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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/riie20

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To cite this article: Mohammadreza Farrokhnia, Seyyed Kazem Banihashem, Omid Noroozi & Arjen Wals (2023): A SWOT analysis of ChatGPT: Implications for educational practice and research, Innovations in Education and Teaching International, DOI: 10.1080/14703297.2023.2195846

To link to this article: https://doi.org/10.1080/14703297.2023.2195846

Published online: 27 Mar 2023.

INNOVATIONS IN EDUCATION AND TEACHING INTERNATIONAL
https://doi.org/10.1080/14703297.2023.2195846

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A SWOT analysis of ChatGPT: Implications for educational practice and research

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ABSTRACT

ChatGPT is an AI tool that has sparked debates about its potential implications for education. We used the SWOT analysis framework to outline ChatGPT's strengths and weaknesses and to discuss its opportunities for and threats to education. The strengths include using a sophisticated natural language model to generate plausible answers, self-improving capability, and providing personalised and real-time responses. As such, ChatGPT can increase access to information, facilitate personalised and complex learning, and decrease teaching workload, thereby making key processes and tasks more efficient. The weaknesses are a lack of deep understanding, difficulty in evaluating the quality of responses, a risk of bias and discrimination, and a lack of higher-order thinking skills. Threats to education include a lack of understanding of the context, threatening academic integrity, perpetuating discrimination in education, democratising plagiarism, and declining high-order cognitive skills. We provide agenda for educational practice and research in times of ChatGPT.

KEYWORDS

Artificial intelligence; ChatGPT; educational technologies; higher education; SWOT analysis

Introduction

Artificial Intelligence (AI) refers to the science and engineering of creating systems that are capable to perform tasks commonly associated with intelligent beings such as learning, judgement, and decision-making (Xu et al., 2021). AI has been shown to be successful in solving complex problems in various domains including education (Ouyang et al., 2022). The application of AI in the natural language processing field has resulted in the creation of intelligent chatbots and virtual assistants capable of both understanding and producing human language (Caldarini et al., 2022). One of the powerful AI-powered chatbots is the 'Chat Generative Pre-trained Transformer' known as ChatGPT. This new AI tool was first made available to the public on November 30th, 2022, and quickly gained over a million subscribers within its first week of release. ChatGPT is developed based on the OpenAI language model and is trained on a large dataset of human conversations, allowing it to perform complex tasks and produce human-like responses (Susnjak, 2022). ChatGPT uses deep learning techniques to

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understand, process, and generate natural human language with a high level of complexity yet fair accuracy and usability (Haque et al., 2022).

Despite its wide range of applications in various domains, the use of ChatGPT has reignited the debate on the potential and risks associated with AI technologies. The introduction of ChatGPT in education has sparked debates about its potential implications for education. While advocates of ChatGPT praise its ability to support education for instance in terms of providing adaptive and personalised environments (Qadir, 2022), some scholars are concerned about the ethical considerations of ChatGPT (Mhlanga, 2023), as well as its potential negative effects on assessment practices (Rudolph et al., 2023), scientific integrity (Cotton et al., 2023; Shiri, 2023), and students' higher-order thinking skills (Susnjak, 2022). In addition, several editorials have been written about how ChatGPT can influence education (Rospigliosi, 2023). These kinds of scientific debates are commonplace when new technologies are introduced into education, as they often disrupt traditional practices and require teachers to adapt to their potential benefits and drawbacks (Qadir, 2022).

Many scholars have written about the potential benefits and concerns for the integration of ChatGPT in education. However, a comprehensive overview is still missing that can establish a theoretical basis for empirical studies aiming to harness the potential of this new AI technology. Such an overview can provide an in-depth analysis of ChatGPT's strengths and weaknesses based on scientific literature and outline the potential opportunities for and threats to education. This review employs the SWOT analysis framework to conduct a thorough analysis of available literature on ChatGPT for education, providing educators and researchers with evidence-informed recommendations on how to effectively leverage this AI technology to enhance teaching and learning practices in higher education.

