain quick, reliable answers to complex medical questions, aiding in their learning and exam preparation processes. This not only enhances the efficiency of medical education but also contributes to better-prepared healthcare professionals capable of delivering high-quality patient care.

b) Providing explanations

ChatGPT has emerged as a valuable tool in medical education, aiding students in understanding complex medical subjects through detailed explanations. Periaysamy et al. [30] emphasized ChatGPT's clear and concise explanatory power, highlighting its significant contribution to medical teaching. Furthermore, its application in nursing education is being scrutinized, emphasizing its potential to elucidate nursing procedures and physical principles. This, in turn, enhances student comprehension and facilitates the retention of skills and knowledge. In real-world applications, ChatGPT can break down intricate medical theories into understandable concepts, helping students and professionals at various levels of education better grasp and retain critical information. For instance, in a classroom setting, educators can leverage ChatGPT to explain complicated topics, providing students with instant clarification and supplementary information. Moreover, ChatGPT can assist in clinical training by offering detailed explanations of diagnostic procedures, treatment plans, and patient management strategies. This comprehensive explanatory capability enhances student comprehension and facilitates the retention of skills and knowledge.

c) Providing feedback

Abdelhady and Davis [31] described how the feedback capabilities of ChatGPT enhanced the accuracy and efficiency of feedback operations in plastic surgery. It provides real-time feedback on documents and ensures thorough and accurate reporting. This highlights ChatGPT's capacity to strengthen feedback mechanisms in medical education by providing rapid and constructive feedback on clinical assignments, evaluations, and documentation. In practical terms, ChatGPT can assist medical students and professionals

by quickly reviewing and correcting medical reports, research papers, and clinical notes, ensuring high standards of accuracy and thoroughness. Additionally, during clinical training, ChatGPT can offer instant feedback on student performance, helping them understand mistakes and improve their skills promptly. This ability to deliver immediate, precise feedback significantly boosts the quality of medical education and clinical practice.

d) Providing suggestions

ChatGPT can play a valuable role in medical education by providing suggestions. In a recent study [32], its early integration into medical education is emphasized, focusing on its capacity to recommend customized study materials, practice questions, and learning strategies to individual students. Another study [33] examined how ChatGPT assists in proposing research themes and methodologies in the field of pediatrics, highlighting its ability to guide medical students and researchers in valuable research areas. For instance, in pediatrics, ChatGPT can suggest emerging areas of research like neonatal care or pediatric infectious diseases, along with appropriate study designs and statistical methods. This guidance can significantly streamline the research process, helping to identify gaps in the current knowledge base and contributing to the advancement of medical science.

ii) PATIENT CARE

ChatGPT has become an invaluable resource in patient care, with applications including enhancing health information and education and symptom checker.

a) Enhancing health information and education

Several studies, including [34] and [35], have underscored the transformative role of ChatGPT in enhancing health information and education. ChatGPT serves as an accessible and knowledgeable resource that provides patients with precise insights into allergies, immunity, cancer, and a range of health-related subjects. Its capacity to comprehend and address patient inquiries ensures that individuals receive customized health education and information, empowering them to make informed choices regarding healthcare. Additionally, investigations such as those mentioned by Nakhleh et al. [36] underscore the potential of ChatGPT in diabetes education, as it can enhance patients' understanding of their condition, treatment alternatives, and lifestyle management.

b) Symptom checker

ChatGPT serves as a reliable symptom checker, offering valuable assistance to individuals seeking information about their health concerns. In a study by Samaan et al. [37], ChatGPT demonstrated its effectiveness in guiding patients through symptom-related inquiries, providing preliminary assessments, and offering suggestions for potential medical conditions. This proves particularly beneficial in scenarios where individuals are unsure about their health-related issues. By interacting with ChatGPT, patients can articulate their symptoms, leading to accurate responses and guidance. This not only enhances patient engagement but also facilitates

the early identification of health issues, thereby promoting proactive healthcare management.

iii) HEALTHCARE PROFESSIONALS SUPPORT

ChatGPT has been used also in the field of healthcare professionals support as an essential tool in clinical documentation and diagnostic assistance.

a) Clinical documentation

ChatGPT demonstrates remarkable potential in streamlining medical record documentation processes. Research studies [38], [39] have showcased ChatGPT's ability to aid in the creation of detailed and accurate clinical notes, discharge summaries, and radiology reports. Moreover, as highlighted by Hamed et al. [40], ChatGPT simplifies the integration of clinical guidelines, ensuring adherence to current evidence-based healthcare practices. In specialized fields like plastic surgery, as noted by Bassiri-Tehran and Cress [41], ChatGPT facilitates the meticulous documentation of surgical procedures and postoperative care plans. These findings underscore ChatGPT's pivotal role in enhancing the efficiency and accuracy of clinical documentation across various medical specialties.

