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ChatGPT in Education: Applications, Concerns and Recommendations

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Abstract

Chat Generative Pretrained Transformer (chatGPT) is a language model that enables users to engage in natural language conversations with the system through text. The model is available through an easy-to-use, free web interface with impressive capabilities, which has contributed to its rapid popularity among students. This significant interest of students in utilizing chatGPT underscores the need to understand its impact on education. This paper presents applications, concerns, and recommendations on the use of chatGPT in education. The reviewed articles highlight several educational applications, including assisting students with writing tasks and helping teachers create learning materials. However, concerns have been raised about its unregulated use among students, particularly issues related to academic integrity, privacy violations, and potential biases. Regardless, many researchers advocate for the integration of chatGPT into the education system. Some do have reservations and recommend measures, including learning goals adjustments and development of new assessment forms to embrace ChatGPT in learning. While there is a great potential of chatGPT use in education, further research is needed to fully understand its implications when used without appropriate guidance and its long-term effects on students.

Keywords

AI Models
ChatGpt
Deep Neural Networks
Education
Natural Language Processing

1. Introduction

Technology and learning have always been intertwined for decades. Countless innovations across the globe have seamlessly integrated into educational domains to support teaching and learning. Audio and video technology as one of the longstanding technologies is a prime example. This technology has consistently yielded constructive enhancements to global learning endeavors [1]. Currently, technology such as tablets and mobile phones have widely been used to assist teaching and learning in schools [2]. These technologies collectively profoundly influence enriching

education, transcending geographical barriers to extend learning even to remote and hazardous environments.

A standout illustration of technology's transformative potential surfaced during the unprecedented circumstances of COVID-19 [3]. Virtual classrooms emerged as a beacon of new educational possibilities, enabling students who were unable to physically attend school to continue their learning journeys [4]. Additionally, technology holds promise for regions marked by elevated levels of violence and social instability, presenting a viable solution for fostering education in challenging contexts.

In recent years, Artificial Intelligence (AI) has revolutionized the world in different fields [5], including teaching and learning. Guan et al. explored over twenty years of Artificial Intelligence (AI) and Deep Learning (DL) as applied to teaching and learning [6]. Few applications presented include approaches such as intelligent tutoring systems, robo-graders, cognitive assistants [7], and AI assistants [8]. In November 2022, Chat Generative Pretrained Transformer (chatGPT) was released. While prior AI tools are impressive, chatGPT ascends to a higher echelon by delivering a novel experience, enabling users to engage in seamless conversations with a machine using natural language—akin to conversing with another human being [9]. A user can ask a range of questions and follow-up questions. The conversation can start with a simple question such as *What is your name?* A fun query such as "write me a joke" or "write me a movie scene" to a complex request such as "compose a conference paper." Because of these features, chatGPT has rapidly gained a lot of users, ending up breaking records as the fastest-growing user base [10], among the users are students [11]. It is this significant interest of students in utilizing chatGPT that underscores the need to understand its impact on education.

To put this growth of chatGPT use into perspective, Brandl and Ellis [12] used the amount of time different technologies reached 1 million users after launch. As observed in Figure 1, chatGPT achieved that growth in just 5 days, 70 days faster than Instagram, which is considered among the popular social media platforms. We should point out that chatGPT is not the first generative AI system, nor is the first to be developed by OpenAI. However, chatGPT is one of the latest breakthroughs in AI and it is worthwhile to review the current research contextualizing chatGPT based on the trending frameworks for discussing the impact of chatGPT on education.

ChatGPT popularity in academia has not limited its application only on education. There are many other practical applications [13] (Figure 2).

