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The role of ChatGPT in higher education: Benefits, challenges, and future research directions

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Abstract

This paper examines the potential benefits and challenges of using the generative AI model, ChatGPT, in higher education, in the backdrop of the constructivist theory of learning. This perspective-type study presents five benefits of ChatGPT: the potential to facilitate adaptive learning, provide personalised feedback, support research and data analysis, offer automated administrative services, and aid in developing innovative assessments. Additionally, the paper identifies five challenges: academic integrity concerns, reliability issues, inability to evaluate and reinforce graduate skill sets, limitations in assessing learning outcomes, and potential biases and falsified information in information processing. The paper argues that tertiary educators and students must exercise caution when using ChatGPT for academic purposes to ensure its ethical, reliable, and effective use. To achieve this, the paper proposes various propositions, such as prioritising education on the responsible and ethical use of ChatGPT, devising new assessment strategies, addressing bias and falsified information, and including AI literacy as part of graduate skills. By balancing the potential benefits and challenges, ChatGPT can enhance students' learning experiences in higher education.

Introduction

Generative Pre-trained Transformer (GPT), which was released by OpenAI (San Francisco, California) in 2018, is a type of Large Language Model (LLM) that aims to replicate human language processing capabilities (Cascella et al., 2023). It leverages deep learning and powerful algorithms to perform various language-related tasks, such as text generation, question answering, and translation, while comprehending the context to produce responses that resemble human language (Lund et al., 2023). OpenAI released the ChatGPT-3.5 language model family in November 2022 and, subsequently, the ChatGPT-4 family in March 2023 (Skavronskaya et al., 2023). This chatbot can engage in coherent and contextually relevant conversations by responding based on its comprehension of the language and context of the prompts (Gilson et al., 2023; Pavlik, 2023). Anyone can sign up for ChatGPT on OpenAI and start using the free, conversational beta version of GPT-3.5 or subscribe to GPT-4 for a fee of $20/month, and both can be used without any training (OpenAI, 2023).

Large language models have become a subject of interest in higher education due to their extensive range of applications, especially as there are now other similar options, such as Bing Chat, Bard, and Ernie (Rudolph et al., 2023b). As such, it is important to carefully consider the potential benefits and challenges associated with their use. Previous studies have covered large language models from students' and academics' perspectives (Farrokhnia et al., 2023; Pérez et al., 2020). Large language models have various applications that can assist students in their learning journey as perceived by them. Researchers have used large language models to produce interactive educational resources, such as quizzes and flashcards, with the aim of enhancing student learning and involvement (Dijkstra et al., 2022; Gabajiwala et al., 2022). Furthermore, recent studies have shown that GPT-3 can stimulate curiosity, enhance students' question-asking skills, and generate programming code explanations (Abdelghani et al., 2022; MacNeil et al., 2022). On the other hand, from the academics' perspective, it has been reported that they have sufficient digital skills but low AI-related skills. Academics acknowledge that ensuring the responsible integration of AI into education is critical (Fadel et al., 2019; Polak et al., 2022). Recent studies have reported that large language models can be a useful resource for academics to evaluate students' pedagogical abilities. Grading effort could be reduced by up to 85% (Bernius et al., 2022; Moore et al., 2022).

Since ChatGPT was introduced in November 2022, researchers have initiated investigations to understand the impact and challenges this technology will present to the education sector, particularly at the tertiary level. For example, in the clinical research and education domain, Cascella et al. (2023) discuss how ChatGPT can aid clinical practice, scientific production, and the logical analysis of public health-related topics. However, they also examine the potential misuse of ChatGPT in medical education. Kasneci et al. (2023) discuss ChatGPT's advantages and disadvantages from both students' and academics' perspectives. Tlili et al. (2023) addressed early adopters' experience in education. They emphasised that ChatGPT is a critical tool for academia, but conscious use is recommended until specific guidelines are established for safe usage. The present study is also a perspective study that discusses the role of ChatGPT's impact on the future of higher education. However, unique from the rest to the best of our knowledge, this study is the first to discuss perspectives from a theoretical basis, namely, the constructivist theory of learning. This theory is employed as a framework to explain how technology can be used for active, collaborative, and personalised learning in higher education. Given this context, our article aims to respond to the following two research inquiries:

RQ1: What are the key benefits of ChatGPT for the future of higher education?

RQ2: What are the key challenges of ChatGPT for the future of higher education?

To address the two aforementioned inquiries, we have identified five critical benefits and five challenges of ChatGPT that will affect the higher education sector. A team of experienced academics and practitioners shared their perspectives in the present study. For each benefit and challenge, we have presented one or more propositions. We hope that researchers, academics, and practitioners in the higher education sector will find these perspectives valuable for their research and practice. The article will be structured as follows in the remaining sections. First, we will provide a brief overview of the ChatGPT tool, followed by a brief overview of the constructivist theory of learning. We will also highlight how the ChatGPT tool could effectively facilitate constructivism learning. Next, the article will discuss five key benefits of ChatGPT for the future of higher education. In the subsequent section, five key challenges of ChatGPT for the future of higher education will be discussed. Following this, we will briefly introduce a framework based on the proposed propositions. Finally, the article will conclude by presenting the study's limitations and suggesting key directions for future research.