SWOT analysis framework

SWOT is an acronym that stands for strengths, weaknesses, opportunities, and threats, originally introduced in the early 1950s as a framework to investigate organisational strategies (Benzaghta et al., 2021). This framework has been used widely in education to inform strategic planning and decision-making in situations that require considering the perceptions and capabilities of various actors (Zhu & Justice Mugenyi, 2015).

Based on the SWOT analysis, a successful strategy in adopting new technology in education is to take advantage of the technology's opportunities by building on its strengths and addressing threats by correcting or compensating for its weaknesses. The SWOT analysis provides a clear structure to gather information from various sources and provides an overview of the internal (i.e. strengths and weaknesses) and external factors (i.e. threats and opportunities) that can affect the integration of new technologies in education. Strength is viewed as a resource or a capacity allowing the new technology to achieve its defined goals. Opportunity pertains to internal or external characteristics associated with the technology that increases demand for what the technology can provide for its users. Weakness is a limitation or a defect associated with the technology which impedes progress towards defined goals. Finally, a threat can be any unfavourable characteristics of the technology that impedes its strategy by presenting a barrier or constraint, thereby limiting the achievement of goals.

Guided by the SWOT framework and informed by the available literature, this review provides a comprehensive overview of ChatGPT's strengths, which can help identify its various opportunities for education. It also provides a clear understanding of the weaknesses of ChatGPT to

highlight potential threats that relevant actors may face in the future. This will enable the development of a tailored strategy to effectively manage and eliminate these threats.

Strengths of ChatGPT

The review of scientific literature revealed the following key strengths of ChatGPT.

Generating plausible responses

ChatGPT is a highly advanced language model that uses 'transformer architecture' for a wide range of natural language processing tasks, including language generation and understanding (Xue et al., 2023). This architecture allows AI-powered chatbots to model relationships between words in a sentence, preserving context and generating responses that are both coherent and relevant (Li et al., 2019). ChatGPT's superior performance is largely attributed to its massive amount of training data (Kasneci et al., 2023), enabling it to capture a wide range of linguistic patterns and relationships, thereby providing a fair understanding of language and context (Lecler et al., 2023; Wang et al., 2023). These features allow ChatGPT to provide plausible and seemingly more credible responses than other similar AI tools (Sobania et al., 2023).

Self-improving capability

A unique feature of ChatGPT is its self-improvement or self-learning capability. ChatGPT uses a more complex language processing model compared to other AI chatbots, called generative pre-training (GPT). GPT is an AI text generator that uses reinforcement learning from human feedback to inform its language model (Mann, 2023). This capability enables ChatGPT to adjust and improve its responses based on input from human evaluators (Shen et al., 2023). Moreover, the ongoing increase of its training data helps ChatGPT to constantly be improved and updated with new data, which means it can become even more accurate over time (Rudolph et al., 2023).

Providing personalised responses

ChatGPT's ability tolearn from its interactions with humans, making it an adaptable conversational agent (Shen et al., 2023). ChatGPT can remember and incorporate previous conversations into its responses. This allows it to maintain context and carry on more natural and coherent conversations with users over time. Due to training on a vast amount of data, ChatGPT has the potential to provide personalised responses based on the context of a given prompt (Haque et al., 2022). Additionally, ChatGPT can generate responses using different tones and structures depending on the user's preferences and needs (Aljanabi & ChatGPT, 2023). This feature allows users to create unique texts in what appears to be and feels like a genuine dialogue with the chatbot that becomes more personalised with every round of interaction.

Providing real-time responses

The processing speed of ChatGPT can vary depending on various factors such as the complexity and amount of queries. However, with the use of an advanced natural language processing model, ChatGPT is able to understand complex inquiries and provide relevant answers in real-time (Deng & Lin, 2022). In a study to investigate the potential of ChatGPT for academic writing, the response rate by ChatGPT was

revealed to be very quick i.e. less than 2 min to give a 300–500 words text output (Kumar, 2023). This capability can significantly simplify the process of obtaining information, as users no longer have to manually search through multiple sources and search engines. In a fast-paced world where finding plausible answers, sometimes under pressure of deadlines or the need for quick decision-making, this feature can have tremendous benefits.