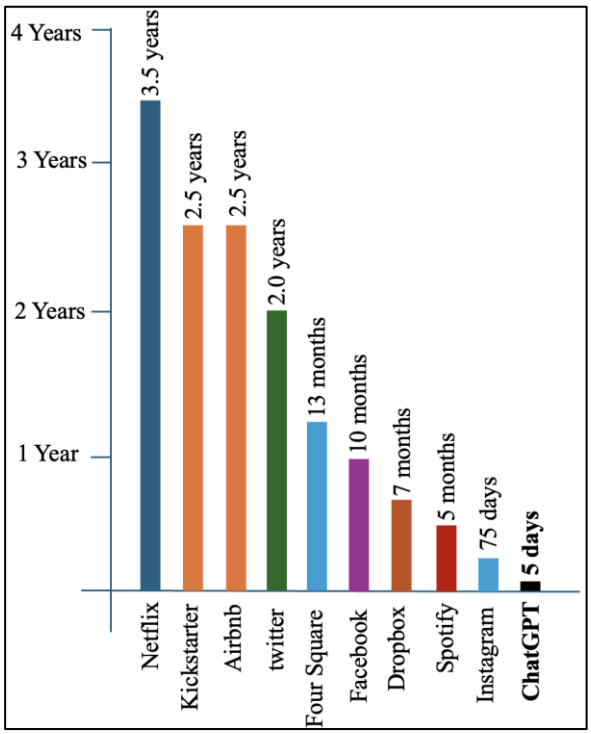

Figure 1. Time to reach 1 million users for different worldwide platforms.

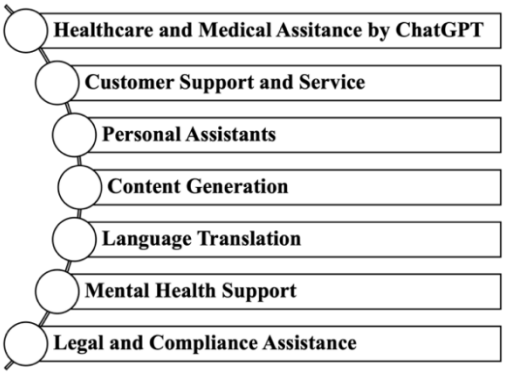

Figure 2. Other applications of ChatGPT.

The details regarding these applications are out of the scope of this review, and interested readers are directed to the following works [13, 14].

The release of chatGPT ignited a global development frenzy in generative AI. Among those, at the top is Google chat service called Gemini formally known as Bard [15], which was officially announced in January 2023. Microsoft came out with Bing Chat [16], and Baidu in China created Ernie [17]. Rudolph et al. [18] did a comparison study using 14 multidisciplinary questions on chatGPT, GPT-4, Bing Chat, and Bard. The authors concluded from the results that all bots offer fairly the same performance on the questions. Hence, this review will only focus on ChatGPT. However, most of the findings in this work can be extended or applied to other generative AI tools.

Technology has a lot of contributions to learning, but there are concerns about its use in education. For example, research studies conducted during the 1970s showed various effects of playing video games and McLean expressed early concerns regarding the integration of video games into learning [19]. Despite those early concerns, video games have continuously been used in training students, and researchers have continued to explore their negative [20] and positive [21, 22, 23, 24] impacts on education. With the existing knowledge of technologies and their integration into education, chatGPT does not stand apart. This review intends to explore its applications, concerns and researchers' recommendations on its integration into the education system.

Literature reviews are necessary as they provide an in-depth understanding of the existing research and current progress of a particular topic. This progress has been slow in some topics, and in others, has been very fast. For chatGPT and learning, a huge interest in both the public and researchers spiked a lot of studies around the world, which means researchers must keep up with an increasing research publications worldwide as new insights in the field are almost published every day.

Studies on chatGPT have been growing exponentially every day. Just in April 2023, a survey by Zhang et al. [25] reported no fewer than 500 articles in Google Scholar that included the word "chatGPT." At the time we are writing this survey, Google Scholar reports 15,500 articles. Among those articles, 11,900 include the words "chatGPT" and "learning".

The rapid rise in the articles shows researchers' interest in this topic and underscores the importance of an up-to-date literature review that organizes the existing works to help researchers, policymakers, and educators to find results at a commonplace. Most recent literature reviews on chatGPT and education, including the work by Patricio et al. [26], are limited to articles published up to the year 2023. We, therefore, saw a great need for a more updated review in the topic. Other recent reviews include the works by Mai et al. [27] and Sumbal et al. [28].

This review is expected to explore up to the most recent publications in 2024 to address two research questions (RQs):

RQ 1: What are the applications of chatGPT and the concerns surrounding its integration into education?

RQ 2: Should chatGPT be allowed or limited in education?

2. Method

We chose to conduct a rapid review [29] on the topic of chatGPT and learning due to time constraints, significant public interest in the topic, and the rapid evolution in this field. Our search for articles was conducted across four electronic databases: Scopus, Web of Science (WoS), Elton B. Stephons Company (EBSCO), and Google Scholar. The first three were chosen for their comprehensive coverage, high-quality sources, and robust citation analysis capabilities. From the search results obtained in these three databases, most relevant articles to our research questions were selected for our review. Google Scholar provided us with an ease of access and a diverse of sources. However, due to Google Scholar's wide range of search results, more time was dedicated in assessing the results to find high-quality articles that are relevant to our topic. Our Google Scholar's articles selection process is shown in Figure 4. The final search of articles used in this review was conducted on the 20th of April 2024 with the following strings used as search strings:

- "Learning and technology"
- "Learning and chatGPT"

Table 1 provides the number of articles selected for this review.