b) Diagnostic assistance

Thus, ChatGPT is a valuable tool for healthcare practitioners. Williams and Shambrook [42] reported that it has the potential to assist in the diagnosis of intricate medical conditions, such as cardiovascular diseases, by providing pertinent insights and data analysis. Lecler et al. [43] illustrated how ChatGPT aids radiologists in interpreting medical images and detecting anomalies. In the field of obstetrics and gynecology, Grunebaum et al. [44] underscored the role of ChatGPT in providing guidance and information to healthcare providers to address women's health concerns. Similarly, Ma [45] accentuated its ability to contribute to the diagnosis of gastrointestinal ailments by offering valuable insights into pathology reports. Collectively, these applications underscore ChatGPT's capacity to serve as a valuable ally in the healthcare sector, lending support to professionals in clinical record-keeping and diagnostic processes, and ultimately leading to the enhancement of patient care and outcomes.

iv) LEARNING

ChatGPT has become an invaluable resource in learning as an application of assessment.

a) Assessment

Recent studies conducted by Li et al. [46] and Bhayana et al. [47] have provided compelling evidence of ChatGPT's superior performance compared to human capabilities in virtual clinical assessments and radiological examinations. These findings underscore ChatGPT's potential as an invaluable resource for healthcare practitioners and students alike, aiming to refine their diagnostic and clinical proficiency. By delivering precise and instantaneous evaluations, ChatGPT emerges as a transformative tool in medical pedagogy, enhancing the efficiency and effectiveness

of educational and evaluative practices within the healthcare domain.

v) MEDICAL RESEARCH

ChatGPT has been used also in the field of medical research as an essential tool in research assistance.

a) Research assistance

ChatGPT serves as a valuable research assistant by offering proactive and well-informed support to researchers in various tasks, including data analysis, literature reviews, and hypothesis generation [48]. This AI-powered tool streamlines the search process, accelerates the retrieval of relevant data, and facilitates the exploration of innovative methodologies. Consequently, ChatGPT not only boosts the efficiency of medical research but also fosters collaboration among researchers, granting access to vital data and driving advancements in medicine and surgery.

2) LIMITATIONS AND CHALLENGES

a: EDUCATION

Using ChatGPT in education has many challenges and limitations that must be addressed to ensure its effective implementation. These include concerns regarding accuracy and reliability, technical challenges, ethical considerations, and human interaction, as provided in Table 4.

i) ACCURACY AND RELIABILITY

One of the major challenges in using ChatGPT for educational purposes is ensuring its accuracy and reliability. ChatGPT responses are generated based on the data on which it is trained, which may not always be up-to-date or complete. This restriction can result in incorrect information being published, which may affect student learning outcomes. For example, in the context of basic skills and quantitative knowledge, relying solely on ChatGPT for explanations and guidance may lead to misinformation, hindering students' understanding of basic concepts [25]. Similarly, in engineering education, where accurate information is critical, the limitations of ChatGPT in providing reliable content can pose challenges in delivering high-quality educational materials [20].

ii) TECHNICAL CHALLENGES

However, integrating ChatGPT into educational systems is technically difficult. These include issues related to seamless integration with existing platforms and software used in education. In the context of software testing education, ensuring that ChatGPT effectively aids the learning process while integrating it with educational tools can be a complex task [26]. Furthermore, in blended learning methodologies, particularly in mathematics education, technical challenges may arise when attempting to align ChatGPT's capabilities with traditional teaching methods and digital resources [21]. Ensuring that ChatGPT supports construction hazard recognition and safety education requires technical compatibility

with training tools and systems used in the construction industry [59]. The technical aspects of pairing ChatGPT with programming education also require careful consideration to enhance the learning experience [23].

iii) ETHICAL CONCERNS

Thus, the ethical use of ChatGPT in education is a serious concern. The implementation of responsible strategies and guidelines is essential to prevent misuse or unethical practices. This is particularly crucial in the context of using ChatGPT as an educational tool, where ethical considerations should be incorporated into its deployment [60]. Addressing ethical concerns is essential to maintaining the integrity of education and ensuring that the use of generative AI aligns with educational goals [61]. The ethical use of ChatGPT also involves transparency and accountability, as shown in a case study of the role of ChatGPT in education [16].

iv) HUMAN INTERACTION

The ChatGPTs' lack of empathy and interpersonal skills can affect their effectiveness in educational settings. In modern education, the transformative effects of ChatGPT may be hampered by the inability to provide empathic responses and understand students' emotional needs [17]. Interpersonal skills are vital to teaching and learning. The use of ChatGPT in mathematics education, for example, may lack the personal touch that human teachers can provide, which may affect student engagement and motivation [19]. Balancing the use of AI tools such as ChatGPT with human interaction and emotional support remains a challenge in the education sector.

b: HEALTHCARE

The integration of ChatGPT within the healthcare domain presents a multitude of challenges and constraints that necessitate thorough consideration to ensure its efficacious deployment. These include apprehensions regarding accuracy and reliability, privacy and security, ethical considerations, medical decision-making, patient interaction, training, and customization, as provided in Table 5.

i) ACCURACY AND RELIABILITY

One of the major challenges in using ChatGPT in healthcare is incomplete knowledge. ChatGPT responses were based on the data on which they were trained, which may not include all medical knowledge or the latest research results. This limitation was highlighted by Kumah-Crysta et al. [62]. In healthcare, where accuracy is critical, relying on an AI model with incomplete knowledge can lead to the dissemination of incorrect information, jeopardizing patient care and medical decision-making.

ii) PRIVACY AND SECURITY

Data privacy is a critical concern when ChatGPT is used in healthcare settings. Sallam et al. [63] emphasized the need

TABLE 3. Potential applications of ChatGPT in healthcare.