Opportunities for education

ChatGPT could potentially offer a wealth of opportunities for both higher education students and teachers. Key opportunities of ChatGPT for education are described below.

Increasing accessibility of information

ChatGPT can offer students and teachers easy access to information through a variety of platforms (e.g. a website or a smartphone app) and in a variety of fields. In addition, it is a more efficient tool compared to traditional search engines as it offers a written-out answer rather than just a list of sources. ChatGPT can find and summarise relevant information (Cascella et al., 2023), making it easier for students to access fine-grained information in a fast manner. From a pedagogical perspective, this means that ChatGPT can save accessing time for students and instead students can spend more time reading and critically reflecting on the given document. For teachers, ChatGPT can assist them in identifying and creating relevant teaching materials. It can also help them to generate lesson plans for teaching with a set of parameters and constraints (Zhai, 2022). For example, ChatGPT can generate a lesson plan for a 60-minute lesson on Argumentation skills for BSc students as shown in Figure 1. This generation can serve as a starting point for novice teachers who have less teaching experience and pedagogical knowledge.

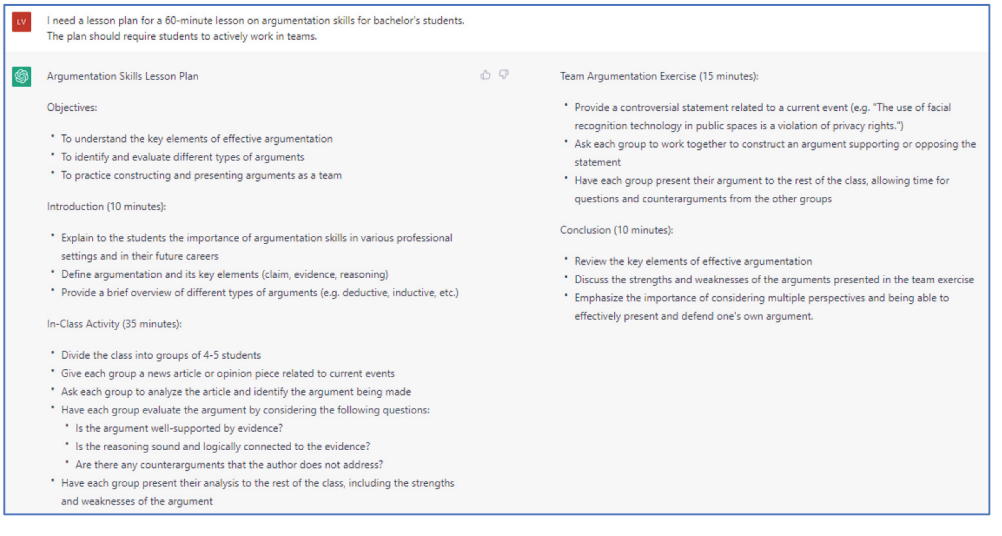

Figure 1. ChatGPT's proposed lesson plan for teaching argumentation skills to BSc students (generated on February 12, 2023).

Facilitating personalised learning

ChatGPT has the potential to provide personalised support and feedback to students at different levels of complexity. For example, in the context of argumentative essay writing as one of the important learning tasks for higher education students (Noroozi et al., 2012), we asked ChatGPT to give feedback on an anonymous essay about 'Video Games for Children' in three different scenarios considering three main features of feedback including constructive, affective, and critical features. While ChatGPT provided more positive and affective feedback with a praising type of prompt, it generated more critical feedback with a critical type of prompt (Figure 2). For teachers, this implies that they should carefully consider the type of question prompts to give personalised feedback to students since when the feedback is solely critical but not positive, students typically do not uptake the feedback because of psychological and emotional reasons (Latifi et al., 2021).