Literature review

An overview of ChatGPT

OpenAI, a US-based company established in 2015, developed ChatGPT, and the 3.5 version was released in November 2022. This cutting-edge artificial intelligence chatbot uses deep learning techniques and has been trained on a huge amount of online text data (Kung et al., 2023; OpenAI, 2022; Taecharungroj, 2023). GPT stands for generative pre-trained transformer, meaning that it can understand inputs provided by humans and produce a response text that is highly similar to the language used by humans, making it almost impossible to distinguish between a human and an AI-generated text (Flanagin et al., 2023; Kung et al., 2023; Thorp, 2023). OpenAI has made several machine learning (ML) products available to the general public, with DALL-E and ChatGPT among the most well-known (Lund et al., 2023). GPT reached one million registered users in five days and 100 million active users within less than three months (Ahmed, 2023; Rudolph et al., 2023b).

ChatGPT is a natural language processing tool that utilises regression language modelling techniques to predict subsequent words with high precision, attributed to its access to billions of parameters and extensive data volumes (Taecharungroj, 2023). Although other language models, such as BERT, RoBERTa, and XLNet, aim to achieve similar objectives, their capabilities have been outperformed by ChatGPT-3.5 (Lund et al., 2023). It is because of its extensive data stores and efficient design that ChatGPT can handle increasingly complex queries, going beyond simple inquiries (Liu et al., 2022a; Liu et al., 2022b; Lund et al., 2023). Furthermore, in March 2023, ChatGPT-4 was introduced, showing significant improvements in reasoning and conciseness compared to its predecessor. However, it is important to note that the output generation speed of ChatGPT-4 is slower than ChatGPT-3.5 (OpenAI, 2023).

Both the 3.5 and 4 iterations of ChatGPT have gained considerable interest from universities worldwide as disruptive tools for teaching, learning, and supporting students (Kasneci et al., 2023; Nautiyal et al., 2023). Many universities have started exploring how to incorporate this AI-driven solution into their pedagogical approach, recognising its potential to transform traditional teaching methods, enhance student involvement, and foster tailored educational experiences. However, some academics and researchers express concerns regarding the potential ethical consequences of using AI in educational environments, such as information privacy, algorithmic bias, and the possible reduction of human interaction, among others (Flanagin et al., 2023; Thorp, 2023). Consequently, the scholarly community is actively investigating the most efficient and responsible methods to integrate ChatGPT into tertiary education.

Constructivist theory of learning

As a dominant educational philosophy, constructivism significantly influences modern learning and teaching processes (Qureshi et al., 2021). The origins of constructivism can be traced back to the works of Dewey (1929), Bruner (1961), Vygotsky (1962), and Piaget (1980). Two essential components of constructivism learning theory are the definition of learning and the approach to learning (Li, 2022; Qiu, 2019). These essential elements should be integrated into an optimal learning environment for students. According to constructivism, learning is a dynamic process of knowledge construction shaped by students' needs, learning materials, tools, and the overall learning environment (Taber, 2011). Academics play a leading role in the teaching process by addressing students' needs, providing relevant learning materials, and offering helpful tools (Qiu, 2019). Constructivism learning theory emphasises autonomous and active learning, while traditional teaching focuses on the passive acceptance of knowledge imparted by academics (Ma & Tsai, 2021).

Constructivism is a theory rooted in observing and systematically investigating how individuals acquire knowledge, drawing inspiration from domains such as philosophy, psychology, sociology, and pedagogy (Bada & Olusegun, 2015). Baser and Mutlu (2011) discovered that educators who integrate educational technologies into their teaching processes could engage more students in their learning. While much of the early work in formal instructional design and teaching was grounded in objectivist philosophy, contemporary scholars have found constructivism learning to be more effective because of its ability to develop critical problem-solving skills (Tam, 2000). Behavioural theories of learning posit that learning is a function of environmental stimuli manifested in the form of behavioural changes, whereas cognitive theories of learning (where constructivist theory is rooted) establish that learning occurs when the learner acquires knowledge and skills that help in forming mental structures aided by the processing of information and beliefs (Schunk, 2012). The constructivist theory emphasises the importance of students constructing their own understanding of knowledge. Regarding the use of educational technologies in teaching and learning, it has been found that technology can accelerate students' interactive and engaging learning experiences, allowing for exploration and experimentation (Makewa, 2019).

A technology-supported constructivism learning environment has been found to be very effective in the context of students' access to information and the analysing, interpreting, and organising of that information to develop their knowledge base (Kılıç et al., 2003). Later, Makewa (2019) found the relevance of constructivist theory in technology-supported knowledge transfer. In line with the constructivism approach, technologies in the learning process enable students to manage their own skills and knowledge to decide exactly what they require to address their knowledge gap (Adar & Kandemir, 2008). Therefore, it is clear that ChatGPT, as an AI-powered tool, has the potential to facilitate a constructivism learning experience for students by enabling them to explore and experiment with ideas, ask questions, and receive immediate feedback that allows them to construct their own understanding of knowledge.

The educational significance of ChatGPT and constructivist theory

In the following sections, we will discuss ChatGPT's influence on the future of higher education in more detail. Before that, it is worth noting that the constructivism learning theory can be considered while discussing ChatGPT's benefits and challenges in the higher education section. The constructivist theory of learning emphasises the importance of learners actively exploring and investigating new knowledge (Piaget,1980; Schunk, 2012), and ChatGPT can facilitate this process. By engaging students in conversation and encouraging them to participate in the learning process, ChatGPT can scaffold their prior knowledge and experiences to help them construct new knowledge. Additionally, ChatGPT's individualised feedback can support this process by building on their prior knowledge and experiences and providing personalised suggestions for further learning (Ippolito et al., 2022; Vygotsky, 1962). This feedback can help students detect errors and guide them towards successful improvement, making ChatGPT an effective "More Knowledgeable Other" (MKO) in the learning process (Geng & Razali, 2020).