Domain	Application	References
Medical education	Answering questions	[27] [28] [29] [49] [50] [51] [52] [53] [54]
	Providing explanations	[30] [55]
	Providing feedback	[31]
	Providing suggestions	[32] [33] [56] [57]
Patient Care	Health Information and Education	[34] [35] [36]
	Symptom Checker	[37]
Healthcare Professionals Support	Clinical Documentation	[38] [39] [40] [41] [58]
	Diagnosis Assistance	[42] [43] [44] [45]
Learning	Assessment	[46] [47]
Medical Research	Research Assistance	[48]

TABLE 4. Challenges and limitations of ChatGPT applications in education.

Aspect	Challenges and Limitations	References
Accuracy and Reliability	Limited Knowledge	[20]
	Misinformation	[25]
Technical Challenges	Integration	[21] [23] [26] [59]
Ethical Concerns	Ethical Use	[16] [60] [61]
Human Interaction	Lack of Empathy	[17]
	Interpersonal Skills	[19]

to protect sensitive patient data. The integration of ChatGPT into healthcare systems requires strict measures to protect patient information and maintain confidentiality. Any breach of data privacy can have legal and ethical consequences, thereby eroding trust in AI-based healthcare solutions.

iii) ETHICAL CONSIDERATIONS

Ethical dilemmas arise when ChatGPT is used in healthcare. Informed consent is difficult to obtain when AI is involved in medical decisions [64]. Patients may not fully understand or consent to AI-based interventions, raising ethical questions regarding independence and transparency. In addition, establishing accountability in cases of AI-related errors poses significant ethical challenges, particularly when medical liabilities are at stake [65].

iv) MEDICAL DECISION-MAKING

The use of ChatGPT in medical decision-making poses many challenges. Diagnostic errors can occur when ChatGPT misinterprets or fails to recognize complex medical conditions [66]. This lack of context poses difficulties in accurately understanding patient histories [67]. These limitations can have serious consequences, and liability concerns are relevant when it comes to AI making medical decisions [68].

v) PATIENT INTERACTION

Another challenge is the inability of ChatGPT to provide empathic responses to patients. In [69], the authors address the lack of empathy in AI interactions. Overcoming language barriers can be complex, particularly when serving non-English speaking or non-technology savvy patients [70].

vi) TRAINING AND CUSTOMIZATION

The ChatGPT performance is highly dependent on the quality and diversity of its training data. Ali et al. [71] highlight the challenge of dataset limitations. Ensuring that ChatGPT remains up-to-date with evolving medical knowledge and can be tailored to suit different medical specialties and contexts is essential for its effective use in healthcare.

B. RQ2: WHAT ARE THE ETHICAL IMPLICATIONS OF USING CHATGPT IN EDUCATION AND HEALTHCARE APPLICATIONS, AND HOW HAVE THEY BEEN ADDRESSED?

a: EDUCATION

Academic integrity is a critical concern in education as it strives to maintain the highest ethical standards in learning environments. This review identified the major ethical impacts of ChatGPT in education. Table 6 classifies the effects into two main types: cheating and plagiarism. The spread of this technology raises ethical concerns about the validity of student work. Kooli [72] sparked a critical examination of the ethical implications and solutions in the context of chatbots in education and emphasized the need for vigilance against academic misconduct. Likewise, Cotton et al. [73] emphasized the importance of implementing strong measures to prevent cheating. Dalalah and Dalalah [74] highlighted the challenges of accurately detecting instances of plagiarism and cheating and called for a careful approach to maintaining academic integrity, leveraging the potential of ChatGPT in education. Collectively, these studies underscore the importance of addressing issues related to cheating and plagiarism during the ethical implementation of ChatGPT in educational environments.

TABLE 5. Challenges and limitations of ChatGPT applications in healthcare.

Aspect	Challenges and Limitations	References
Accuracy and Reliability	Incomplete Knowledge	[62]
Privacy and Security	Data Privacy	[63]
Ethical Considerations	Informed Consent	[64]
	Accountability	[65]
	Diagnostic Errors	[66]
Medical Decision Making	Lack of Context	[67]
	Liability	[68]
Patient Interaction	Lack of Empathy	[69]
	Language Barriers	[70]
Training and Customization	Dataset Limitations	[71]

TABLE 6. Ethical implications of using ChatGPT in education.

Ethical Implication	Type	References
Academic Integrity	Cheating	[72] [73]
	Plagiarism	[74]

Educational institutions should proactively address the ethical implications of using ChatGPT in the academic realm, specifically focusing on preserving academic integrity. Educational institutions emphasize the importance of critical thinking by incorporating strategies such as implementing traditional in-class assessments [75], employing interactive discussions [76], and designing creative project assignments [77]. These measures aim to encourage students to actively engage in the learning process, foster independent thought, and reduce their reliance on AI tools for basic information recall. Moreover, in the field of instructional design, strategies like embedding multimedia-enhanced questions [78] and adopting essay-style questions [76] are being employed. These approaches enhance assessment methods and provide a more comprehensive evaluation of students' understanding and analytical skills. To safeguard academic integrity, institutions use strategies such as leveraging AI writing detection tools [78] (e.g., [79] and [80]) and implementing reference verification processes [73], [75], [78]. These measures help identify and address instances of plagiarism or unauthorized content generation, ensuring a fair and ethical academic environment. Finally, ethical guidelines are reinforced through strategies such as providing frameworks for responsible implementation [81], establishing anti-plagiarism guidelines [78], and offering academic integrity training [82]. These initiatives contribute to creating a culture of ethical AI tool usage in academic settings, emphasizing responsible and conscientious practices.