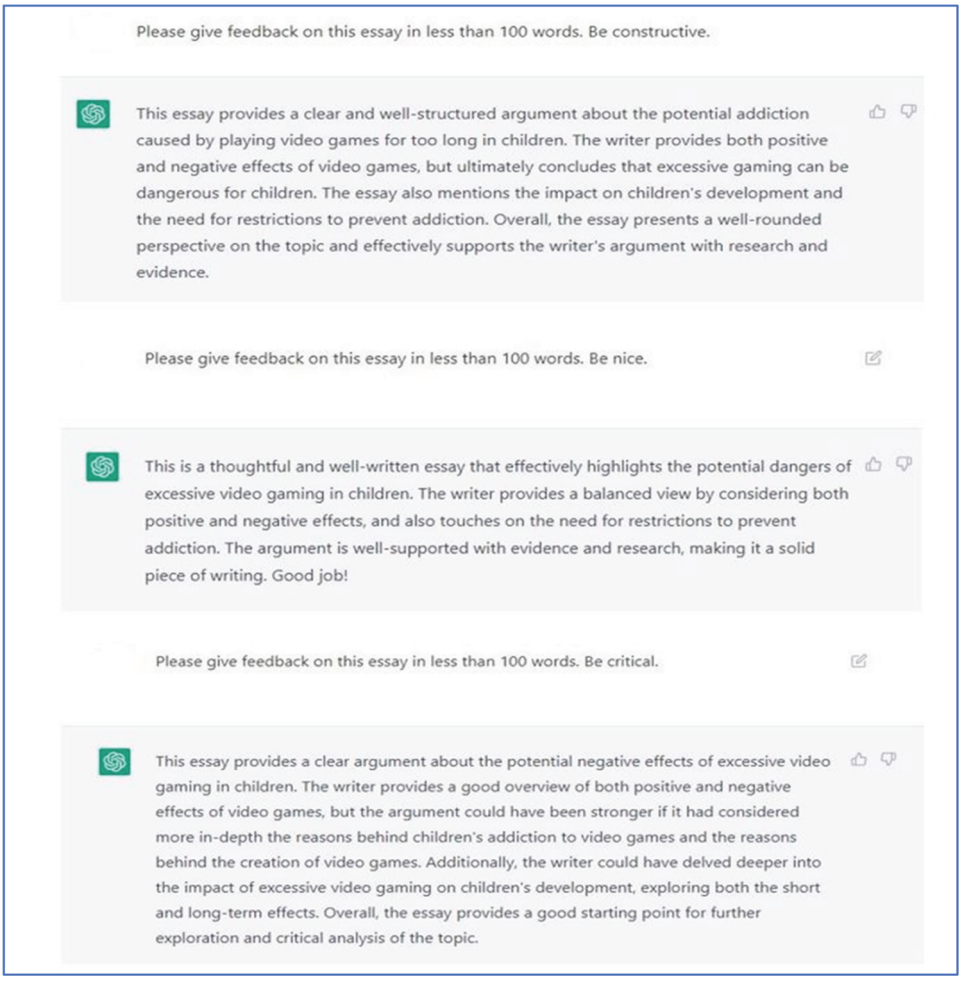

Figure 2. ChatGPT's feedback with different question prompts (generated on February 12, 2023).

As shown by the example, ChatGPT can remember the context of the first question and can provide relevant responses to the student's follow-up questions. This feature is highly useful for providing interactive and meaningful dialogues between students and ChatGPT. Being a conversational agent allows students to ask for further explanations of ChatGPT's responses and even correct them in case they are wrong (Azaria, 2022).

Facilitating complex learning

Previous findings indicated the potential of AI tools in facilitating the development of complex learning such as language learning (F. Jia et al., 2022) and critical thinking (Hapsari & Wu, 2022). The same holds for ChatGPT as an intelligent tutoring system that can provide customised instruction and feedback to students about their complex tasks, such as academic writing skills (Zhai, 2022) and programming skills (Biswas, 2023). ChatGPT was also shown the capability to stimulate critical thinking among students by challenging them to respond to a set of questions tailored to each student's level of proficiency (Cotton et al., 2023). Given its potential to act as an intelligent conversational agent, it can also provide students with valuable opportunities to improve their argumentation skills as another complex learning outcome through low-stakes practices (Bayat et al., 2022). Students can take one side of the debate and ask ChatGPT to take the other side, presenting their points and having the chatbot rebut them. Furthermore, similar to other pre-trained language representation models (Q. Jia et al. 2021), ChatGPT can assist students to evaluate their peer assessments so that students can learn to improve their feedback.