Furthermore, constructivist theory emphasises the importance of authentic assessment, which assesses students' abilities to apply knowledge and skills to real-world contexts (Wiggins, 1990). Incorporating ChatGPT into the assessment process can help students construct their knowledge actively. By building on their prior knowledge and experiences, ChatGPT can provide personalised feedback that guides them towards successful improvement and helps them detect errors in their work. This feedback serves as an MKO, facilitating the construction of new knowledge. Adaptive learning, a foundational concept of constructivist theory, suggests that learning is constructed based on previously acquired knowledge (Schunk, 2012). ChatGPT's logical algorithms that build new knowledge based on existing knowledge align with this approach (Hein, 1991). Thus, ChatGPT is an effective tool for facilitating constructivism learning.

Benefits of ChatGPT in higher education

The wide variety of applications offered by large language models, such as ChatGPT, has made them literally a juggernaut in the higher education sector, especially in the tertiary education section, from both the students' and academics' perspectives. In addition, they have great potential for academic learning designers to better perform their tasks. While students, academics, and practitioners could benefit from ChatGPT, the relevant challenges, such as ethical considerations, data privacy, and bias, should be carefully addressed.

Adaptive learning

Adaptive learning is an educational approach that tailors learning experiences to the unique needs of individual learners through personalised feedback and resources (Yang et al., 2013; Huang & Shiu, 2012). In the online learning context, Kerr (2016) defines adaptive learning as a way of delivering learning materials where a learner's interaction with previous content determines the nature of materials delivered subsequently. This education method utilises computer algorithms and artificial intelligence to provide personalised resources and learning activities (Kaplan, 2021). However, implementing adaptive learning requires significant time and resources (Kuo & Chang, 2022; Peng et al., 2019). Nonetheless, adaptive learning systems aim to transform students from passive recipients to active collaborators through a scaffolded approach to learning (Deng & Yu, 2023; Zawacki-Richter et al., 2019).

Large Learning Models (LLMs) such as ChatGPT provide a scaffolded approach to learning that is consistent with the constructivist theory of learning (Schunk, 2012). As discussed previously, the theory holds that learning is constructed based on previously acquired knowledge, and cognitive abstraction based on previously held knowledge leads to the construction of new knowledge. Integrating ChatGPT API (i.e., Application Programming Interface) into an institution's learning management systems enables educators to create personalised learning experiences that are student-centred and active, based on the student's pre-existing knowledge (Chen et al., 2023). Students can access individualised just-in-time feedback through a chatbot that can provide easy-to-understand explanations, inspire exploration of relationships between constructs, and provide on-demand access to educational resources and support. This enables educators to effectively develop tailored lesson plans through LLMs such as ChatGPT, promoting higher-order thinking and, subsequently, knowledge creation (June et al., 2014).

ChatGPT can effectively achieve adaptive learning through a constructivism approach by building on existing information through appropriate prompts (Rudolph et al., 2023a). This improves learning by connecting previous knowledge to make new connections and meanings that lead to new knowledge. The conversational nature of LLMs such as ChatGPT facilitates the active construction of students' knowledge as they are continuously engaged with the task, encouraged to find patterns through a scaffolded approach (Stapleton & Stefaniak, 2019), and learn through experimentation and experience, which is an important part of knowledge generation (Rudolph et al., 2023a). In contributing to a smart learning environment, ChatGPT can utilise big data and learning analytics to monitor student performance, predict success, and respond to students, including their emotional states, in real-time, resulting in personalised adaptive learning (PAL) that is consistent with constructivist theory (Peng et al., 2019; Rudolph et al., 2023a).

Overall, incorporating ChatGPT in the learning process enables educators and students to benefit from personalised learning experiences, efficient and effective use of resources, and adaptive learning approaches that enhance the learning outcomes for all, consistent with the principles of constructivist theory (Bada & Olusegun, 2015; Stapleton & Stefaniak, 2019). By facilitating thinking and problem-solving skills, students can engage in discovery learning, and educators can provide prompts that facilitate the learning process rather than a didactic approach (White et al., 2014; Kasneci et al., 2023). This approach facilitates personalised learning through a spiral curriculum approach, which is a teaching method where a particular topic or concept is revisited repeatedly throughout a student's education, leading to self-discovery and learner-centred knowledge construction (Kasneci et al., 2023) while allowing students to undertake self-evaluation of their learning and refine their own problem-solving approaches (Rudolph et al., 2023a).

Proposition 1 (P1): Higher education institutions should look to integrate LLM APIs into their learning management systems as part of an adaptive learning system. In particular, this could be used to encourage students to dive deeper into each particular topic.

Proposition 2 (P2): Educators should explore the utility of augmenting their teaching approach with LLMs in developing tailored lesson plans.

Proposition 3 (P3): Future research may empirically test whether and how student interaction with ChatGPT facilitates student learning outcomes.

Individualised feedback

Individualised feedback, which is based on the constructivist theory of learning, is a valuable pedagogical approach that provides personalised guidance to students and enhances their learning journey (Nicol & Macfarlane-Dick, 2006; Hattie & Timperley, 2007; Pritchard, 2017). The theory posits that learning occurs when new knowledge is built into existing knowledge. Individualised feedback adds value to the student's existing knowledge, leading to improved subject comprehension, motivation, and performance (Shute, 2008). In addition, it promotes self-regulated learning and a supportive learning environment by allowing students to set goals and develop strategies to achieve those goals (Brookhart, 2008).

