



The Educational Affordances and Challenges of ChatGPT: State of the Field

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Accepted: 30 January 2024 / Published online: 17 February 2024
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Abstract

ChatGPT was released to the public in November 30, 2022. This study examines how ChatGPT can be used by educators and students to promote learning and what are the challenges and limitations. This study is unique in providing one of the first systematic reviews using peer review studies to provide an early examination of the field. Using PRISMA principles, 44 articles were selected for review. Grounded coding was then used to reveal trends in the data. The findings show that educators can use ChatGPT for teaching support, task automation, and professional development. These were further delineated further by axial sub codes. Eight student uses were 24/7 support, explain difficult concepts, conversational partner, personalized feedback and materials, provide writing support, offer self-assessment, facilitate engagement, and self-determination. In addition to be affordances of the AI, the data from the articles also showed limitations to ChatGPT and misuses, specifically, inaccuracies and hallucinations, potential bias, and tool limitations. Misuses are plagiarism and cheating, privacy issues and spread of false information. This study is a springboard for researchers, practitioners, policy makers and funders in understanding the emerging state of the field of ChatGPT.

Keywords Artificial intelligence · AI · ChatGPT · GenAI · Generative AI · PRISMA · Systematic review

Introduction

On November 30th, 2023, ChatGPT was released to the public. Two months later it was estimated to have reached 100 million monthly active users, making it the fastest-growing consumer internet application in history (Reuters, 2023). ChatGPT is an artificial intelligence tool that generates text for a given response and has been used across society in a variety of settings, including science (Surameery & Shakor, 2023), the military (Biswas, 2023), and healthcare (Sallam, 2023). ChatGPT has quickly moved into educational settings. With a short prompt, ChatGPT can provide customized lesson plans, summarize text, and create test questions that can be used by educators and students to support learning. However, with this powerful tool, students could also use ChatGPT to cheat by having it do the work for them.

With the rapid appearance of this powerful AI program, those in the educational community need to understand exactly how ChatGPT can be used in this context (Fuchs, 2023). Therefore, the purpose of this study is to examine early literature, from November 2022 through to August 2023, on ChatGPT to determine how it can be used to support learning and the misuses and limitations in the educational context.

Background

Artificial Intelligence

The interest in artificial intelligence has grown significantly since the introduction of ChatGPT and other generative AI (GenAI) systems (Bozkurt et al., 2023). However, artificial intelligence is not new, and the term has been used for almost 70 years, since the Dartmouth conference in 1956 (Kline, 2011). Artificial intelligence uses computers to simulate human intelligence, and it trains computers to learn human behaviors such as learning, judgment, and decision-making (Chen et al., 2020). AI is a compilation of computer

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science, logic, biology, psychology, philosophy, and many other disciplines. AI has many processes and applications, such as speech recognition, image processing, natural language processing, proof of automatic theorems, and intelligent robots (Duan et al., 2009).

Generative AI

GenAI has a long history in artificial intelligence, dating back to the 1950s with the development of Hidden Markov Models and Gaussian Mixture Models (Cao et al., 2018). However, it wasn't until the advent of deep learning that generative models saw significant performance improvements. This development has led to rapid growth in GenAI in the last five years (Orchard & Tasiemski, 2023). GenAI uses a very large body of data, such as text, images, and audio to create, new versions of text, and provide data analytics (Euchner, 2023). With these affordances, GenAI has been used in advancements, such as drug development, material science, and chip design (Wiles, 2023). The release of ChatGPT has caused increased interest in GenAI and produced a variety of GenAI tools for many applications in a variety of areas. For example, Autodesk has, for many years, used GenAI to incorporate features into its design software that use goals and constraints set by users to generate and test physical designs (Autodesk, 2023).

ChatGPT

ChatGPT is an artificial intelligence-generated content (AIGC) model developed by OpenAI. Since its November 2022 release, it has attracted worldwide attention for its capability of dealing with challenging language and understanding and generating tasks in the form of conversations (Wu et al., 2023). ChatGPT is based on GPT 3.5, one of the largest Large Language Models (LLMs) with more than 175 billion parameters and is trained on a diverse set of approximately 570 GB of internet texts (Shen et al., 2023). ChatGPT gained one million users in its first week after launch, and in the initial months gained an estimated 1.6 billion monthly website visitors, and 100 million active users (Robert and Cai (2023). With the variety of applications that ChatGPT can provide, it has been used in numerous contexts including medicine (Sedaghat, 2023), business (Alshurafat, 2023), the military (Biswas, 2023), publishing (Nigel, 2023), and academia (Firaina & Sulisworo, 2023).

ChatGPT and Education

ChatGPT is a versatile tool that can be used in multiple ways in education by both teachers and students (Grassini, 2023). Some of the affordances provided by ChatGPT include providing personalized learning experiences, adaptive testing,

and predictive analytics (Montenegro-Rueda et al., 2023). One of the advantages of ChatGPT is that it can be used across all learner levels, from primary grades through higher education (Rahman & Watanobe, 2023). In addition, it can be used in educational disciplines such as medicine (Sedaghat, 2023), law (Choi et al., 2023), journalism (Pavlik, 2023), and engineering (Qadir, 2022).

While ChatGPT is being championed as a tool that has the potential to transform and revolutionize education, there are numerous concerns and risks involved in its use. One of the most frequently stated concerns regarding the use of ChatGPT is the possibility of plagiarism and cheating (Lodge et al., 2023). Other concerns such as bias and equity issues indicate the need for educators to be informed about both the power and the potential challenges of the use of ChatGPT (Kasneji et al., 2023; Nikolic et al., 2023).