Decreasing teaching workload

ChatGPT holds great potential to considerably decrease teachers' workload. For example, it can be used as a feedback tool to give feedback on students' tasks, essays, and assignments (Qadir, 2022). Teachers can ask ChatGPT to create different forms of tests such as open-ended questions, multiple choices, or even a rubric for evaluating students' assignments (Zhai, 2022). ChatGPT could be used for the automatic grading of assignments, especially for text-based courses (Cotton et al., 2023). Moreover, teachers can simply provide students with feedback on students' essays in a short amount of time (Mizumoto & Eguchi, 2023).

Weaknesses of ChatGPT

Despite its strengths, ChatGPT has also certain limitations and weaknesses as listed below.

Lack of deep understanding

ChatGPT lacks a deep understanding of the meaning of the words it processes (J. Gao et al., 2023). It recognises patterns and generates plausible responses, but it does not fully grasp the concepts behind the words (Bogost, 2022). This may result in responses that are sometimes lacking depth and insight (Borji, 2023) and potentially off-topic (Gupta et al., 2023), particularly for performing tasks that require a nuanced understanding of specific domain knowledge (Dimitrov, 2023). In an empirical study, ChatGPT exhibited the ability to generate acceptable responses to complex problems in Pathology; however, its responses lacked a deep understanding

of the theoretical concepts (Sinha et al., 2023). This weakness does not have to be a problem, as long as there is a process to help with the depth and nuance that is needed for a more meaningful and less superficial understanding. However, when such a process is lacking, the use of ChatGPT could lead to a kind of 'dumbing down' of the users.

Difficulty in evaluating the quality of responses

ChatGPT lacks the human ability to assess the credibility of the data it was trained on (Lecler et al., 2023). This weakness limits its capability to evaluate the accuracy of the generated information (Sallam, 2023), except for those that there is a fair amount of consensus, such as 'flat-earth theory' (Grawitch, 2023). ChatGPT doesn't have access to the Internet and currently has limited knowledge of world events after 2021 (Stokel-Walker & van Noorden, 2023). As knowledge continues to evolve, this limitation may sometimes result in the provision of outdated and inaccurate responses. For instance, when required to include up-to-date references, ChatGPT may fabricate ones that seem plausible but do not point to real-world sources (Choi et al., 2023).

The risk of biases and discrimination

ChatGPT can perpetuate biases and discrimination (Zhai, 2022). The reasons include biases in training data, algorithmic design, and societal context. Following the old 'garbage-in-garbage-out' principle, AI algorithms can perpetuate biases through the use of big data that reflects these biases (Barocas & Selbst, 2016). For the same reason, Amazon had to discontinue its AI recruiting tool in 2018 after discovering it was biased against women because its training data was dominated by male resumes. AI algorithms can also perpetuate discrimination by focusing on objectives like profits and efficiency without considering unintended consequences such as reinforcing existing biases (O'neil, 2017).

Lack of higher-order thinking skills

Although ChatGPT can facilitate the development of complex learning outcomes, the chatbot itself is less competent when it comes to content that requires higher-order thinking skills, such as critical and analytical thinking (Rudolph et al., 2023). This is mainly because of the high dependency of AI tools on the data that are trained without a deep understanding of the context (Dimitrov, 2023), common sense (Baymurzina et al., 2021), and emotions (Bakpayev et al., 2022), which are crucial for higher-order thinking. For instance, its ability to generate higher-level critical thinking – type questions is limited, as these questions require a deeper understanding of the subject matter (Sun & Hoelscher, 2023).

Threats to education

While ChatGPT's strengths provide various opportunities for education, its weaknesses pose certain threats which are listed below.