The deployment of advanced LLMs like ChatGPT presents an opportunity for both automating and augmenting feedback in the context of learning (Raisch & Krakowski, 2021). Educators can automate parts of the feedback process, such as providing formative feedback to students before submitting their final work, to enhance learning (Farrokhnia et al., 2023; Sok & Heng, 2023). In addition, educators can augment their assessment feedback by drawing on their subject-matter expertise and focusing on providing higher levels of detail in feedback rather than spending time on structural items like grammar and referencing, which can be easily generated by LLMs (Kasneci et al., 2023).

As indicated earlier, ChatGPT can provide individualised feedback based on the students' prompts, making learning a more rewarding experience (Bridges, 2009; Weldy & Turnipseed, 2010). Specifically, the diagnostic feature of ChatGPT has the potential to serve as the MKO, providing diagnostic individualised (formative) feedback that helps students detect errors and guides them to improve successfully. This feedback supports a student's construction of their own knowledge and understanding by allowing them to ask questions and seek information in an adaptive and individualised way rather than relying solely on traditional learning methods like lectures and textbooks. This is consistent with the constructivist theory of learning, which emphasises the importance of building new knowledge into existing knowledge and scaffolding to support the learning process (Geng & Razali, 2020).

AI applications like ChatGPT can provide accurate and efficient individualised feedback and automated grading, but users need to carefully check the outputs as they depend on the prompts (Rudolph et al., 2023a). This has the potential to reduce costs and time associated with human assessors, especially in cases where there are large numbers of students, as the costs and time involved in calibrating and training the systems (supervised machine learning) would be offset (Zawacki-Richter et al., 2019). Overall, ChatGPT's ability to provide individualised feedback based on the constructivist theory of learning has significant potential to enhance the learning experience and promote successful learning outcomes.

Proposition 4 (P4): Academics should consider automating feedback elements more meaningfully using current LLMs, such as ChatGPT, to empower students.

Proposition 5 (P5): Academics should explore the possibility of complementing personalised feedback provided by ChatGPT with other forms of feedback from peers, academics, and self-assessments.

Research, writing and data analytics support

In higher education, large language models like ChatGPT have the potential to greatly assist researchers and students with various tasks, such as efficiently and effectively completing research and writing tasks, including text generation, language translation, and responding to academic queries (Dwivedi et al., 2023; Kasneci et al., 2023; Lund et al., 2023). The constructivist theory of learning, which emphasises active learning, discovery-based learning, and collaboration, supports the use of LLMs in research and writing tasks (Hein, 1991). Such LLMs can help conduct initial literature reviews, summarise research papers, generate draft versions of research papers (Rahman et al., 2023; Rudolph et al., 2023a), and even assist authors from non-English speaking backgrounds in overcoming language barriers (Gao et al., 2022).

One of the key concepts in constructivism is that the learners are active participants in knowledge creation to the extent that they explore and discover the principles underlying the concepts they study (Geary, 1995). To support the above approach, the learner, according to the constructivism learning theory, would be involved in observations, data collection, and hypothesis testing and work collaboratively, to name a few (Bruning et al., 2004; Geary, 1995). LLMs like ChatGPT could be used as effective tools that support and enable the above-mentioned research activities. However, it is imperative to ensure that the research activities are conducted using ChatGPT to comply with academic integrity principles, such as honesty, rigour, transparency, fairness, respect, recognition, accountability, and promotion (National Health and Medical Research Council, 2018).

Similar to tools like Leximancer (Smith & Humphreys, 2006), LLMs can also reliably conduct text analysis for sentiment analysis, pattern detection, and emotion detection (Dwivedi et al., 2023; Guo et al., 2023). ChatGPT's research and analysis support, though currently at a basic level, has the potential to fundamentally impact research and higher education, depending on the quality of the prompts (Dwivedi et al., 2023). As learning in constructivism is contextual (Hein, 1991), ChatGPT's ability to build new knowledge based on existing knowledge supports this theory.

However, the impact of ChatGPT on critical thinking remains a grey area that warrants further exploration (Dwivedi et al., 2023). ChatGPT can act as a research assistant, answering users' questions based on the related literature it has learned (Lin, 2023), and analysing data (Goel, 2020). Additionally, it can serve as a writing assistant (Ippolito et al., 2022; Rudolph et al., 2023a) and provide writing support (Geng & Razali, 2020). Nevertheless, users should exercise caution as ChatGPT may be prone to hallucinations (Alkaissi & McFarlane, 2023) and fabricate references and quotes (Sallam, 2023; Shen et al., 2023).

Proposition 6 (P6): Policies on academic integrity need to be in place to ensure that the use of ChatGPT for research and data analytics does not compromise academic integrity.

Proposition 7 (P7): Higher education institutions need to train students and academics in the use and misuse of ChatGPT for research and data analytics.

Proposition 8 (P8): Compare ChatGPT's effectiveness in promoting active collaborative learning, student engagement, and academic performance against traditional research methods.

Automated administrative support

The demand for high-quality academic and non-academic (administrative) support services has increased to assist students with their studies and enhance their interest in learning (Zhao et al., 2022). The constructivist theory of learning emphasises the context of the learning environment being supportive and promoting learning while the students engage in the active process of constructing knowledge (June et al., 2014). The integration of ChatGPT can assist in creating a supportive learning environment for students by providing timely and accurate information, reducing administrative burdens, and presenting a cost-saving measure for higher education institutions. Additionally, prior research has found that deploying chatbots and online chat systems is positively linked with enhancing students' engagement in higher education institutions (Abbas et al., 2022).