Extant Literature

Although ChatGPT has only been available for use since November 30, 2022, there has been significant interest in the opportunities that ChatGPT can provide in educational settings. Researchers have presented an early look at what possibilities ChatGPT can provide. Three studies reviewed the extant literature between November 2022 and February 28, 2023. A fourth study extended its review through June 2023.

Lo (2023) conducted a rapid review of the literature and reviewed 50 articles written by the end of February 2023. The results of this review provided the countries of study, the type of publication, how ChatGPT was used in different subject domains, and how it can be used to enhance teaching and learning. This early review of the literature was important; however, over half of the 50 articles (32) were published as preprints, indicating that they had not gone through a rigorous peer-review process. Ipek et al. (2023) reviewed 40 articles written through February 15, 2023. They identified how ChatGPT can be integrated into education and identified possible problems. Sallam (2023) reviewed 60 articles published through February 16, 2023. These researchers focused specifically on the use of ChatGPT in healthcare practice, healthcare education, and academic writing. As with Lo many (one-third) of the articles in the Sallam study were preprints, lacking a rigorous peer review.

Finally, Montenegro-Rueda et al. (2023) reviewed publications through June 2023. These authors only included articles that were peer-reviewed and those that were written in either English or Spanish. The results revealed the countries in which the research took place and the advantages and disadvantages of the use of ChatGPT in education. However, the study only examined 12 studies, providing only a brief snapshot of studies in education. While all these systematic reviews have begun the process of analyzing the research

regarding ChatGPT, they all call for further research in this area. Time is needed to fully explore the potential of ChatGPT as well as the misuses and limitations.

Purpose

The purpose of this study is to respond to this call for further research and investigate how ChatGPT could be used in education across all learner levels. This includes how educators could use ChatGPT to help with their teaching responsibilities, such as developing lesson plans, test questions, and develop pedagogical/andragogical activities. Concomitant exploration into student use reveals how this tool can be used by students to promote learning. This study will also explore the challenges and limitations of ChatGPT at this time, recognizing that ChatGPT is constantly being revised.

Therefore, the main question guiding this study is: How can ChatGPT be used to promote learning and what are the challenges and limitations? Three sub-questions further refine this examination:

1. What are the ways educators can use ChatGPT to support teaching responsibilities?
2. What are the ways students can use ChatGPT to support their learning?
3. What are the limitations of ChatGPT and how can it be misused?

Method

To answer the three questions driving this study, a configurative systematic review (Page et al., 2021; Thomas & Harden, 2008) methodology was utilized to gain early information on how ChatGPT can be used in education. The PRISMA extension Preferred Reporting Items for Systematic Reviews and Meta-Analysis for Protocols (PRISMA-P; Moher et al., 2015) was used to direct this systematic review. In addition to the PRISMA protocol, the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA principles; Page et al., 2021) were used to report the procedure for searching, identifying, and selecting the information to be included in this systematic review (Moher et al., 2015, PRISMA Statement, 2021).

Following the selection of the inclusion studies, qualitative grounded coding (Strauss & Corbin, 1994) was used to unpack the information gathered to answer the three research questions. This inductive, constant comparative, iterative method was used to examine themes and allowed the researchers to generate new theories from the collective understanding (Gough et al., 2017) of how ChatGPT could be used in the educational context.

Search Strategy

Literature from November 30th, 2023, when ChatGPT was released until 1st August was gathered for this study. Data was retrieved via an electronic search of the databases Wiley Online Library, JSTOR, Science Direct, and Web of Science. From the three research questions, the Boolean search included the terms ChatGPT and Education, searched as [ChatGPT AND Education]. The electronic search included a request for only peer-reviewed articles and identified the dates to be included. The search resulted in 210 possible studies for inclusion in this systematic review.

Inclusion and Exclusion Criteria

From the 210 studies, 20 duplicates were removed. This reduced the number of studies to 190. Those remaining articles were then examined against the inclusion/exclusion criteria in Table 1.

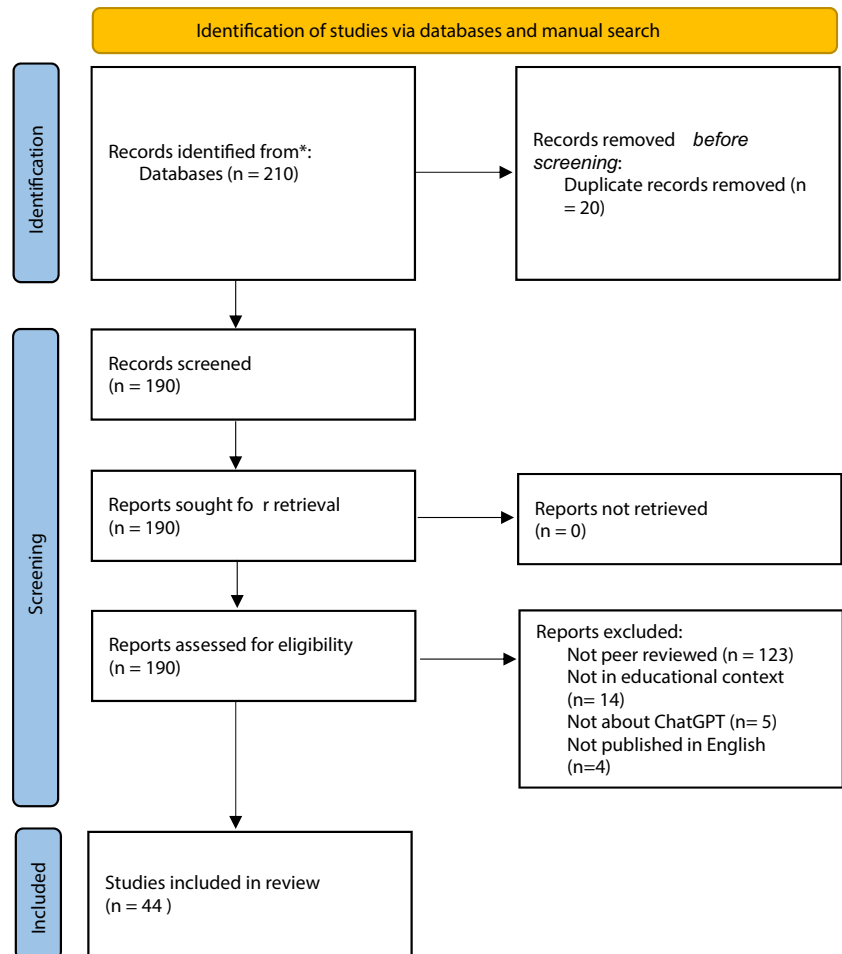
Two researchers independently reviewed each article against the inclusion and exclusion criteria to determine inter-rater reliability. Calculated using percentage agreement (Belur et al., 2021), researchers arrived at a 97% inter-rater agreement. In examining and discussing the misaligned articles, a 100% agreement was achieved. The inclusion and exclusion criteria resulted in 166 studies being removed, leaving 44 articles for final inclusion in the systematic review. Figure 1 provides a chart of the numbers following the PRISMA principles.