Table 1. Selected articles on each of the database.

Database	Number of Articles
Google Scholar	50
Scopus	18
WoS	08
EBSCO	04

A summary of selection criteria used in this review are provided in Table 2. We divided our search using two main search strings mentioned above. Our focus was on conference and journal articles mostly relevant to our review. However, some other publications relevant to the topic were also included. We also limited our selection to articles written in English, any articles in other languages were excluded.

For the articles discussing chatGPT and learning, we focused our selection on publications since 2022. Our choice of more recent studies is because chatGPT continues to receive attention, and we believe recent studies provide more understanding of how chatGPT supports or impedes learning. From the few articles that we selected and reviewed in this group, other highly cited articles were identified and obtained from either Scopus, WoS and EBSCO. Figure *3* shows the number of peer reviewed articles selected up to the time this review paper was submitted.

We should point out some of the selected articles are not peer reviewed publications and were published as news articles, but because of their relevance and contribution to this review, they were selected. Table 2 presents the criteria used for selecting peer reviewed publications from the databases presented in Table 1.

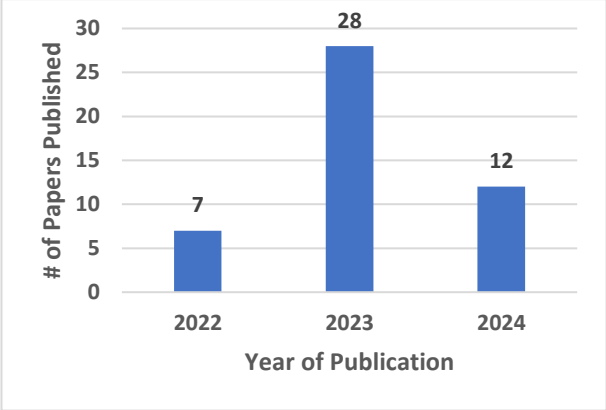

Figure 3. Number of articles selected in learning and ChatGPT.

Table 3 provides an overview of selected articles with respect to the topics they discuss. We have also included the number of articles that were used in explaining key important concepts such as Large Language Models (LLM) and Generative Pre-Trained Transformer (GPT) as other topics.

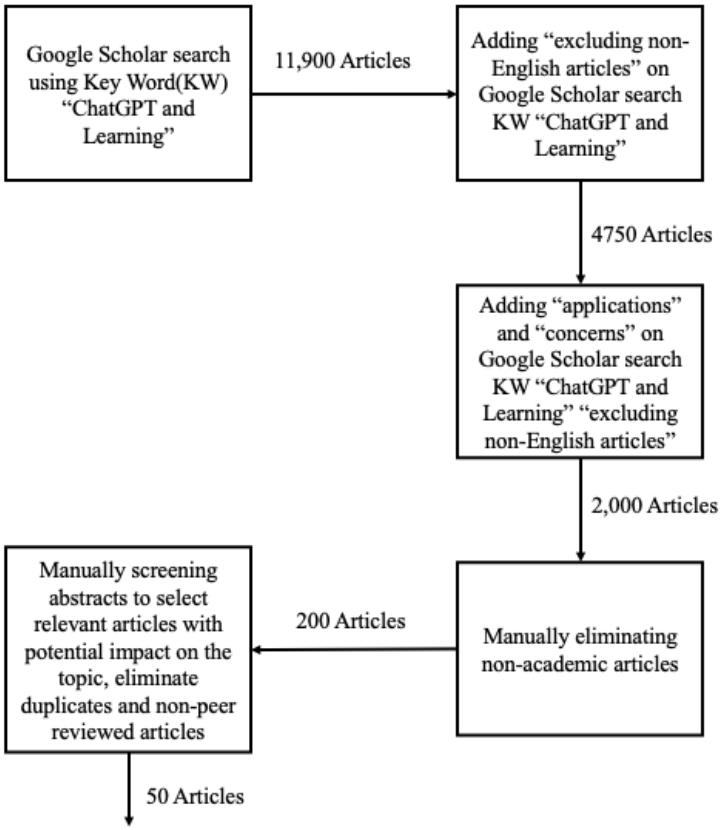

Figure 4. Selection of articles through Google Scholar

Table 2. A summary of inclusion and exclusion criteria for articles reviewed.