ChatGPT has the potential to provide significant benefits to the tertiary education sector for both students and academic staff. The constructivist theory of learning emphasises the importance of active learning, where learners actively participate in their own learning rather than simply receiving information passively (Hein, 1991). ChatGPT integrated into the learning system using ChatGPT API may facilitate active participation in learning by providing students with opportunities to interact with the system and take ownership of their administrative tasks. Additionally, the theory recognises the importance of feedback in learning, as it helps students to monitor their progress and adjust their strategies as needed (June et al., 2014). Automated administrative support through ChatGPT can use data and analytics to provide timely and personalised non-academic feedback to students, such as notifications about upcoming deadlines, reminders about incomplete tasks, and progress reports on completed tasks, based on individual needs and preferences.

For academic staff, ChatGPT may be able to summarise and clarify student emails for administrative members to process more efficiently and generate personalised response templates for staff to address students' queries (Dwivedi et al., 2023). Furthermore, the integration of automated administrative support can benefit students in their sense-making process of knowledge creation (Tangney, 2014). This provides a degree of efficiency and effectiveness, allowing for a synchronous interaction for students (Howlett, 2017; Okonkwo & Ade-Ibijola, 2021) and presenting a cost-savings measure for higher education institutions (Merelo et al., 2022).

It is obvious that the implementation of advanced LLMs like ChatGPT has the potential to revolutionise the tertiary education sector by automating some elements of administrative support and providing a degree of efficiency and effectiveness. While further research is needed to fully understand the potential of ChatGPT in the tertiary education sector, the constructivist theory of learning supports the use of ChatGPT for automated administrative support as it can facilitate active participation in learning, provide personalised feedback to students, and create a supportive learning environment.

Proposition 9 (P9): The automated administrative support provided by ChatGPT to the academic community needs to be further studied to understand the efficiency and effectiveness in the context of the constructivism learning theory.

Innovative assessment activities

In the higher education sector, innovative assessment activities have gained a lot of attention because they assist students in getting involved with learning resources to think critically and have real learning experiences (Boud & Soler, 2016). Drawing from the constructivist theory, which emphasises the importance of authentic assessment and formative feedback (Schunk, 2012; Wiggins, 1990; Black & Wiliam, 2009), different approaches have been suggested in previous literature, such as the implementation of e-portfolios to facilitate self-regulated learning and reflective practices (Challis, 2005; Schön, 1983). Falchikov (2013) further suggested collaborative assessments that include peer and self-assessments to promote cooperative learning and the development of metacognitive abilities, aligning with the social constructivist theory's emphasis on collaboration and social interaction in learning.

Overall, it has been found that innovative assessment activities promote a learner-centred educational environment while contributing to a more holistic and meaningful evaluation of student learning outcomes. ChatGPT has been recognised for its ability to develop assessment questions, lesson plans, and curricula in higher education (Dwivedi et al., 2023; Mollick & Mollick, 2022). By focusing on authentic assessments, in line with the constructivist theory (Wiggins, 1990), and allowing students to engage with topics they are genuinely interested in, ChatGPT can foster creativity and critical thinking skills (Rudolph et al., 2023a; Dennick, 2016). This technology can be integrated into innovative assessment activities, facilitating collaborative learning, scaffolding, real-time feedback, personalised learning, scalability, interactivity, and fostering knowledge creation and dissipation effectively (Kumar, 2021).

Although chatbot technology has shown positive influences on explicit reasoning, learning achievement, knowledge retention, and learning interest, studies have not yet demonstrated significant improvements in critical thinking, learning engagement, and motivation (Deng & Yu, 2023). ChatGPT can generate initial ideas for assessment design,

create multiple-choice or short-answer questions for academics, and produce drafts of case studies or other assessments for further editing (Bridgeman et al., 2023; Liu & Bridgeman, 2023). It can also be integrated into assessment tasks, where students critique generated text or essays and build high-quality articles based on generated drafts, provoking students' existing mental models and developing critical thinking skills (Dennick, 2016). This approach helps students develop important skills for engaging with ChatGPT in future workplaces.

The ubiquity of LLMs like ChatGPT has prompted a re-evaluation of assessment design, with a focus on fostering creativity, critical thinking, authenticity, practicality, and collaboration (Nieminen et al., 2022; Villarroel et al., 2018), aligning with the constructivist theory's emphasis on authentic and formative assessment (Wiggins, 1990; Black & Wiliam, 2009). Educators should ensure that assessment tasks address relevant learning outcomes for each subject (Van Der Veen & Van Oers, 2017). Assessment designs should engage students with tasks that require critical thinking and cannot be easily replicated by LLMs (Crawford et al., 2023; Kuhn, 2019; Iordanou et al., 2019). For example, students could be asked to expand and justify their chosen sources to support specific positions (Kuhn & Modrek, 2021). LLMs like ChatGPT can also be incorporated into assessment tasks as text-generators, with students tasked to critically evaluate the generated output (Monash University, 2023). Overall, ChatGPT's potential is notable in creating meaningful, innovative assessment activities.

Proposition 10 (P10): ChatGPT's ability to develop innovative and authentic student assessments depends on its focus on the work context and the students' existing knowledge.

Proposition 11 (P11): It is crucial to provide appropriate training and support for students and academics on how to use ChatGPT for innovative assessment activities to ensure its effective use.

Proposition 12 (P12): The integration of ChatGPT in innovative assessment activities can promote critical thinking, problem-solving, and collaboration skills among students.