Coding

Grounded coding (Strauss & Corbin, 1994) was used to analyze the data in the articles to specifically look for ChatGPT and 1) how it can be used to support teaching and learning,

Table 1 Inclusion/exclusion criteria

| Inclusion | Exclusion |
|---|---|
| <ul style="list-style-type: none"> • Peer-reviewed journal articles • Involves education • Includes the use of ChatGPT in teaching and/or learning • Literature published between 30th November- 1st August • Published in English | <ul style="list-style-type: none"> • Learning about ChatGPT and not using ChatGPT for learning |

Fig. 1 PRISMA study identification process

2) how it can be misused, and 3) the limitations of ChatGPT in the educational context. “In vivo” (Saldana, 2015) coding was also used which involves using language from the primary document, which ensured consistency with the primary authors’ intent. With the grounded coding design, a constant comparative method was used to identify important text from the articles. Through an iterative, inductive, process, the initial codes led to axial codes to further examine the specifics of the affordances/challenges. The coding was deemed theoretically saturated when the data on affordances/challenges fit with one of the codes. To provide confidence in the codes, two researchers were involved in the coding and reached an inter-rater agreement of 97%. The misaligned articles were then discussed which resulted in 100% agreement.

Findings and Discussion

This section is organized by the three questions guiding this study. The first question examined how educators can use ChatGPT. The second question investigated how students

can use ChatGPT and the third question explored the limitations and possible misuse of ChatGPT.

RQ1. What are the Ways Educators Can Use ChatGPT to Support Teaching Responsibilities?

The findings from the grounded coding of each of the 44 articles revealed that ChatGPT can be used in a wide variety of ways to support the activities that educators are responsible for. Three overarching codes emerged from the studies: 1) Teaching support, 2) Task Automation, and 3) Professional Development. These were extended further by axial codes providing more detail. Figure 2 provides a visual of the educator codes and axial codes. Studies by earlier researchers (viz., Ipek et al., 2023; Lo, 2023; Montenegro-Rueda et al., 2023) cited similar ways in which ChatGPT can support teaching responsibilities. However, Ipek et al. (2023) and Montenegro-Rueda et al. (2023) did not differentiate between the support that could be provided specifically for teachers. Lo (2023) only provided two categories of uses for teachers, teacher preparation and assessment.