Inclusion criteria	Exclusion criteria
A result from the search string "Learning and technology"	Not in the search results using the string "Learning and Technology"
A result from the search string "Learning and chatGPT"	Not in the search results using the string "Learning and chatGPT"
English articles	Non-English Articles
Academic articles	Non-academic articles
Discussing learning and technology, and includes its support or concerns to learning	Do not discuss learning and technology and do not include support or concerns in learning
Discussing learning and chatGPT published since 2022	Discussing learning and chatGPT published before 2022
Addressing RQ1 and RQ2	Not addressing RQ1 and RQ2
Peer reviewed articles	Non-peer reviewed articles

Table 3: Summary of selected articles for the review.

Topics	# of selected articles
Learning and Technology	23
Learning and ChatGPT	47
Others (LLM, GPT)	10

To respond to our two research questions (RQ 1 and RQ 2), the following steps were followed to perform an in-depth analysis of existing literature, organize the selected articles, synthesize the knowledge gathered and provide a critical discussion responding to the two research questions in the introduction:

A. We conducted an in-depth analysis of existing literature, selecting articles relevant to our research questions.

B. We synthesized the knowledge gathered from the selected articles and organized them accordingly.
C. We provided an overview of chatGPT's special features compared with other technologies.
D. We presented the potential applications of chatGPT in education.
E. We discussed the implications and concerns of allowing the use of chatGPT in education.
F. Finally, we discussed both sides of the argument to answer our research questions, provided researchers recommendations and our opinion in the conclusion section.

3. Overview of chatGPT

ChatGPT, developed by Open AI [30], is built upon its predecessors GPT-1 launched in 2018 [31], GPT-2 [32], GPT-3 [33], and GPT 3.5 [34]. chatGPT is based on LLM implemented as a Deep Neural Network (DNN) with deep layers of transformers, which are specifically engineered to handle sequential data and have the capability to produce consistent and human-like responses. To reach its potential, a chatGPT model is pre-trained unsupervised on a large corpus of digitized unlabelled text data (books, articles, and conversations among other sources) to learn patterns and relationships in words, phrases, and sentences [35]. The resulting model is then fine-tuned through supervised learning for conversational usage to make it task-specific [31].

The operation principles of chatGPT start with a user prompt or a question to the model through a user interface. The model then uses its accumulated knowledge to generate an appropriate and coherent response, which is then returned to the user who decides from the response to continue the conversation or submit another question just like how two people will hold a conversation.

Training and Fine-tuning

The training process of the chatGPT model begins with unsupervised learning on a vast collection of unlabelled data. For instance, GPT-3 underwent training using over 8 million documents and more than 10 billion words [36]. This training is iterative as depicted in step 1 of Figure 5. During this phase, the model acquires knowledge of patterns and relationships within words, phrases, and sentences.

In Step 2, the pre-trained GPT Model from Step 1 undergoes fine-tuning using a relatively limited amount of annotated data through supervised learning. Figure 5 illustrates this process, where the annotated data consists of selected prompts along with corresponding expected output responses generated by human annotators or developers. These prompts can either be chosen from OpenAI's API requests or created manually. Due to the labour-intensive process and costly nature of manually generating annotated data, the entire process becomes time-consuming, yielding relatively modest outcomes.

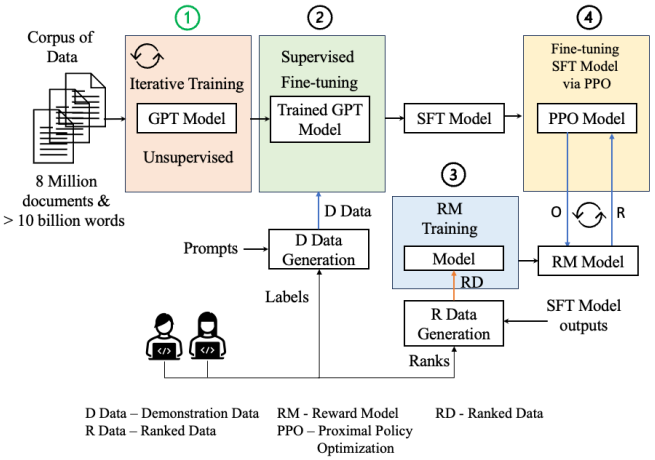

Figure 5. Training chatGPT model.