Challenges of ChatGPT in higher education

Above, we briefly discussed some key areas in which large language models, such as ChatGPT, benefit the higher education industry for both academics and students. Along with many benefits, LLMs also pose many challenges in the higher education sector. In the following section, we present five key challenges, followed by some propositions.

Ethical and equity considerations

It is no secret that ChatGPT challenges ethical and equity practices in the higher education sector, as it potentially contradicts the constructivist theory of learning that emphasises active student participation and the construction of knowledge. The misuse of ChatGPT to create content instantly as a shortcut goes against the philosophy of constructivism and any learning theory, for that matter. Using ChatGPT to facilitate learning could lead to unethical and inequitable practices, destroying the spirit of learning (Hein, 1991). Digital inequity can also occur as access to technology and high-speed internet is not evenly distributed among students, which could exacerbate existing inequities in the educational system (Vogels, 2021).

According to the constructivism learning theory, learning happens best when there are good interactions between the instructor and learner (Schuh, 2003). Furthermore, the learning environment includes social groups, instructional strategies, and a motivational atmosphere, to name a few (Zajda, 2021). The above conditions would be missing in a learning environment solely aided by generative AI tools such as ChatGPT. Despite the ethical and equity challenges, ChatGPT has the potential to democratise education and support diverse students' participation in higher education by providing personalised and accessible learning experiences (Popenici & Kerr, 2017; Pavlik, 2023). However, ChatGPT could impact students' ability to actively construct their own knowledge, as some students may have greater access to ChatGPT than others, resulting in a knowledge gap between students (Hein, 1991). Therefore, higher education institutions must ensure equitable access to technology and assistive devices to make ChatGPT an inclusive technology and address digital inequities (Lim et al., 2023).

Another challenge of ChatGPT is the acceptance of feedback provided by AI rather than human instructors, which is against the constructivist theory of learning that emphasises interactions and social collaboration in learning (Hein, 1991). To build trust in the technology, higher education institutions should utilise ChatGPT in conjunction with human instructors to provide feedback to students, thereby ensuring accurate and credible feedback and reducing the spread of false information (Dwivedi et al., 2023; Zhuo et al., 2023). Moreover, copyright concerns can arise as ChatGPT may have trained from and provided similar answers to content under copyright protection. Higher education institutions must consider copyright issues in their policies to mitigate this issue and ensure that ChatGPT does not infringe on copyright laws (Dwivedi et al., 2023; Karim, 2023). In addition, students with disabilities may require assistive technology devices such as text-to-speech software or speech recognition tools to use ChatGPT effectively, which raises concerns about equitable access (Hemsley et al., 2023). Therefore, higher education institutions must address digital inequities and ensure that assistive technology devices are made available to students who require them to make ChatGPT an inclusive technology (Lim et al., 2023).
Proposition 13 (P13): Higher education institutions need to explore how to encourage collaboration among students when using ChatGPT to ensure that all students have opportunities to construct their own knowledge through interactions with teachers and social collaboration with others.

Proposition 14 (P14): It is important to consider the barriers and facilitators to equitable access to ChatGPT for students from diverse backgrounds and how institutions and educators can address these issues.

Maintaining academic integrity

Maintaining academic integrity is a significant challenge when using ChatGPT as an AI platform for writing academic assessments, dissertations, and papers (Cotton et al., 2023; Sullivan et al., 2023). The constructivist theory of learning emphasises learners' active involvement in constructing meaning (Hein, 1991). Passive shortcuts, potentially resulting in academic integrity breaches, hinder the active involvement of learners and hence impede learning. Therefore, to maintain academic integrity while using ChatGPT, responsible and ethical use of information generated by the model is necessary (Keith, 2022; Sullivan et al., 2023). ChatGPT generates information based on data inputs and learned patterns, and users are responsible for critically evaluating the accuracy and validity of the information. To maintain academic integrity, users must acknowledge and cite ChatGPT as a source of information and declare its use in research and data analytics (Cradle, 2023).

Using various online-based tools to generate academic content is not a new phenomenon. Still, it is made easier and more tempting for students, and detecting such academic misconduct is difficult due to the probability-based and unreliable nature of AI-generated text detectors (Raschka, 2023). The constructivist theory of learning emphasises active learning experiences that reflect real-world situations and problems (Hein, 1991). Using ChatGPT as a tool for exploration and inquiry, students can actively construct their own knowledge and meaning, reducing the likelihood of academic dishonesty, such as plagiarism or cheating (Keith, 2022).

To address the challenge of maintaining academic integrity, it is proposed that a preventive approach is taken by building a culture of academic integrity and communicating the risks of not achieving key learning outcomes to students. Furthermore, it is necessary to rethink the assessment of student learning outcomes and consider assessing the learning processes rather than just their artefacts of learning, which can easily be replicated by ChatGPT (Lodge, 2023; Cradle, 2023). The constructivist theory holds that learners are active thinkers that amass authentic learning experiences rather than passive receivers of knowledge. Creating authentic learning experiences would require collaborative and consultative learning experiences (Muhajirah, 2020). By emphasising the importance of authentic learning experiences, educators can help students understand the value of academic integrity and the importance of using their own ideas and work.