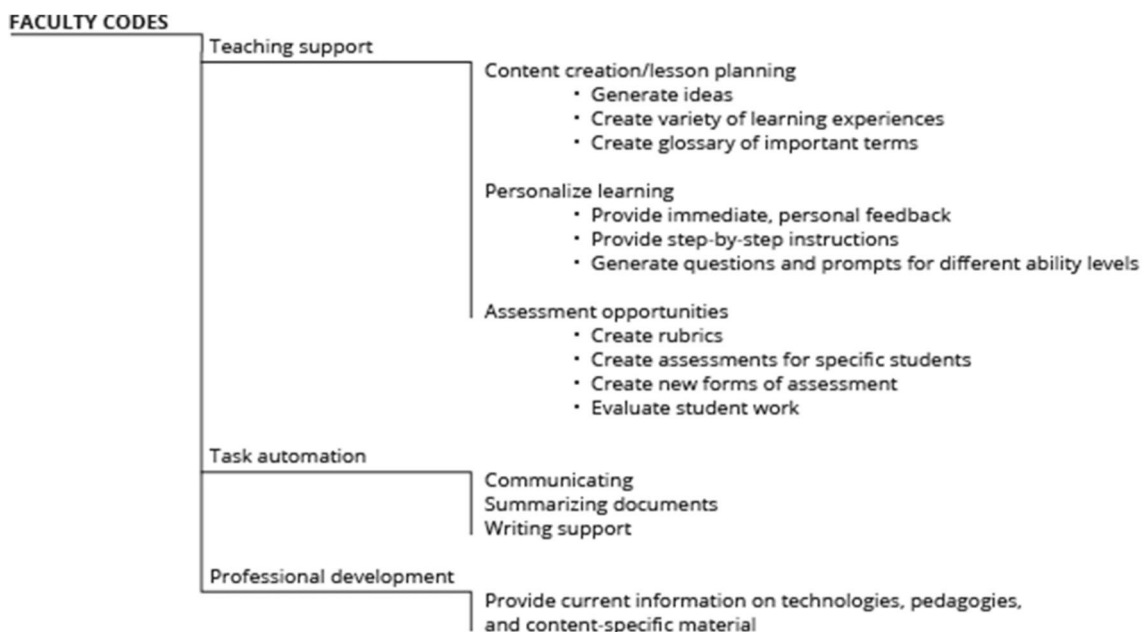


Fig. 2 Faculty affordances to using ChatGPT

Teaching Support

Three axial codes emerged from the coding of how ChatGPT can support teaching. These include 1) content creation/lesson planning, 2) personalizing student learning experiences, and 3) assessing student learning. ChatGPT can assist teachers in the creation of content, lesson plans, and learning activities (Lodge et al., 2023; Trust et al., 2023). From a holistic perspective, ChatGPT could be used to create an entire course syllabus (Kasneci et al., 2023). At a more granular level, it can draw on its vast knowledge of educational fields and aid in the generation of specific lesson plans or specific learning activities (Bonner et al., 2023). Topsakal and Topsakal (2022) suggest using ChatGPT to generate dialogues that students can use in learning a foreign language. Cooper (2023) involves generating ideas for science units using the 5Es model. Across disciplines Cotton et al., (2023) posited the use of the tool to create interactive games and use chatbots or virtual assistants that can challenge students to solve problems or answer questions through natural language interaction.

One of the challenges all teachers have is personalizing student learning and adapting their instruction to meet the varying needs of their students. The data show that ChatGPT can assist in helping teachers to provide personalized learning experiences for their students in a variety of ways. ChatGPT can level student texts topically, lexically, and syntactically (Bonner et al., 2023). By providing ChatGPT with specific instructions about the desired grade level, length of the passage, and a specific topic, teachers can create

passages that are well-suited to the needs of the learners. ChatGPT has the potential to provide learning tasks at different levels of complexity (Farrokhnia et al., 2023). Kasneci et al. (2023) suggest that teachers can use ChatGPT to analyze student's writing and responses and provide tailored feedback and suggest materials that align with the student's specific learning needs. They also suggest that teachers can generate questions and prompts that encourage participation at different knowledge and ability levels and elicit critical thinking and problem-solving.

Trust et al. (2023) state that ChatGPT can be used by teachers as an individual tutor for a student in any subject, providing research support, directions, and explanations about complex topics at a more accessible level. ChatGPT can serve as a teachable agent that encourages students to learn by teaching ChatGPT a concept through a text-based conversation. Finally, teachers can personalize learning by having ChatGPT provide recommendations for resources, such as books tailored to the student's needs and interests (Cotton et al., 2023).

Assessment of student learning plays an important role in teaching. A well-developed assessment can help teachers identify students' academic understandings and issues, and then provide appropriate assistance or guidance (William et al., 2004). It appears from the data that ChatGPT can assist in developing a variety of methods of assessing student learning. Some of these methods include generating targeted and personalized practice problems and quizzes, which can help to ensure that students are mastering the material (Kasneci et al., 2023; Qadir, 2022; Mizumoto & Eguchi, 2023).

Other methods include creating rubrics that students can use to self-assess their learning (Cooper, 2023) and creating different forms of tests such as multiple choice, and constructed response (Zhai, 2022).

Task Automation

The ability of ChatGPT to automate numerous tasks holds great potential to considerably decrease teachers' busy workload (Farrokhnia et al., 2023). The coding of the articles revealed three specific axial codes that involve task automation: 1) communicating, 2) summarizing documents, and 3) writing support. As teachers spend significant time communicating with a variety of constituencies, ChatGPT can assist in automating these tasks. Trust et al. (2023) suggest using ChatGPT to draft emails, write text messages in different languages to send to students' family members, or provide text for a classroom newsletter or website to keep students and family members up to date.

Halaweh (2023) states that ChatGPT serves as an effective tool to aggregate and summarize information. This can be beneficial to teachers in saving time and effort that may have otherwise been spent on searching through hundreds of web pages and databases, downloading files, and filtering them. Data also show ChatGPT supporting as a proofreader and editor. It can quickly and efficiently identify and rectify grammatical errors, incorrect spelling or punctuation, awkward sentence structures, and stilted syntax. In addition, it can assist with word choice, and suggest alternative phrasing (Sun & Hoelscher, 2023).

Professional Development

The final axial code for task automation is professional development. This describes the way ChatGPT can provide information on a wide range of topics, from general research to specific assignments to support educators gain new information (Yorio, 2023). This access to information can allow educators to stay current regarding new technologies, pedagogies, and content area-specific information. This immediate access to the most current resources can contribute to teaching effectiveness. Kasneci et al. (2023) state that these resources can be used to improve the clarity of teaching materials, locate information or resources that educators may need as they learn on the job, as well as used them for on-the-job training.

As ChatGPT and other GenAI systems continue to become incorporated into teachers' practice, researchers need to continue to explore further uses of these systems. This exploration should expand to investigate use with specific student populations and with specific subject matter content, as uses will vary depending on the context in which ChatGPT is used.

RQ2. What are the Ways Students Can Use ChatGPT to Support Their Learning?

The findings from the grounded coding of each of the 44 articles revealed eight codes that support student learning: 1) provide 24/7 support and accessibility, 2) explain difficult concepts, 3) act as a conversational partner, 4) provide personalized feedback and materials, 5) provide writing support, 6) allow self-assessment, 7) facilitate student engagement, and 8) facilitate self-determination. Furthermore, axial codes provided further specifics on the eight codes. Figure 3 provides a visual of the student codes and axial codes. It is interesting to note that the first 6 areas are affordances that are commonly attributed to ChatGPT; however, the final two, student engagement and facilitating self-determination are less commonly and provide two new research opportunities to explore the use of ChatGPT. Previous researchers (viz., Ipek et al., 2023; Lo, 2023; Montenegro-Rueda et al., 2023) investigated the uses of ChatGPT as tools for students. However, Ipek et al. (2023) and Montenegro-Rueda et al. (2023) reported broadly about the uses for both students and teachers and did not differentiate by user. Lo (2023) only provided two categories for students, learning and assessment.