Table 7 categorizes these strategies into four main aspects: critical thinking (utilizing traditional in-class assessments, employing interactive discussions, and designing creative project assignments), instructional design (embed-

ding multimedia-enhanced questions and adopting essay-style questions), safeguarding academic integrity (leveraging AI writing detection tools and reference verification), and ethical guidelines (providing frameworks for responsible implementation, anti-plagiarism guidelines, and academic integrity training).

b: HEALTHCARE

Similarly, this review identified the major ethical impact of ChatGPT in healthcare. Table 8 describes the impact of errors and biases on the medical decision-making process and their main types. Although ChatGPT is a powerful language model, it is not infallible, and its responses are generated based on patterns learned from the data [65]. This can lead to incorrect or biased information being provided to healthcare professionals and patients [34]. In critical medical situations, relying solely on ChatGPT recommendations may lead to incorrect diagnoses or inappropriate treatment decisions [83], which can have serious consequences for patient health. Ethical concerns extend to accountability and responsibility. When an AI, such as ChatGPT, is involved in medical decision-making, it can be difficult to determine who should take responsibility for any adverse outcomes. Healthcare providers, patients, and AI developers share varying degrees of responsibility, creating ethical dilemmas surrounding liability [84].

Addressing the ethical implications of ChatGPT in healthcare is paramount to ensuring the integration of AI technologies into medical decision-making processes. This review identified significant concerns, particularly regarding potential errors and biases in ChatGPT responses, which could impact the quality of medical decisions. Strategies have been proposed to mitigate these risks, including rigorous data validation processes and regular updates with diverse datasets to enhance the accuracy [84]. Emphasizing the role of ChatGPT as a decision-support tool rather than a standalone decision-maker is crucial, particularly in critical medical situations [85]. Healthcare professionals are encouraged to critically evaluate and validate ChatGPT

TABLE 7. Strategies addressing ethical implications of ChatGPT in education.

Aspect	Strategy	References
Critical thinking	Utilizing Traditional In-Class Assessments	[75]
	Employing interactive discussions	[76]
	Design creative project assignments	[77]
Instructional design	Embedding multimedia-enhanced questions	[78]
	Adopting Essay-style Questions	[76]
Safeguard academic integrity	Leveraging AI- writing detection tools	[78]
	Reference verification	[73] [78] [75]
Ethical guidelines	Providing frameworks for responsible implementation	[81]
	Anti-plagiarism guidelines	[78]
	Providing academic integrity training	[82]

TABLE 8. Ethical implications of using ChatGPT in healthcare.

Ethical Implication	Type	References
Errors and Biases	Potential for errors and biases	[34] [84]
	Accountability and responsibility	[84]
	Reliability	[83]

recommendations to ensure patient safety [85]. Furthermore, enhancing accountability in AI-assisted medical decision-making involves establishing clear guidelines and protocols for the roles and responsibilities of healthcare providers, patients, and AI developers [86]. Transparent communication about the limitations of ChatGPT and clarification of accountability in different scenarios are integral to navigating ethical dilemmas in the evolving landscape of healthcare AI [86]. Table 9 categorizes these strategies into three main aspects: error and bias mitigation (i.e., rigorous data validation processes and regular updates with diverse datasets), critical decision support (i.e., positioning ChatGPT as a decision-support tool and emphasizing critical evaluation by healthcare professionals), and enhancing accountability (i.e., establishing clear guidelines and protocols for roles, responsibilities, and transparent communication on accountability).

IV. DISCUSSION

This study aims to conduct a scoping review of the literature related to the application of ChatGPT in education and healthcare to gain a better understanding of its current applications, challenges, and ethical implications. This review focused on articles published between March and July 2023. Therefore, two versions of ChatGPT based on GPT-3.5 and GPT-4 were used. The results indicate that ChatGPT has the potential to enhance applications in the fields of education and healthcare (please refer to Tables 2 and 3 for further details). However, there are limitations and challenges across several additional applications (please refer to Tables 4 and 5 for more details). In addition, the use of ChatGPT has various

ethical implications (see Tables 6 and 8 for additional details). Therefore, urgent strategies are necessary to address these implications (please refer to Tables 7 and 9 for additional details) and to enhance the use of ChatGPT in the context of education and healthcare.