Lack of understanding of the context

The lack of a deep understanding of the context and the true meaning behind words may pose various risks, especially within the realm of education. For example, ChatGPT used for personalised learning may not have a deep understanding of the curriculum, the learning style of each student, and the cultural context in which the student lives, resulting in content recommendations that are either too difficult or too easy for students. Another example is the use of ChatGPT for essay grading, which may not have the context and background knowledge needed to accurately grade an essay.

Threatening academic integrity

With the emergence of ChatGPT, many concerns have been raised about online assessment security and cheating in online exams through ChatGPT (Garg & Goel, 2022). ChatGPT has been shown to generate human-like text, which could pose a potential risk to the integrity of online exams, especially in higher education settings where such exams are becoming more prevalent (Susnjak, 2022). It is also shown that ChatGPT has the potential to respond sufficiently to exam questions in the fields of medical (Kung et al., 2022) and law (Choi et al., 2023). In an empirical study, Fijačko et al. (2023) showed that the answers provided by ChatGPT to the life support exams at a university were on average relevant, accurate, and significantly better congruence with resuscitation guidelines than previous studies using other AI tools. With such performance, ChatGPT is a serious threat to academic integrity, especially in higher education (Cotton et al., 2023).

Perpetuating discrimination in education

There are concerns about the possibility of perpetuating discrimination and exhibiting biases in education enforced by ChatGPT. According to Kasneci et al. (2023), when the trained data is biased towards a certain group, it may lead to unfair discrimination against different populations. For instance, if AI is trained using data from Western European students, it may not be effective or appropriate when used with other groups from different regions of the world (Pedro et al., 2019). In an empirical study, Zhuo et al. (2023) reported that while ChatGPT performs slightly better than other existing AI tools, it still shows evidence of ethical risks, in terms of perpetuating social stereotypes and unfair discrimination. Likewise, in a study with three experienced university teachers who used ChatGPT for a whole week, the teachers reported that ChatGPT is prone to errors such as the provision of bias (Tlili et al., 2023).

Democratisation of plagiarism in education/research

ChatGPT has raised various ethical issues such as encouraging plagiarism and cheating (Gašević et al., 2023) and being prone to errors such as the provision of fake information (Tlili et al., 2023). According to OpenAI, none of ChatGPT's responses is exact copies of any specific text but rather generated by synthesising the training data. Despite this, the model does have the potential to produce responses that are similar to existing sources. This is evidenced by a recent test in which ChatGPT wrote a 500-word essay with a 45% similarity to existing sources (Plagexpert, 2023). Therefore, it comes as no surprise that Mike Sharples warns that 'GPT democratises plagiarism' (Welle, 2023). Students may utilise ChatGPT due to its promising capabilities without realising that it may lead to plagiarism. In addition, there is a high risk of plagiarism becoming more prevalent in academia. Empirical studies showed that ChatGPT can generate research studies at an acceptable

level for publication (Dowling & Lucey, 2023) and can write scientific abstracts with fabricated data that may not be detectable by reviewers (C. A. Gao et al., 2022). These capabilities may encourage higher education students to solely rely on ChatGPT when writing academic essays. This ethical issue becomes, even more, serious when considering the fact that ChatGPT is prone to generating incorrect and nonsensical answers, increasing the risk of misinformation spreading in scientific publications (Liebrenz et al., 2023).

Declining in high-order cognitive skills

Over-dependence on ChatGPT can have negative consequences both for students and teachers. For students it can lead to a decline in their higher-order cognitive skills such as creativity, critical thinking, reasoning, and problem-solving. This is because the use of ChatGPT can result in simplification of the process of obtaining answers or information, which can have a negative impact on the students' motivation to perform independent research and arrive at their own conclusions or solutions (Kasneci et al., 2023). For teachers, over-dependence on ChatGPT can reduce the quality of their interactions with students and exacerbate existing inequalities.

Conclusions, implications, and recommendations for practices

The SWOT analysis of ChatGPT revealed that this new AI technology has various potential applications for education, but also comes with certain challenges, as shown in Figure 3.