24/7 On-Demand Support and Accessibility

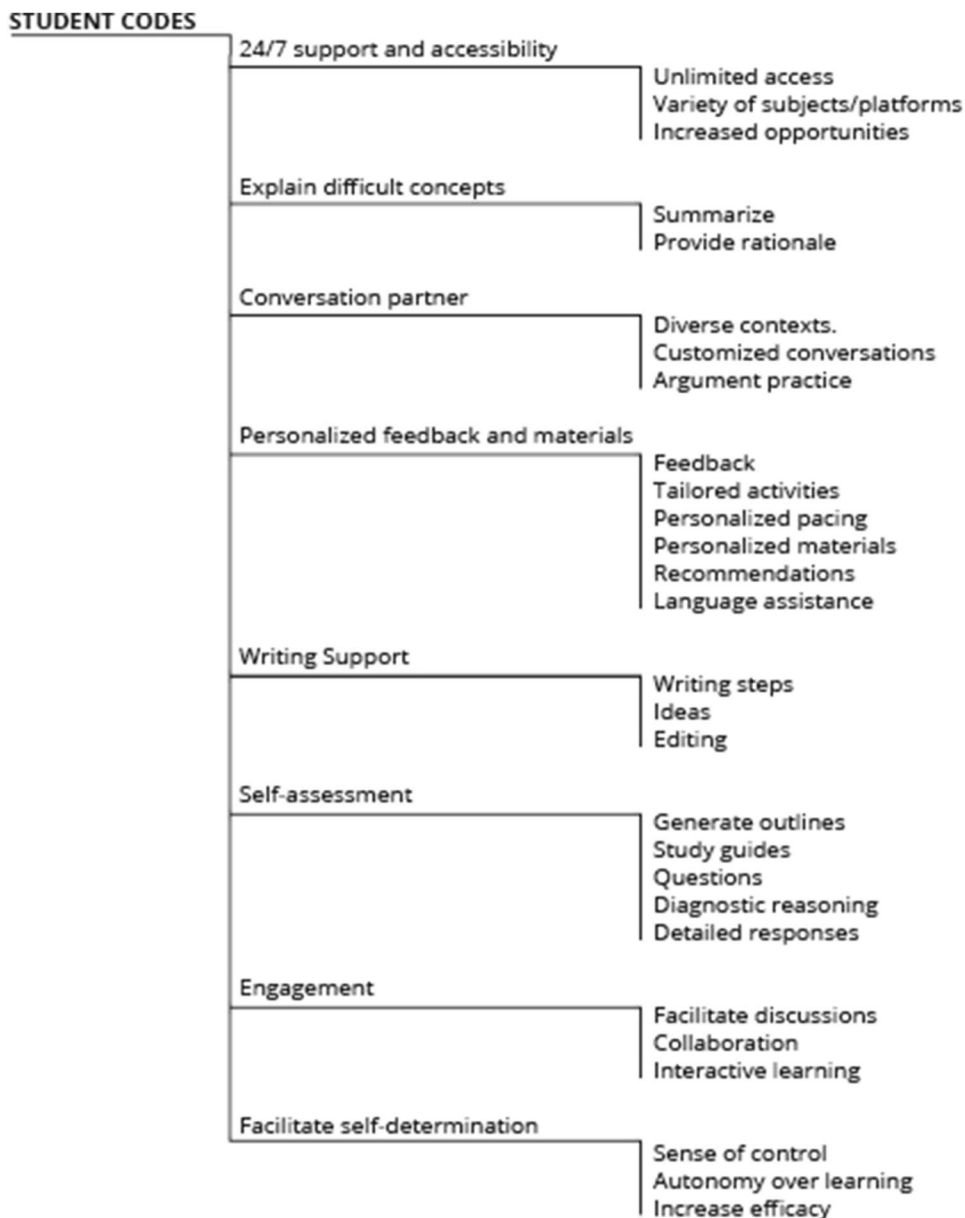
The data show that as ChatGPT is available around the clock 24 h every day, students can access ChatGPT as a tool for learning at any moment in time. Sun and Hoelscher (2023) state that this unlimited access provides students a unique opportunity to receive immediate answers to questions and be promptly directed toward relevant resources. Farrokhnia et al. (2023) maintain that ChatGPT can offer students easy access to information through a variety of platforms (e.g., a website or a smartphone app) and in a variety of subjects. They posit that is a more efficient tool compared with traditional search engines as ChatGPT offers written answers rather than just a list of sources.

Accessibility for learning opportunities for students with disabilities is greatly enhanced by ChatGPT. ChatGPT can empower learners with visual impairments by providing speech-to-text or text-to-speech solutions (Kuzdeuov et al., 2023). Additionally, it can adapt writing, translate, and highlight important content in various formats (Trust et al., 2023).

Explain Difficult Concepts

ChatGPT can explain difficult or complex topics assisting students in their understanding of difficult content. ChatGPT can summarize text at the appropriate language level and provide a written summary of the content to help facilitate student understanding (Bonner et al., 2023). Sun and Hoelscher

Fig. 3 Student affordances to using ChatGPT



(2023) explain that the use of sophisticated algorithms for keyword extraction, sentence scoring, text compression, and advanced language comprehension capabilities allows the generation of succinct yet comprehensive summaries of lengthy articles, texts, or documents. This can be a useful tool for students who need to quickly navigate through extensive materials. They also state that ChatGPT can enhance students' grasp of complex concepts by efficiently outlining rationales explaining those concepts.