The result of step 2 is a Shrink and Fine-Tune (SFT) Model. This model suffers three primary drawbacks due to the limited amount of data used in the fine-tuning process.

First, the SFT model might output texts that are very likely not user-attentive, which may result in responses that are limited in addressing the needs or query of the user. The second drawback is misalignment, which causes failure in the SFT model to capture the intricacies of the target domain as the model was insufficiently exposed to less data during fine-tuning. The third drawback is high scalability costs as scalability requires a model that can scale more effectively. To achieve such scalability, more data must be created for finetuning. This process is costly. Generally, small data used in fine-tuning a model will have a huge impact on its performance, leading to generalization failure on new examples, and a struggle to capture more complex queries.

These challenges can be mitigated by expanding the dataset utilized in fine-tuning of GPT Model. Nevertheless, employing human annotators or developers to create a larger dataset proves to be a laborious and costly endeavor. The solution to this problem is steps 3 and 4 where human annotators are used in ranking different outputs of the SFT model and create a data set that is used to train a reward model.

In step 3, outputs from the SFT model selected prompts are ranked best to worst by human labelers, creating a new dataset where the rankings are the labels. Because in this case humans only provide ranks, the process is much faster and can scale up much more effectively. On average, a dataset is 10 times bigger than demonstration data generated in step 2.

The new data created is used in step 3 to create a Reward Model (RM), which is used to fine-tune the SFT model generated by step 2 via Proximal Policy Optimization (PPO).

Step 4 uses reinforcement learning, specifically the PPO algorithm to fine-tune the SFT model by letting it optimize Rank Model. The fine-tuned SFT model at this step is referred to as the PPO model. PPO is an "on-policy" algorithm that uses the trust region optimization method to ensure continuous adaptation of the policy through action from the PPO model (O) and reward (R) from the Rank Model.

4. Potential Application of ChatGPT in Education

The capabilities inherent in chatGPT offer promising opportunities for innovative integration within educational environments. The tool can be a powerful teaching assistant or a tool for creativity and can play a significant role in enhancing student learning.

Researchers have explored the potential benefits of integrating chatGPT into educational systems from two primary perspectives: the student's and the teacher's. In the forthcoming sections, we provide a comprehensive summary of various studies conducted within each perspective, shedding light on the diverse insights and findings.

4.1 Students and chatGPT

ChatGPT emerges as a valuable tool for students, offering enhanced learning experiences. Baidoo-Anu and Ansah [37] claim the tool has showcased its strength to craft content ranging from a brief paragraph to a detailed research work, presenting a convincing or nearly convincing output to earn it several applications in education. A public opinion sought through web mining and Natural Language Processing also presents chatGPT as a useful writing tool for both students and educators [38]. The same findings are also shared with Mogavi et al. [39] where the authors found 78.11% of chatGPT users in their study used it for content creation.

Kasneci et al. [40] explored the application of chatGPT across various educational levels, highlighting its positive impact on student learning,

including the use of chatGPT for the development of reading and writing skills in elementary school students, learning of language, and writing styles for various subjects for middle and high school students, research and writing tasks for university students, facilitate discussions and debates for groups and remote learning and combination with speech-to-text or text-to-speech to empower learners with disabilities. Across all levels, chatGPT can provide summaries, and explanations of complex texts, generate practice problems and quizzes, develop students' research and problem-solving skills, and can be used to span the range of open research questions.

In the study conducted by Dijkstra et al. [41], they developed an end-to-end multiple-choice quiz generator. The researchers observed that many of the generated quizzes demonstrated a high level of coherence and reasonableness. The authors emphasize that their work puts chatGPT as a valuable tool not only for teachers but also for students, enabling them to enhance their learning experience by utilizing quizzes to train and evaluate their knowledge, particularly in the context of exam preparation.

Another use of chatGPT is in open education. The work by Firat explains the potential application of chatGPT in autodidactic students, which encourages independence and autonomy [42]. The study highlights five ways that chatGPT can be instrumental in supporting self-directed learning:

- Provision of personalized support as chatGPT responds to questions and follow-up questions, it adjusts the responses according to students' goals, making the conversation more tailored to the student. Mhlanga [43] and Qadir [44] discuss this support offered by chatGPT as a virtual personal tutor for students.
- Delivery of real-time feedback and guidance, which is necessary for autodidactic learners to stay on task and achieve their goals on time.
- Increased accessibility as chatGPT can be accessed through varieties of devices, providing students with more options to access educational materials compared to conventional means.
- Convenient and flexible learning as chatGPT can be accessed anytime and anywhere at students' convenience with no appointments.
- Self-assessment and reflection as chatGPT offer students a tool they can self-assess and reflect on their progress and learning. The result of the assessment and reflection can be used to pinpoint specific areas that might need more assistance and direction.