The outcome of the SWOT analysis could help address this question: '*what should we do with ChatGPT?*' Here, a couple of scenarios can be considered as also proposed by Schroeven et al. (2023). *First*, we can fully focus on ChatGPT's weaknesses and its potential threats to

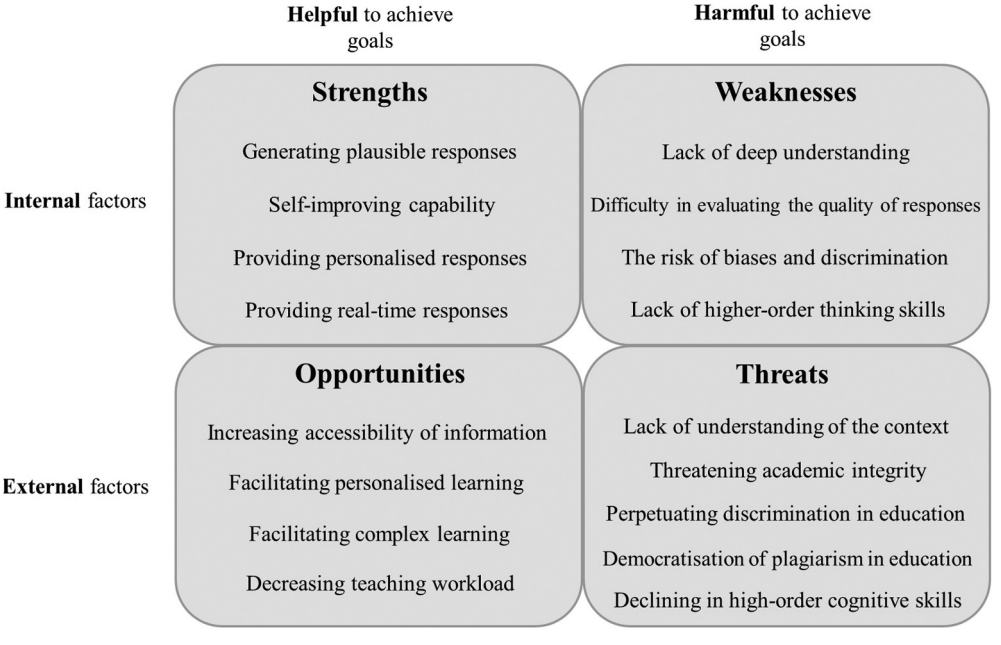

Figure 3. SWOT analysis of using ChatGPT in education.

education and attempt to ban ChatGPT from educational institutions for the fear of a negative impact on education and learning. However, attempts to ban emerging technologies in higher education have historically been destined to fail (Finkle & Masters, 2014; Spies et al., 2010) and the same would likely be true for ChatGPT. *Second*, we can still focus only on ChatGPT's threats to education and attempt to look for ways to outsmart students, for example, by asking them to write essays by hand at home. This option is not feasible because this generation of students has grown up with technology (Spies et al., 2010) and thus could always find a way to use new technologies such as ChatGPT behind the scene to do their assignments. *Third*, we can continue to ignore ChatGPT's strength and its opportunities for education and just attempt to rely on software such as *GPTZero* to detect AI-generated texts in students' assignments and online exams in order to minimise its threats to education. However, this is only a temporary remedy and does not help solve the big issue (Rudolph et al., 2023). The speed of AI detection software cannot compete with the rapid developments of emerging AI technologies. Advanced AI tools emerge rapidly, including Google's AI-powered chatbot '*Brad*' and new versions of ChatGPT, which are expected to be even more accurate than their predecessors. *Fourth*, we can attempt to just pretend nothing is wrong and ignore the existence of ChatGPT which could create chaos in educational settings and cause frustration both for teachers and students. In this case, teachers can never find out whether an assignment has been performed by a human or by a machine.