NLP serves as the backbone of ChatGPT’s ability to deliver personalized experiences in both education and healthcare. It encompasses a series of computational techniques and algorithms designed to enable machines to understand, interpret, and generate human language, mirroring human communication. ChatGPT utilizes state-of-the-art NLP models, such as transformer-based architectures, which leverage deep learning algorithms to process and comprehend text data effectively. Semantic understanding is a cornerstone of ChatGPT’s NLP capabilities, enabling it to analyze the meaning and context of user inputs to generate relevant responses. Through techniques like word embedding and attention mechanisms, ChatGPT can capture the semantic relationships between words and phrases, allowing it to grasp the nuances of language and generate coherent responses. Furthermore, NLP enables ChatGPT to engage in natural language generation (NLG), where it generates human-like text based on the input it receives. This process involves generating grammatically correct sentences that convey meaningful information. ChatGPT accomplishes this by learning from vast amounts of text data during its training phase, allowing it to generate contextually appropriate responses. In the context of education, ChatGPT’s NLP capabilities enable it to analyze student queries, understand their learning objectives, and tailor responses accordingly. By identifying keywords, context clues, and syntactic structures, ChatGPT can provide personalized study materials, explanations, and feedback that cater to individual learning styles and preferences. In healthcare, ChatGPT’s NLP mechanisms facilitate accurate interpretation of patient symptoms, medical history, and inquiries. By parsing medical terminology, identifying relevant clinical information, and drawing upon vast medical knowledge bases, ChatGPT can offer personalized health information, preliminary diagnoses, and treatment recommendations tailored to each patient’s unique circumstances.

TABLE 9. Strategies addressing ethical implications of ChatGPT in healthcare.

Aspect	Strategy	References
Error and Bias Mitigation	Rigorous data validation processes	[84]
	Regular updates with diverse datasets	[84]
Critical Decision Support	Positioning ChatGPT as a decision support tool	[85]
	Emphasizing critical evaluation by healthcare professionals	[85]
Enhancing Accountability	Establishing clear guidelines and protocols for roles and responsibilities	[86]
	Transparent communication on accountability	[86]

Beyond semantic understanding and NLG, ChatGPT's NLP capabilities encompass syntax analysis, sentiment analysis, named entity recognition (NER), and discourse analysis. Syntax analysis parses grammatical structures to ensure coherent responses, while sentiment analysis gauges emotional tones to respond empathetically, particularly beneficial in healthcare settings. NER identifies and classifies named entities within text, extracting relevant information for contextually appropriate responses. Discourse analysis maintains conversation flow and coherence over extended dialogues, enhancing the overall user experience. ChatGPT's NLP capabilities play a crucial role in transforming both education and healthcare. In education, these capabilities support differentiated instruction, tailoring teaching methods to accommodate diverse learning needs. By providing customized educational experiences, ChatGPT bridges the gap between traditional teaching methods and individual student requirements, fostering better understanding, retention of knowledge, and active learning. Moreover, ChatGPT's instant feedback and explanations empower students to self-correct and learn more efficiently, particularly in subjects where timely feedback is essential for mastering complex concepts. In healthcare, ChatGPT's interaction is equally significant, democratizing access to healthcare information and fostering engagement through empathetic support. Its availability and ability to offer personalized health information, preliminary diagnoses, and treatment recommendations streamline healthcare delivery, aiding in triage, administrative tasks, and decision-making processes. This results in improved efficiency and continuity of care, ultimately enhancing patient experiences and outcomes. Overall, ChatGPT's comprehensive suite of NLP capabilities revolutionizes how users interact with information and support resources, whether in education or healthcare. By bridging the gap between human language and machine understanding, ChatGPT enhances learning outcomes, patient care, and overall user experiences, marking a significant advancement in both fields.

However, there are several ethical ChatGPT-related risks that need to be addressed before officially being adopted as virtual assistant in schools or hospitals. These risks include but are not limited to compromised data privacy, biased information, inaccuracies and misleading results,

unreliability, plagiarism, and a lack of transparency and accountability.

In addition to these applications, several open questions remain regarding ChatGPT's broader impact. These include its influence on language learning and teaching in various contexts, its role in improving accessibility for people with disabilities, its potential applications in language translation and multilingual communication, and how it can contribute to the development of conversational agents and chatbots. These questions underscore the wide-ranging capabilities and significance of ChatGPT.

A. WHAT IS THE IMPACT OF CHATGPT ON LANGUAGE LEARNING AND TEACHING IN VARIOUS CONTEXTS?

ChatGPT significantly influences the landscape of language learning and teaching across various scenarios. In terms of language proficiency, ChatGPT offers a personalized learning journey by leveraging its training on an extensive array of sentences, allowing it to produce coherent and grammatically sound sentences [75].

Functioning as a potent educational instrument, ChatGPT grants learners access to a diverse array of educational resources. It replicates real-life scenarios, encourages authentic application of a language, and augments exposure to the target language [22].

ChatGPT can also improve language learning efficiency by providing personalized instructions, instant feedback, and a wide range of training materials, making the learning process more efficient, effective, and less time-consuming. ChatGPT can translate educational materials into different languages and achieve state-of-the-art results in several translation standards by understanding the meaning of sentences in one language and generating accurate translations in another language [87]. Thus, it has significant potential for self-learning and for instructors and educational establishments to enhance language instruction and evaluation. It also presents researchers with various research options, notably regarding individualized learning support [88].

The ChatGPT architecture integrates humans as evaluators in the training process through reinforcement learning based on human feedback. However, ChatGPT shows a functional bias toward English users [81]. Despite its multilingual capabilities, it tends toward monocultural capabilities.