Other applications of chatGPT for students have been explored by different researchers through evaluation of chatGPT's performance on academic exams. One notable area of examination is in healthcare education [45]. In this case, chatGPT was tested on the United States Medical Licensing Examination [46]. The performance of chatGPT in this exam demonstrated its proficiency in the field, indicating that students in healthcare education can utilize chatGPT as a valuable tool to enhance their scientific writing skills, promote research equity, and foster versatility in their learning. Further, chatGPT can offer essential assistance to students in personalized learning, allowing students to concentrate on critical thinking and problem-based learning.

Another academic exam taken by chatGPT was a law school exam. Choi et al. [47] administered the test and chatGPT scored an average of a C+ grade. While the analysis of the individual scores on four courses taken showed chatGPT could have been a mediocre law student, the authors saw considerable promise in the use of chatGPT as a tool for practicing lawyers. From this study, the results

showed a promising tool that could improve the performance of struggling law students or those students studying under time constraints for their exams.

Many other studies put chatGPT in the spotlight as a tool that can assist students in learning. For example, Wardat et al. [48] reveal the capabilities of chatGPT in providing students with basic mathematical knowledge on various topics. Philipp Bitzenbauer [49] introduced two practical examples that demonstrate a simple yet an effective integration of chatGPT within physics classrooms. These examples specifically aim to nurture critical thinking skills among secondary school students.

4.2 Teachers and chatGPT

ChatGPT can serve as a valuable tool to augment teachers' efforts in various instructional tasks, enriching the overall learning experience for students. Nonetheless, it is important to note that chatGPT should not be considered a replacement for educators [50, 51]. In this section, we will explore how chatGPT is reported to assist teachers in their instructional practices and training methods.

One way that chatGPT can assist teachers is through the design of learning assessments [52], enhancing pedagogical practice, creating brainstorming ideas and research article outlines, and offering a virtual learning environment [53, 54, 55]. A study by Xiaoming Zhai [51] demonstrated the potential for chatGPT to assist teachers in developing assessments and learning guidance automatically. The study also shows how chatGPT can become useful by suggesting learning materials for learners with special needs to teachers.

Another way chatGPT can be usable by teachers is by assisting them to create quizzes, exams, course syllabus, lesson plans, and other educational resources [37]. ChatGPT can also be used as an automatic grading system in which students' tasks such as research articles, essays, and a wide range of written assignments could be checked for strengths and weaknesses [40]. Undertakings such as creating quizzes and examinations demand a substantial amount of time, and the use of chatGPT can significantly alleviate this time burden for teachers. The time saved can be dedicated to other activities such as designing teaching techniques creatively, encouraging independence, and engaging in ways that meet students' needs [18].

5. Implications and Concerns

5.1 Academic Honesty and Integrity

One major concern in the use of chatGPT by students is academic honesty and integrity, which was raised very early by Stokel-Walker [56]. A recent survey reported about 89% of students in American colleges use chatGPT to complete their homework assignments, among them, 53% seek assistance from chatGPT to write articles, 48% use chatGPT during exams, and 22% use it to write paper outlines [57]. Stanford University presents similar concerns on students' use of chatGPT to complete different assignments [58]. Unless students honestly cite their produced work [59, 60], their submissions are cases of plagiarism, which is becoming hard to detect day by day as chatGPT is becoming more sophisticated producing responses very close to humans as discussed in [61, 62, 63]. This misuse of chatGPT raises a question of unfair learning assessment as judging students on the fairground becomes a challenge.

Similarly, students who have utilized chatGPT and submit high-quality written assignments are more likely to receive better scores than their peers. This unfair assessment has far more repercussions for students than its immediate benefits including the negative impact on students’ emotions. The same applies for students using chatGPT to

generate essays, who might be unfairly admitted in colleges, which raises a huge concern as their writings may not reflect their true level of intellect.

It is also a concern that current anti-plagiarism software tools used today are still lagging when it comes to chatGPT-generated content [64]. Several GPT detectors are becoming available including OpenAI own's tool, GPTZero, Content at Scale, Hugging Face, CrossPlag, Writer AI Content Detector, Draft Goal, and Turnitin, which is also adding GPT detection capabilities.