Conversation Partner

ChatGPT has the capability to serve as a conversation partner with students. Extant studies show that this is a particularly

effective tool for learning foreign languages. Designing conversations as a teaching activity is a very important, yet challenging, and time-consuming task. Topsakal and Topsakal (2022) state that ChatGPT is particularly valuable in producing high-quality, customized, and personalized conversations for students to use. Although the use of conversation partners is most evident in language learning, this can be used in a variety of different content areas. A study by Bayat et al. (2022) described how ChatGPT can provide students with valuable opportunities to improve their argumentation skills through low-stakes practices. Students can take one side of the debate and ask ChatGPT to take the other side, presenting their points and having the ChatGPT rebut them (Bozkurt et al., 2023). As ChatGPT functions by taking in a user's

input and using its language model to generate a response, it can serve as a conversational partner in any educational context.

Provide Personalized Feedback and Materials

ChatGPT operates on a one-to-one basis with the user. It appears that this can be used to personalize individual students' learning experiences. These personalized learning experiences include providing feedback and generating questions and providing practice problems, explanations, and assessments that are tailored to the student's level of knowledge so that they can learn at their own pace. (Trust et al. 2023). Others include creating appropriately leveled topical texts when provided with specific instructions about the desired level, length of the passage, and a specific topic (Bonner et al., 2023). ChatGPT can also recommend books and other materials based on a student's reading level, interests, and reading history. Finally, ChatGPT can provide language assistance for non-native speakers (Yorio, 2023). This allows students to focus on the learning content and not have to navigate translating the content beforehand.

Writing Support

As the ability to communicate in writing is a skill that transcends all content areas, ChatGPT's capacity to assist students in developing their writing skills is an important benefit. Across disciplines, Sun and Hoelscher (2023) posit that ChatGPT can efficiently and effectively identify and correct grammatical errors, awkward sentence structures, stilted syntax, and incorrect punctuation or spelling. For students needing help starting writing, ChatGPT can be used to brainstorm writing topics and content to help facilitate the writing process (Zhai, 2022). For those studying writing, Anders and Sahakyan (2023) posited that ChatGPT can help students with each of the seven steps of the writing process: (a) choosing a topic, (b) brainstorming, (c) outlining, (d) drafting, (e) soliciting feedback, (f) revising, and (g) proofreading. ChatGPT can assist with word choice, suggest alternative phrasing, and help maintain a consistent style and tone in the student's writing, ensuring a preferred voice and presentation.

Self-Assessment

Students' ability to assess their level of understanding regarding specific content is an effective learning strategy, and the data show that ChatGPT could assist in this process. Self-assessment strategies provided by Sun and Hoelscher (2023) include generating outlines, study guides, and study questions. They also suggest having ChatGPT create open-ended questions for critical thinking and diagnostic

reasoning, as well as providing detailed responses with rationale for each question. Finally, they suggest that ChatGPT can produce multiple-choice questions with correct answers and an accompanying rationale. These features can be valuable tools for students to help reinforce their understanding of specific content and better prepare them for exams.

Student Engagement

It was interesting to see student engagement emerge as a trend in the data, specifically how ChatGPT can be used to improve student engagement and participation. In Trust et al.'s (2023) paper on ChatGPT, they note that ChatGPT can facilitate group discussions and debates by providing a discussion structure, real-time feedback, and personalized guidance for students during discussions. They also suggested collaborative writing activities, where multiple students work together to write a document or a project. Yorio (2023) provides an additional example where ChatGPT can be used to create interactive learning experiences, such as virtual book clubs or author visits.

These types of learning opportunities and interactions can help students feel more connected to the material and can lead to a deeper understanding of the subject concepts (Nikolic et al., 2023). The conversational style of ChatGPT can make the learning experience more engaging and enjoyable for students, reducing the boredom and disinterest that can arise in traditional lecture-style teaching.

Facilitate Self-Determination

The grounded coding revealed a trend of ChatGPT and self-determination. This is a unique find as it has not appeared in prior systematic reviews that used a pre-determined set of criteria that the researchers were looking for. This is an important find as we understand the human technology interactions. The coding showed that while using ChatGPT it was supporting students' basic psychological needs of autonomy, competence, and relatedness which lead to helping facilitate self-determination (Geary et al., 2023). Crawford et al. (2023) maintain that ChatGPT can provide students with a sense of control and psychological autonomy by providing them with more control over their learning. ChatGPT-3 can do so by placing autonomy in the hands of the students and supporting students by bolstering their feelings of competence by equipping them with the skills and resources needed to be successful learners.

What is new in this study is the emergence of two new areas as AI is supporting students with student engagement and self-determination. Both areas can play powerful roles in increasing student learning (Erdogdu, 2019; Tian & Park, 2022). Exploring how ChatGPT can facilitate

student engagement and self-determination are important for researchers to explore further. Additionally, continued investigation into the how ChatGPT can be used as a tool to support student learning specific populations and subject matter. Different contexts will necessitate different uses and strategies for optimal success.

RQ3. What are the Limitations of ChatGPT and How can it be Misused?

Although ChatGPT is a powerful tool for learning, it has limitations and the potential for misuse. The grounded coding from this research study revealed the following limitations, 1) Inaccuracies and hallucinations, 2) Potential bias, and 3) Tool limitations. Misuses include 1) Plagiarism and cheating, 2) Privacy issues and 3) Spread of false information, see Fig. 4. Other researchers (Lo, 2023; Montenegro-Rueda et al., 2023; Sallam, 2023) raised similar concerns regarding limitations and potential misuses of ChatGPT; however, their analysis was limited. Sallam (2023) only reported concerns regarding healthcare education. Montenegro-Rueda et al., (2023) & Lo (2023) only discussed cheating and accuracy concerns.