B. WHAT IS THE ROLE OF CHATGPT IN IMPROVING ACCESSIBILITY FOR PEOPLE WITH DISABILITIES, AND WHAT ARE THE CHALLENGES IN THIS REGARD?

The remarkable capabilities of ChatGPT in enhancing accessibility for individuals with disabilities are manifested across various domains, particularly in the realm of augmenting communication through speech-to-text mechanisms for those with visual or auditory impairments. Moreover, ChatGPT assumes a pivotal role in furnishing invaluable support in providing inclusive learning environments to impaired students facing challenges such as limited resources, disabilities, or learning disorders. Additionally, it contributes to inclusivity by accommodating individuals in diverse living circumstances, including those with family responsibilities and non-native speakers [81].

However, despite the considerable potential benefits that ChatGPT offers to people with disabilities, its utilization can inadvertently cast a shadow over this demographic, potentially exacerbating harm and discrimination. It is important to acknowledge that ChatGPT, although a promising technology, remains a work in progress and is not immune to inaccuracies or reliability issues. Furthermore, there exists a genuine risk that ChatGPT may inadvertently generate malicious directives or perpetuate biased content. From a technical perspective, it is imperative to ensure that ChatGPT seamlessly integrates with screen-reading programs and coexists with other electronic device technologies, thus optimizing its compatibility and usefulness for a diverse user base.

C. WHAT ARE THE POTENTIAL APPLICATIONS OF CHATGPT IN LANGUAGE TRANSLATION AND MULTILINGUAL COMMUNICATION, AND HOW DOES IT COMPARE TO OTHER NLP MODELS?

The potential applications of ChatGPT in language translation and multilingual communication are closely linked to its impact on education and healthcare in several ways. As its name suggests, translation and communication are essential to demonstrating ChatGPT's power as a chat tool, due to the mutually reinforcing relationship. By breaking down language barriers, ChatGPT not only improves access to education and healthcare but also enhances the quality of services provided in these fields, potentially leading to better outcomes for individuals and communities. Similar to other NLP models, ChatGPT has many potential applications in language translation, grammatical explanations, and multilingual communication. ChatGPT can be used to translate text from one language to another for various purposes, such as practicing language skills and learning to communicate with patients. Although ChatGPT is not explicitly trained on healthcare data, it has the potential to transform communication with patients in medical facilities and healthcare settings [89].

ChatGPT can also serve as a foundation for creating multilingual chatbots that interact with users in multiple lan-

guages, facilitating communication across language barriers, and bridging cultural context gaps.

Compared to other NLP models, in terms of size, most models, such as GPT-2, and text-to-text transfer transformer (T5), are similar in terms of parameters and slightly outperform others, such as bidirectional encoder representations from transformers (BERT), the robustly optimized BERT approach (RoBERTa), and eXtreme language understanding interdependence transformers (XLNet). On the comprehension side, ChatGPT achieved an average performance comparable to the BERT base (78.7% vs. 79.2%), but it was still lower than the performance of other robust BERT-style models (e.g., RoBERTa-large, 87.8%) by a clear margin [90].

In addition, in terms of speed, ChatGPT quickly generated responses in real time, similar to Google BERT, which mainly focused on accuracy, resulting in slower responses than the other models. However, practitioners can fine-tune models, such as T5, to specific datasets and translation tasks, making it a powerful tool for various NLP applications and may even outperform ChatGPT in terms of translation accuracy.

The performance of ChatGPT compared with other NLP models depends on the specific use case and the quality of fine-tuning for multilingual tasks. Although specialized translation models may excel in terms of accuracy, the versatility of ChatGPT in handling various language-related applications is a notable advantage.

D. HOW DOES CHATGPT CONTRIBUTE TO THE DEVELOPMENT OF CONVERSATIONAL AGENTS AND CHATBOTS, AND WHAT ARE THE CHALLENGES IN THEIR IMPLEMENTATION?

Recent advances in LLMs represent a major leap for chatbots and conversational agents. LLM-based models can engage in more effective conversations with humans than traditional language models. Specifically, these models interact naturally and seamlessly, understanding the instructions, intent, and context of human prompts to provide appropriate responses. The ability to have fluid, multi-turn conversations in vital sectors such as education and healthcare is an essential characteristic of contemporary LLMs. To understand ChatGPT's contribution to developing conversational agents, comprehensive evaluation is necessary, especially with the continuous release of new LLMs, each with unique strengths and weaknesses. Therefore, thorough quantitative assessment is essential to measure these models' capabilities across various dimensions in education and healthcare.

ChatGPT, in turn, has contributed to the development of conversational agents and chatbots. Understanding natural language is a valuable component of chatbots. ChatGPT conversations are attractive and dynamic because of their ability to understand the context, which makes them more interactive with users. Their uses can be customized to the individual needs of users and tuned to specific applications and fields. ChatGPT's performance also improves through continuous learning, as it allows chatbots to adapt to changing

user needs and stay up-to-date. They can also be integrated with text-to-speech technology, enabling chatbots to have voice conversations with users.

However, there are challenges associated with the implementation of ChatGPT in conversational agents and chatbots. The main challenge is creating blocks of text that are fluent in content with which humans are familiar so that it can be easily exploited for fraud and plagiarism. The widespread use of chatbots across different channels and platforms presents a logical challenge, particularly for organizations and companies. There are also security risks associated with chatbots supported by ChatGPT within organizations. Therefore, achieving a balance between conversation capabilities and controlling responses represents a challenge in preventing the creation of harmful or inappropriate content. The time factor also presents a challenge for fine-tuning ChatGPT training and achieving optimal performance.