5.2 Privacy and Bias Concerns

The training of chatGPT is fueled by personal data from the internet without any consent, which is a privacy violation. Wu et al. discuss four privacy risks in chatGPT [65, 66]. This includes privacy leakage due to public data exploitation, privacy leakage due to personal input exploitation, emerging new privacy attacks on Large Language Models and lack of transparency.

Like many other AI tools, bias is another concern for chatGPT users. chatGPT has been trained mostly on internet data, which is not diverse enough and has bias [67]. To fine-tune chatGPT, labeled data is used. However, labelers are usually not representative enough to encompass wide viewpoints. Any bias in the data that is used to train or fine-tune the model will be reflected in the output. The danger in this bias is the unfairness of chatGPT answers specifically for marginalized groups. This bias is presented in work by Caliskan et al. [68], which demonstrated an application of machine learning to ordinary human language results in human-like semantic biases. Bias is also reported by Bolukbasi et al. [69] to exist in natural language processing when word embeddings, a popular framework used to create text data, are used.

6. Integrating ChatGPT in Education

The integration of ChatGPT into the educational system has sparked significant debate since it gained widespread attention in 2022. Researchers, educators, and stakeholders are divided in their opinions on the matter. This review categorizes the analyzed articles into two groups: those advocating for the adoption of ChatGPT in education and those recommending its limitations.

6.1 Embracing chatGPT

Researchers who agree that chatGPT can be effectively integrated into the education system are backed by Trust et al. who suggest that the best approach to combat the misuse of chatGPT is its inclusion into the education system and not its exclusion [70]. To achieve this integration, Trust et al. recommend that educators must find the best ways to incorporate AI tools such as chatGPT into assignments and curricula so students can properly leverage chatGPT to enhance understanding, productivity, comprehension, and creativity.

Similarly, a study by Zhai [51] suggests an adjustment of learning goals that embrace AI tools such as chatGPT as part of the student's learning process if chatGPT must be effectively integrated into education. Zhai also suggests a new form of assessment that limits the use of chatGPT and emphasizes critical thinking and creativity in the follow-up study [65], which also recommends professional knowledge such as pedagogical practice for integrating chatGPT into learning as necessary knowledge to be acquired by teachers to effectively embrace chatGPT.

Geo et al. also believes chatGPT can be a contributing part in education especially after chatGPT proved its ability to write a believable scientific research abstract for high-impact factor journals with completely generated data. However, more must be done to maintain rigorous scientific standards. Geo et al. suggest the inclusion of AI output detectors in the editorial process and clear disclosure if these technologies are used [71].

Cutton et al. [61] acknowledges plagiarism to be the main concern for the integration of ChatGPT in education. However, they suggest that teachers should provide instructions on the assignments that follow a customized submission structure, use rubrics in assessment to ensure students' effort and understanding is fairly assessed, and use manual (in-person) forms of assessment in addition to automatic assessment on the assignments to ensure students' true level of understanding. Cotton et al. continue to suggest strategies that can be used to prevent plagiarism such as educating students on plagiarism, receiving a draft of the assignment for review before final submission, using plagiarism detection tools, setting, and communicating clear guidelines on when and how chatGPT can be used, and finally monitor students work closely.

6.2 Limiting ChatGPT Use in Education

There exists a notable divergence within the academic discussion regarding the integration of chatGPT within educational settings. Some regions have even adopted a more stringent stance, imposing restrictions on its use within schools. A case in point is the decision made by the New York City Department of Education (NYC DoE) in January 2023, wherein they opted to limit the utilization of chatGPT within schools. This decision was motivated by concerns surrounding its adverse impact on student learning, as well as apprehensions regarding the safety and accuracy of its content, as highlighted by Dan [72].

These apprehensions about chatGPT's role in education have spurred numerous educational institutions worldwide to take precautionary measures aimed at curbing its usage by students. Australia has witnessed the prohibition of chatGPT in various school settings, as noted by Cassidy [73]. Similar measures were taken in Paris's top university Science Po [74], RV University in Bangalore India [75], and many more. While behind these restrictions is the encouragement of correct and ethical use of chatGPT, the concerns hanging around many academicians were reinforced by a joint letter signed by well-known figures in tech industries including Elon Musk expressing concerns over AI systems that compete with human intelligence, and recommended a six-month suspension on its use and the cessation of developing large models such as GPT-5 [76].