Limitations

Inaccuracies and Hallucinations

A significant limitation of ChatGPT is found in inaccuracies and hallucinations in the output provided. The term hallucinations is often used when ChatGPT generates output that provides many details that appears that ChatGPT

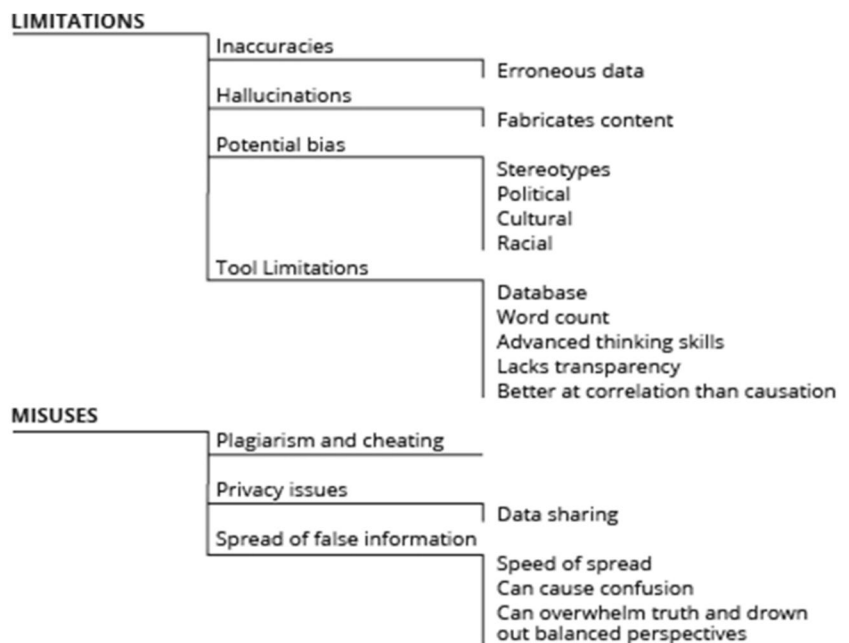
understands what is being asked and can provide an answer; however, the information is wrong. From the studies, authors found both inaccuracies and hallucinations.

When Naidoo (2023) asked ChatGPT to generate a paragraph about research on employee recognition, with a reference list for the citations, it generated relevant text with citations that looked plausible but did not exist. Specifically, four out of the five references it generated were fake. Wang (2023) quizzed ChatGPT on a nonformulaic conceptual question in quantum mechanics. The answer given was wrong and ChatGPT cited a nonsensical reason for the answer. Dennings (2023) described attempts by people to request self-biographies and were provided with a description of a person that did not match who they were.

Potential Bias

Another limitation from the data appears to show ChatGPT perpetuating biases. As a machine learning model, ChatGPT has been trained on a large body of data, and any biases present in that data will be reflected in the output created by the model. If the training data contains stereotypical gender roles or political, cultural, or racial biases, ChatGPT’s output will most likely reflect these biases (Nikolic et al., 2023). Therefore, it is important to ensure that the training data or the data used for updating the model is representative of different groups of people and diverse. Regular monitoring and testing of the model’s performance on different groups of people could help identify and address any biases early on. Human oversight in the process is indispensable and critical for the mitigation of bias of large language models in education (Kasneci et al., 2023). Nonetheless, humans perhaps

Fig. 4 Limitations and misuses of ChatGPT



need to remain cognizant of their own bias each time they attempt to ameliorate that bias as humans introduced bias in the first instance.

Tool Limitations

The review of the literature revealed four tool limitations regarding the use of ChatGPT. 1) database currency 2) word count, 3) lack of transparency, and 4) lack of higher-level thinking skills. The first limitation is database currency. The current iteration of ChatGPT has a knowledge base cutoff date of 2021, which limits its capability to provide, summarize, or synthesize accurate and current information. Sun and Hoelscher (2023) share that this is a particular concern for educational settings that rely on the most current data, such as, medical environments. The second limitation is word limits. ChatGPT has a word limit for the input it can process, and while this is often increasing, it limits current users from being able to input entire articles or book chapters. To navigate this issue, Sun and Hoelscher (2023) recommend break large text into smaller sections and inputting a section at a time. The third limitation is the perceived lack of transparency of how ChatGPT creates and provides output (Masters, 2023). When AI developers are asked to explain their algorithms, and they do not, it is not because they do not wish to; it is because they cannot. In this ‘black-box scenario, no-one knows to the full extent how the algorithm is functioning. Haggart (2023) cautions that unlike a book, which provides information about the publisher, the author, and the author’s sources that can be reviewed to determine its trustworthiness, ChatGPT is a set of algorithms that lack transparency and traceability.

A fourth limitation uncovered from the literature is that it appears ChatGPT is less competent when it comes to content that requires higher-order thinking skills, such as critical and analytical thinking. Farrokhnia et al. (2023) explain that this is the result of the high dependency of AI tools on the data that are trained without a deep understanding of context, emotions, and common sense, which are critical for higher-order thinking. This lack of the ability to process higher-order thinking skills results in ChatGPT being better at correlations than understanding causations. ChatGPT breaks words, sentences, paragraphs, and texts into data and looks for patterns of words and sentences that tend to appear together in certain situations. In Wang’s (2023) study of the use of ChatGPT in physics, he found that ChatGPT can interpret simple physics problems, assume relevant parameters, and write correct codes; however, it was wrong when answering conceptual questions. Haggart (2023) cautions that it is possible that LLMs like ChatGPT could create a completely new form of knowledge, one in which correlations confer legitimacy, and in which the evaluation of the

truthfulness of these correlations occurs behind the scenes, embedded in programming decisions and hidden labor.