Currently, major technology companies are competing to replicate the enormous success of the GPT language model in all its versions. New models are constantly being released, each of which has its own strengths and weaknesses. Therefore, evaluating these models has become a necessary need for a comprehensive quantitative measurement of the models' capabilities across different dimensions that are common to both the fields of education and health care. Evaluation of LLMs requires rigorous quantitative assessment using progressive benchmarks. Based on OpenCompass [91], models are evaluated based on 6 dimensions, including examination, language, knowledge, understanding, reasoning, and resilience (refer to Fig. 4), which contribute to ensuring optimal quality, enhancing user experience, meeting regulatory standards, and discovering shortcomings in LLMs. However, it is important to note that the field of LLM assessment is still evolving, and these dimensions may expand or become more precise over time. For examination, the models undergo diverse assessments across tasks, including middle school, high school, college, and vocational exams. This encompasses handling multiple-choice questions in subjects, as in C-Eval. It also gauges performance in human-centric standardized exams (AGIEval) and comprehensive tests like MMLU. Evaluation extends to assessing large model performance in benchmarks like GAOKAO-Bench and CMMLU, which require extensive world knowledge and problem-solving ability. The models language understanding and generation are evaluated across various benchmarks. Syntax and semantics are assessed in WiC and CHID, focusing on context and word sense disambiguation. Tasks include text classification and information extraction in benchmarks like AFQMC and BUSTM, emphasizing semantic similarity and topic matching. SummEdits evaluates factual reasoning, while content generation tasks in benchmarks such as WSC, WinoGrande, TyDiQA, and Flores cover pronoun disambiguation, question answering, and machine translation. The knowledge dimension assesses the model's recall and application of learned factual and procedural knowledge. Evaluation tasks include Common-Sense-Based QA,

Knowledge-Based QA, and Fact-Based QA. Benchmarks like BoolQ, CommonsenseQA, NaturalQuestions, and TriviaQA cover yes/no questions, commonsense knowledge, article comprehension, and evidence-based answers, respectively. For understanding, the models responsiveness to user inputs is evaluated across diverse tasks. This includes maintaining conversation context, interpreting implicit meanings, and demonstrating empathy. Benchmarks like C3 and RACE assess reading comprehension skills through multiple-choice questions. LCSTS and XSum evaluate content summarization, while EPRSTMT and LAMBADA gauge sentiment analysis and broader discourse tracking, respectively. For reasoning, the model is evaluated across diverse tasks, including mathematical, logical, causal, and factual reasoning. Benchmarks like CMNLI, OCNLI, and AX-b test logical relationships. RTE assesses factual inference; COPA and ReCoRD test causal reasoning. Benchmarks HellaSwag, PIQA, and SIQA evaluate logical endings based on scenarios. Standards MATH and GSM8K assess mathematical thinking. TheoremQA and DROP test mathematical expression generation. Additionally, problem-solving and decision-making are evaluated in HumanEval, MBPP, and BBH, requiring code snippet generation based on a specific question and template. Another benchmark that is taken into great consideration is resilience, which evaluates the LLM's capabilities to conduct multi-turn dialogue, in order to compare generated conversations with ground truth (GRAvel) conversations.

Fig. 5 shows an assessment of the strongest competitors in LLMs based on OpenCompass comprehensive evaluation. Although some models appeared late, they have significant competition. The results revealed a diverse landscape of strengths and weaknesses among these models. GPT-4, developed by OpenAI, demonstrated a well-rounded performance with all scores exceeding 62 and particularly excelled in the Examination metric with a score of 77.2. In contrast, Qwen-14B, an open-source model proposed by Alibaba Cloud, achieved a commendable score of 71.3 in Examination but showed relatively lower scores in Language and Knowledge. Yi-34B, developed by 01.AI, outperformed all models in the Examination metric with a score of 78.1, although its Resilience score was not available for comparison. Claude-1, developed by Anthropic AI, showed the lowest performance across all metrics, with its highest score being 55.2 in Understanding. Lastly, LLaMA-2-70B, developed by Meta, exhibited a high score in Knowledge of 67.7, but its Resilience score was significantly lower than the others at 11.3. These findings underscore the fact that the choice of model would largely depend on the specific requirements of the task. For instance, if Resilience is a critical factor, GPT-4 might be a better choice over LLaMA-2-70B despite the latter's higher Knowledge score. Conversely, if Examination performance is paramount, Yi-34B could be the preferred model.

This analysis provides valuable insights into the potential contributions of LLMs in developing chatbots and conversational agents. The choice of model largely depends on the



FIGURE 4. LLMs benchmarks evaluation (Data source: [91]).

specific requirements of the task. If flexibility is a crucial factor in developing chatbots and conversational agents, GPT-4 excels and becomes a better option despite LLaMA-2-70B having a higher knowledge base. Conversely, if screening performance is critical for developing specialized chatbots and agents, GPT-4 might not contribute as effectively. This variability in LLM performance and its impact on chatbot development underscores the need for specific criteria in

selecting the most suitable model for tasks in education and healthcare. Establishing these criteria is essential to leveraging the full potential of LLMs in these fields.