7. Discussions and Recommendations

From this review, we can observe that different researchers have varying perspectives on chatGPT's applications and concerns in learning, yet many agree that the rapid proliferation of AI technologies, including chatGPT, will exert a substantial influence on education[77]. In the following section, we synthesize and discuss the review in previous sections and provide recommendations articulated by different researchers to answer RQ 1 and RQ 2.

Table 4. Recommendations for embracing of chatGPT in education

Recommendations for Embracing ChatGPT	Articles
Find best ways to incorporate AI tools such as chatGPT into assignments and curricula.	[70]
Adjust learning goals that embrace AI tools such as chatGPT as part of the student's learning process.	[51]
Develop new forms of assessment that limits the use of chatGPT and emphasizes critical thinking and creativity in the follow-up study.	[65]
Provide professional knowledge such as pedagogical practice for integrating chatGPT into learning as necessary knowledge to teachers.	[65]
Inclusion of AI output detectors in the editorial process and clear disclosure if these technologies are used in writing	[71] [61]

Table 5. Summary of potential applications and concerns of integrating chatGPT in education.

RQ 1a	ChatGPT can be used to:	Articles
Potential applications	Facilitate reading, learning languages and writing	[40, 39]
	Develop students' research and problem-solving skills, span the range of open research questions, create summaries, and explain complex tasks	[40], [45], [46], [37]
	Facilitate discussions and debates for groups	[40]
	Empower learners with disabilities by combining it speech-to-text or text-to-speech ability	[40]
	Generate practice problems and quizzes to train and evaluate knowledge	[40], [41], [37]
	Provide personalized support to students as a virtual personal tutor, real-time feedback, increased access, self-assessment, and reflection to autodidactic students	[42], [43], [44], [46], [53]
	Provide cases for practicing lawyers	[47]
	Provide basic knowledge on various topics	[48], [49]
	Design learning assessments, teaching methodologies and guidance automatically	[51], [53], [52] [54], [55]
	Suggest learning materials for learners with special needs	[51]
	Grade assignments automatically and classify students by strengths and weaknesses	[40], [37]
RQ 1b	ChatGPT	Articles
Implications and Concerns	Can provide results that may contain factual errors	[37], [78], [79]
	Can lead to unfairness in high scores earned by students using chatGPT from low scores earned by those who do not use chatGPT	[43], [80]
	Can lead to concerns in academic honesty and integrity in education	[38], [56], [57], [58]
	Can violate privacy and can have bias	[65], [67]

For the first research question, it is apparent to us that most researchers see the potential use of chatGPT in education. Both students and teachers can reap the benefits of chatGPT, which is highly reported to assist in writing tasks. This assistance means less time for teachers in preparation of teaching materials and improved writing skills for students. Other potential applications of ChatGPT are summarized in Table 5. While the benefits are clear for the students, concerns raised by researchers are based on chatGPT's uncontrolled use in learning, which may lead to academic dishonesty. These concerns were reviewed in Section 5 and a summary is provided in Table 5.

For the second question, our review uncovers diverse of opinion from different researchers and stakeholders regarding the integration of chatGPT in education as presented in Section 6. There is a strong advocation from researchers for the careful integration of chatGPT into the education system, and several studies have demonstrated that embracing chatGPT will yield more benefits than restricting its use. These researchers offered several recommendations to such integration as summarized in Table 4.

During our review, we found that relatively few articles provided findings supporting the restriction of chatGPT in education. However, we identified different measures taken by governments in different countries and universities to stop or significantly limit the use of chatGPT by students until a deeper understanding of its capabilities and impact on education is achieved.

Therefore, it is made clear that chatGPT has a lot of applications in education but its uncontrolled use by students is raising concerns. Both its applications and concerns are summarized in Table 5 thus responding to RQ 1.

As for RQ 2, many researchers support the integration of chatGPT into our education system and recommended how to do it as summarized in Table 4. Other education stakeholders felt that more work was needed to address all concerns relating to the use of chatGPT in education and opted a limitation or a complete ban in the use of chatGPT in education.

8. Conclusion

Considering the applications and concerns discussed, we believe that ChatGPT has the potential to revolutionize education for both students and teachers. However, its use must be carefully controlled until all concerns are thoroughly addressed.

In the meantime, we recommend more research efforts to address ethical considerations surrounding the use of chatGPT in education, investigate how it can be integrated into collaborative learning environments, explore the long-term impact of chatGPT integration on students' academic achievement, learning outcomes, and critical thinking skills.

CONTRIBUTIONS OF CO-AUTHORS

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