The potential for unethical or ill-intentioned use of ChatGPT is a significant challenge for higher education institutions (Lim et al., 2023). While some institutions are banning ChatGPT due to the inadequacy of current detection methods, such as Turnitin, such bans may have the opposite effect and increase the use of ChatGPT due to the Streisand effect (Lim et al., 2023). The Streisand effect is the phenomenon that explains the efforts of censorship attempts that lead to counterproductive and opposite effects (Jansen & Martin, 2015). Therefore, institutions must balance preventing academic misconduct and promoting academic freedom and innovation. Moreover, as ChatGPT becomes increasingly incorporated into students' lives, not just for academic purposes but also for personal and professional reasons, higher education institutions must educate students on its use and misuse. This education should include understanding the limitations and biases of AI and how to critically evaluate AI-generated content. It is also essential for students to develop their critical thinking and writing skills and value the learning process rather than just the final product. By doing so, students can leverage the benefits of AI while upholding academic integrity and ethical values.

Proposition 15 (P15): Higher education institutions should prioritise educating students on the responsible and ethical use of ChatGPT and other AI tools.

Proposition 16 (P16): Academics should develop new assessment strategies that ChatGPT cannot easily replicate.

Potential bias and falsified information in information processing

Large language model use, including ChatGPT, in tertiary education presents challenges due to the potential introduction of bias and falsified information in information processing (Chen et al., 2023; Hartmann et al., 2023). The constructivist theory of learning emphasises that learners construct meaning through reflective activity and prior knowledge and experience (Pritchard, 2017; Hein, 1991). While ChatGPT has the potential to aid in higher education by providing assistance with research, analysis, and writing tasks, concerns surrounding potential bias and falsified information need to be addressed to ensure its use is ethical and reliable (Dwivedi et al., 2023; Firat, 2023; Gatzemeier, 2021; Silberg & Manyika, 2019). Moreover, insufficient training of data sets can lead to biased models and outputs, reinforcing misconceptions held by learners rather than helping them construct accurate knowledge (Lund & Wang, 2023; Dwivedi et al., 2023; Pritchard, 2017).

Furthermore, ChatGPT-generated text may contain factual biases due to biased training data, which could perpetuate misconceptions held by learners (Karim, 2023). If learners interact primarily with ChatGPT, they may not engage in collaborative learning and discussion, which is essential in constructivist theory to critically evaluate information and construct knowledge (Muhajirah, 2020; Zajda, 2021; Hein, 1991). The falsified information and references generated by ChatGPT would potentially mislead students (Hsu & Thompson, 2023). Therefore, it is crucial for students to fact-check all ChatGPT output during interaction with the system to identify potential biases or inaccuracies to construct an accurate understanding of the topic.

While OpenAI has announced that the new version of ChatGPT will support plugins that allow it to access the latest information and data, these developments do not negate the potential issues discussed above associated with the biases and falsified information (OpenAI, 2023). Tertiary educators and students must address these concerns when using this technology for academic purposes to ensure its use is ethical and reliable. Therefore, it is obvious that the challenges

of ChatGPT on potential bias and falsified information in information processing must be acknowledged and addressed in tertiary education to ensure that learners construct accurate knowledge and engage in collaborative learning and discussion.

Proposition 17 (P17): Addressing bias and falsified information in ChatGPT is crucial for ethical and reliable use in tertiary education, allowing students to construct accurate knowledge.

Evaluate graduate skill sets

ChatGPT and other LLMs are not designed to assess or evaluate graduate skill sets and requirements (Atlas, 2023). However, the constructivist theory of learning suggests that learners actively develop knowledge for themselves through experiences and interactions with others rather than passively acquiring it through external tools like ChatGPT (Geary, 1995). Nonetheless, the use of ChatGPT and similar AI models may impact the development of certain graduate skills, such as critical thinking and problem-solving, if it is used for rapid and superficial learning (Seo et al., 2021). Alternatively, the appropriate use of ChatGPT as a tool of assistance could facilitate the development of some graduate skills (Dwivedi et al., 2023).

Graduate skills, including critical thinking and problem-solving, communication, collaboration and teamwork, leadership, adaptability, digital literacy, global and cultural awareness, ethics, and professionalism, are essential for future professional and personal success (Abelha et al., 2020; Osmani et al., 2019; Oliver & de St Jorre, 2018; University of Adelaide, 2022; University of Sydney, 2022). Constructivism emphasises the importance of discovery-based and experiential learning methods in which learners are encouraged to engage in authentic, real-world problems and situations to construct their own understanding of the subject matter (Fosnot, 1996). Therefore, the incorporation of these methods into the curriculum and assessment could promote the development of graduate skills beyond the use of ChatGPT alone.

The use of ChatGPT presents an opportunity to incorporate artificial intelligence literacy as part of graduate skills, preparing graduates for effective workplace application of large language models that may replace some existing jobs and create new ones (Cradle, 2023). As ChatGPT and other AI models become increasingly prevalent in the workplace, graduates must be equipped with the necessary knowledge and skills to navigate these technologies effectively. The development of artificial intelligence literacy could include an understanding of the capabilities and limitations of these models, as well as the ethical and social implications of their use. This skill development could be scaffolded and gradually developed through strategic curriculum design and embedded into assessments to differentiate uniquely human capabilities (Cradle, 2023). Therefore, incorporating AI literacy as part of graduate skills could enhance graduates' employability and preparedness for the rapidly evolving job market.

Proposition 18 (P18): The use of ChatGPT in learning and assessment can impact the development of graduate skills, such as critical thinking and problem-solving.