V. LIMITATIONS

This review presents a comprehensive study of the ChatGPT tool for application in education and healthcare. However, it is

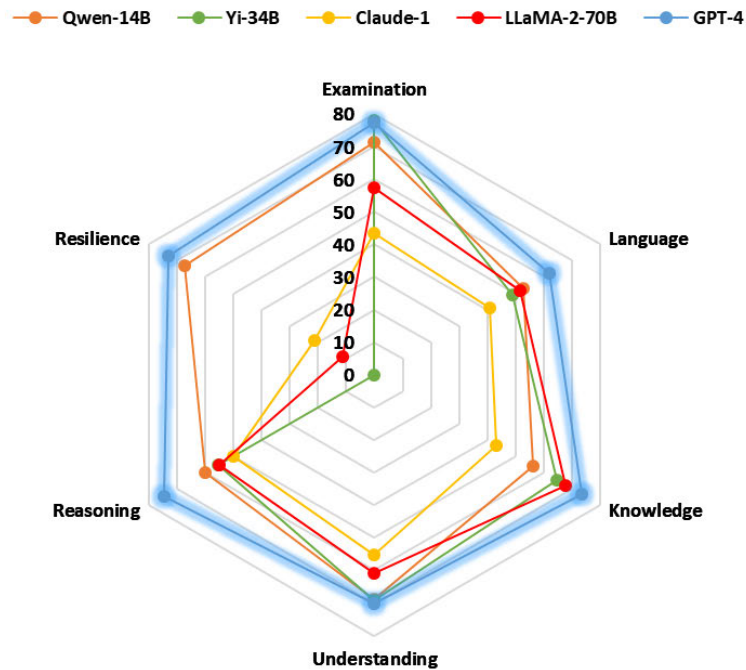


FIGURE 5. An evaluation of the most powerful competitors in LLMs (Data source: [91]).

important to carefully consider the findings of this review in light of some inherent limitations.

The selected articles were gathered from five well-known digital databases, including journal publications and conference proceedings, without consulting reviews or other publication forms. The exclusion of non-English records may have introduced bias in the selection process. Similarly, excluding numerous inaccessible records may result in the loss of relevant data, despite their small number. The rapid growth of literature addressing ChatGPT applications necessitates further research in other subject areas and the integration of ChatGPT applications in both education and healthcare, such as special needs education. Future reviews could expand their scope to include other ChatGPT applications in education and healthcare.

As ChatGPT technology continues to evolve and may undergo further advancements in the future, it is essential for educators and healthcare professionals to remain vigilant and proactive in their understanding and assessment of its capabilities and limitations. Conducting ongoing research and reviews will enable the development of updated guidelines and ethical policies to adapt to these advancements and ensure responsible use in educational and healthcare contexts.

VI. FUTURE PERSPECTIVES

This study aims to identify the potential applications of ChatGPT, clarify the limitations and challenges associated with its implementation, and delve into ethical considerations for its use in the fields of education and healthcare. It is worth noting that previous scientific works have mostly

provided theoretical perspectives on these aspects without empirical investigations. In future research, it is expected that specific applications and challenges will be subjected to empirical scrutiny, allowing for a more comprehensive assessment of their impact on ChatGPT development and implementation. Research findings from the reviewed studies provide valuable information and insights, bridging the gap between theoretical exploration and practical implementation in the field of ChatGPT applications in education and healthcare.

VII. CONCLUSION

Based on the findings of this review, several key insights have emerged regarding the potential applications, limitations, challenges, and ethical implications of ChatGPT in education and healthcare. ChatGPT has demonstrated significant potential applications in both fields. In education, ChatGPT can provide personalized learning experiences, instant feedback, and tailored study materials, enhancing the learning process for students. In healthcare, ChatGPT can offer preliminary diagnoses, personalized health information, and support for administrative tasks, improving patient care and operational efficiencies. However, current limitations include the need for robust data privacy measures, the potential for misinformation, and the requirement for ongoing supervision and evaluation by human professionals to ensure accuracy and reliability.

The ethical implications of using ChatGPT in educational and healthcare applications are multifaceted. Concerns include the potential for academic dishonesty, such as

plagiarism and cheating in educational settings, and the risk of over-reliance on AI for medical advice, which could lead to errors in patient care. Addressing these ethical issues requires updating guidelines and policies related to academic integrity and medical practice. Additionally, comprehensive training for teachers, students, clinicians, and other stakeholders is crucial to ensure the ethical use of ChatGPT. Stakeholders must be aware of the technology's limitations and challenges and its potential impacts on education and healthcare operations.

Furthermore, ChatGPT's flexibility and 24/7 availability can be leveraged to support individuals with special needs, providing an effective communication tool and ongoing assistance. While ChatGPT offers promising opportunities for advancing education and healthcare, careful consideration of its limitations and ethical implications is essential. Immediate actions include updating sector-specific guidelines, enhancing stakeholder training, and promoting responsible and ethical use of ChatGPT technology. These measures will help to maximize the benefits of ChatGPT while mitigating potential risks, ultimately enhancing our community's understanding and application of this technological advance.

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