Misuses

Plagiarism and Cheating

The review of the research in this study revealed that the most often misuse cited regarding ChatGPT was plagiarism or cheating, consequently creating threats to academic integrity. In a poll of more than 4,000 Stanford students, 5% of the respondents reported submitting materials directly from ChatGPT for assignments without any additional editing (Cu & Hochman, 2023). Although cheating and academic integrity are not new considerations in education, it is important to note that ChatGPT has lowered the barriers to engaging in cheating behavior and the ability to detect cheating has become significantly more difficult, if not impossible (Lodge et al., 2023). Garg and Goel (2022) share the example of cheating occurring in general online assessment security and specifically cheating on online exams. Another opportunity for plagiarism is the ability to have ChatGPT create text and then submit the text as one’s own. In a survey featuring data from more than 1,000 students who were older than 18, 53% reported using ChatGPT to write an essay for class (Study.com, 2023).

While the challenge of easily accessible opportunities to cheat is available by using ChatGPT, researchers are not calling for restricting its use, but rather they are calling for the need to educate students and provide guidelines to ensure the proper use of ChatGPT (Cotton et al., 2023). Another option would be a call to educators to rethinking how students are assessed. Some options include assessment approaches that develop students’ skills in presentation and defense, evaluating information, correcting information, referencing work, and developing new creative ideas (Lodge et al., 2023).

Privacy Issues

Users’ privacy when accessing ChatGPT is a concern for possible misuse. OpenAI’s privacy policy for ChatGPT indicates that the company collects information from the user, including log data, usage data, cookies, device information, IP address, interactions with the site, and date and time of use. The policy states that this information may be shared with vendors and service providers, law enforcement, affiliates, and other users. While users can request to have their data deleted, OpenAI will not delete any prompts a user inputs. If a user inputs a sensitive prompt, such as giving personal details about a medical condition or mental health issue, OpenAI keeps a permanent record of that input (Trust et al., 2023). There is the potential that this information could be used to compromise users’ privacy.

Spread of False Information

Another misuse of ChatGPT is its ability to spread misinformation quickly and easily. When asked to produce false narratives for 100 controversial topics, ChatGPT obliged 80% of the time (Brewster et al., 2023). This presence of false information can create both confusion and exhaustion by saturating resources with material that overwhelms the truth or at least drowns out more balanced perspectives (Bell, 2023).

This study provides a robust look at the potential limitations and misuses of ChatGPT. The presence of concerns regarding the use of ChatGPT serves as a caution to both users and researchers. As with all technologies, humans need to be the primary determiners of practical and ethical applications. This is particularly true with ChatGPT, as its use is in the nascent stage and there is still much to be learned about its power and potential pitfalls.

Gaps and Future Research

This study examines the first eight months following the release of ChatGPT. Researchers (Ipek et al., 2023; Lo, 2023; Montenegro-Rueda et al., 2023; Sallam, 2023) called for more research in the use of ChatGPT in education. While this study provides further information, more is needed to determine the potential and pitfalls of ChatGPT in the educational context to consider the changes to the technology and as educators and students navigate the use of the tool. This study only included peer-reviewed articles. Again, due to the fast-moving environment in which ChatGPT finds itself, authors might consider investigating the grey literature regarding ChatGPT. The studies in this review were only those published in English. As ChatGPT is a tool being used worldwide in a variety of languages, researchers could consider investigating articles published in languages other than English. Finally, this study focused only on the use of ChatGPT. Since its availability, numerous other similar GenAI tools have been made available, i.e., Bard, Claude, and AppleGPT. Future researchers could examine the tools collectively or in comparison studies.

Conclusion

This study answered the call for further research into how ChatGPT could be used in education and the challenges and limitations. This study is unique in providing a review that examines specifically how ChatGPT can be used by educators and a separate review of how it can be used by students.

Extant studies have been using non peer review data as there was not enough evidence early in the immediate months following the release of ChatGPT. At this time, there is enough peer review evidence to provide a more detailed rigorous understanding of this tool.

The findings revealed three codes for educator use, that educators of all ages could use ChatGPT for 1) Teaching support, 2) Task Automation, and 3) Professional Development. The grounded coding of student use revealed eight codes, as ChatGPT could be used to 1) provide 24/7 support and accessibility, 2) explain difficult concepts, 3) act as a conversational partner, 4) provide personalized feedback and materials, 5) provide writing support, 6) allow self-assessment, 7) facilitate student engagement, and 8) facilitate self-determination. In addition to be affordances of the AI, the data from the articles also showed limitations to ChatGPT and misuses, specifically, 1) Inaccuracies and hallucinations, 2) Potential bias, and 3) Tool limitations. Misuses include 1) Plagiarism and cheating, 2) Privacy issues and 3) Spread of false information. The study findings are especially useful for researchers, practitioners, policy makers and funders as we move forward with an educational landscape that is now trying to understand AI in education.

Acknowledgements We would like to thank Kris Naro, Lead Graphics Designer at ODUGlobal for creating the graphics.

Authors' contribution DB was involved in the conception, data gathering, and analysis, writing the primary draft and editing. HC was involved in the conception, data gathering, and analysis, writing the primary draft and editing.

Funding The authors did not receive support from any organization for the submitted work.

Data availability Data is available on request to corresponding author.

Declarations

Ethics approval N/A.

Financial interests The authors have no relevant financial or non-financial interests to disclose.

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