The *last* and most promising scenario is to reflect deeply on the issue and take advantage of ChatGPT's opportunity for education while attempting to minimise its threats to education. In this scenario, we need to adjust curricula and include learning goals, learning tasks, and assessment approaches. This can be done by including essential forms of literacy, such as media and digital literacy to enhance students' capability to properly evaluate, assess, and make use of these new technologies (Koltay, 2011).

As education becomes more dependent on AI, it is also imperative to focus on developing higher-order learning outcomes such as creativity and critical thinking skills (González-Pérez & Ramírez-Montoya, 2022). With the shift towards high-order learning outcomes, a change in designing learning tasks also seems crucial (Farrokhnia et al., 2022) . Instead of simply asking all students to write an essay on a single topic, with the help of ChatGPT, teachers can now swiftly ask students to evaluate and reflect on AI-generated essays on a range of topics while explaining their reasoning and justifying their evaluation. In addition, ChatGPT's strengths in creating personalised learning experiences (Shen et al., 2023) and the significance of adaptive learning for promoting higher-order learning outcomes (Gašević et al., 2023), make it a powerful tool to design effective learning tasks to support higher-order learning outcomes.

In terms of consequences for assessment, evaluating only a finished product (i.e. summative assessment) is no longer reliable as ChatGPT can produce that at an acceptable level. Teachers should use formative assessment, wherein the learning process is monitored through authentic assessment practices such as self-assessment (Rushton, 2005), reflection reports, portfolios, and peer feedback (Banihashem et al., 2022; Noroozi et al., 2016). Authentic assessment has long been proven to be beneficial in higher education (Villarroel et al., 2018), and now it is time to scale and amplify this approach by engaging students in activities that ChatGPT may not be able to generate an appropriate response for, such as solving real-life problems.

Finally, reflection with not just staff but also with students on the implications of the use of technologies like ChatGPT and how they can stimulate or block their learning is critical. Students who are 'in it for the credits and the diploma' as a means to quickly

'move on', so to speak, will use ChatGPT differently, compared to those who are curious and want to learn something that stays with them and will help them grow. Becoming aware of this and developing a more conscious relationship with technology is crucial.

The use of ChatGPT, with its positive and negative impacts on education, is still in its infancy and that implies the need for more empirical research. Based on the SWOT analysis outcomes, several avenues for future studies can be suggested. First, one of the main opportunities of ChatGPT for education is its ability to facilitate personalised learning. More studies are needed to show how such personalised learning can happen in practice and what is the optimal application of this tool for facilitating students' personalised learning in different contexts (Xia et al., 2022). Second, the review of the literature revealed that ChatGPT has the potential to generate plausible and real-time feedback. However, it is not yet clear to what extent feedback provided by ChatGPT can help students during the learning process in comparison to other sources of feedback. An empirical study can compare the effect of the feedback provided by ChatGPT with teacher feedback and peer feedback on various learning outcomes. Third, since ChatGPT has shown the potential to facilitate complex learning (Susnjak, 2022), future studies could focus on identifying optimal instructional designs for leveraging this new AI tool in facilitating complex learning among higher education students. Fourth, given that the quality of ChatGPT-generated essays highly depends on the users' prompts and the types of constraints, it is recommended to provide proper instructions and guidelines on how to define such prompts in writing academic essays in different contexts. Empirical research on the relevance of such prompts for different types of essays (e.g. reflective, argumentative, or descriptive) and their effectiveness for the quality of essays and learning are recommended. There are various ethical issues associated with ChatGPT application in higher education (Cotton et al., 2023; Gašević et al., 2023). Future studies should focus on how to address these issues by developing ethical principles and guidelines for the use of ChatGPT in higher education.

In the end, it should be noted that while SWOT analysis can provide an in-depth analysis of ChatGPT in education, it has limitations in prioritising the issues identified in each category, as also noted by Leiber et al. (2018). Therefore, empirical studies with quantitative approaches such as the best-worst method (see Rezaei, 2015) are necessary to extend the current review findings. This can be achieved through in-depth interviews with relevant experts to determine the weights and importance of the identified opportunities and weaknesses.

Disclosure statement

No potential conflict of interest was reported by the authors.

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