Assessing students' learning outcomes

The use of ChatGPT in higher education poses challenges for assessing student learning outcomes based on the principles of constructivist theory. The constructivist theory emphasises the importance of active engagement with the learning material through the manipulation of materials and social interaction (Schunk, 2012). However, the use of ChatGPT for assessment is a passive process and does not allow for social interaction, hindering students' ability to construct meaning through reflection on their experiences (Biggs, 2014). Furthermore, using ChatGPT in higher education presents a challenge in assessing higher-order skills such as critical thinking and problem-solving (Liu et al., 2014). Students who rely on ChatGPT for answers may not engage in critical thinking and reflection, limiting their learning outcomes (Firat, 2023). This could also make it challenging to evaluate the effectiveness of group learning activities and assess students' ability to work collaboratively.

Another challenge of using ChatGPT for assessment is ensuring the authenticity of students' work (Sambell et al., 2019). Students could easily copy and paste responses generated by ChatGPT without fully engaging in the learning material. This raises concerns about fairness and equity in assessment design, regardless of students' backgrounds, abilities, or access to ChatGPT (Tai et al., 2022; Hemsley et al., 2023; Lim et al., 2023; Vogels, 2021). To enhance assessment authenticity and rigour when using ChatGPT, the assessment design should shift towards assessing students' learning processes rather than the final outcomes that are at high risk of being replicated by ChatGPT (Abramson, 2023). Instructors can break assessments into chunks or ask students to work on a draft and improve it based on feedback received throughout the term, promoting active engagement with the learning material. However, there is a risk of missing key learning outcomes if the assessment design focuses too much on making it 'AI-secure' (Lupyan cited in Abramson, 2023). Therefore, avoiding biases towards certain types or formats and ensuring constructive alignment is crucial to enhance assessment security while avoiding missing key learning outcomes.

Proposition 19 (P19): Assessment design for evaluating student learning outcomes using ChatGPT should prioritise assessing learning processes, avoid biases, and ensure constructive alignment for enhanced authenticity and rigour.

Discussion

The paper presented five challenges and five benefits of ChatGPT for the higher education sector in the backdrop of the constructivism learning theory (Figure 1). There were 19 propositions presented in the paper—twelve for the benefits and seven for the challenges. The first benefit is ChatGPT's ability to facilitate adaptive learning. This benefit holds that generative AI, such as ChatGPT, can customise

learning experiences to individual learners' needs through personalised feedback. Adaptive learning facilitates acquiring real-world experience based on the learner's existing knowledge in an active learning environment, as the constructivist theory supports. As an extension to adaptive learning, the second benefit emphasises ChatGPT's ability to provide personalised feedback to the learner in the higher education environment. As indicated above, personalised feedback helps build new knowledge into existing knowledge and scaffolding to support the learning process. This process, supported by contextual inputs, helps the learner gain real-world experiences that lend to developing critical thinking and problem-solving skills, as the constructivist theory postulates. The third benefit revolves around supporting research, writing, and data analysis. These supports equip a person to be an independent, active learner who explores real-world experiences gaining cues from the contextual elements and social interactions as expounded by the social constructivist theory. The fourth benefit focuses on the automated administrative services provided by ChatGPT for the students, staff, and academic staff in higher education environments. This benefit allows personalised feedback to the learners, administrators, and educators and acts as a contextual supporting factor that creates the right environment for active learning. The fifth benefit recognises ChatGPT's capability to aid in developing innovative assessments. Among other things, the innovative and authentic assessment activities thus developed would promote cooperative learning that allows social interactions consistent with the principles of constructivist theory. The innovative assessments would foster creativity and critical thinking skills that contribute to a more holistic and meaningful evaluation of student learning outcomes.

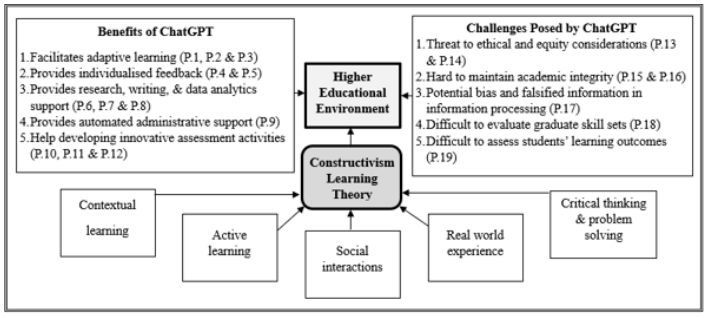

Figure 1: The benefits and challenges of ChatGPT – an integrated framework.

The widely deliberated challenge of using ChatGPT stems from ethical and equity considerations and academic integrity. The first two challenges of the paper discuss these two issues. The use of ChatGPT easily triggers academic integrity concerns, such as plagiarism, contract cheating, and collusion, to name a few. The unethical and unfair use of ChatGPT also lends itself to inequity as it is not accessible to all. Furthermore, the basic constructs of constructivist theory, such as social interactions, contextual learning, active learning, real-world experience, and critical thinking and problem-solving skills, would be severely compromised by the academic integrity issue. Another major issue about ChatGPT is the technology's unreliability in consistently providing accurate information. This unreliability shakes the foundation of the constructivism learning theory and learning basics. Another shortcoming of using ChatGPT is its inability to evaluate and reinforce graduate skill sets. Graduate skills such as critical thinking, problem-solving, collaboration, and teamwork would need real-world experiences, contextual inputs, and social interactions that ChatGPT cannot fully support. Additionally, the difficulty of ChatGPT in assessing students' learning outcomes is a perennial issue. Constructivist theory encourages active engagement with the learning material and context of learning. The theory also propagates social interactions, active learning, critical thinking, and problem-solving. A passive process with the overuse of ChatGPT would hinder achieving the right learning outcomes that demand constructing meaning through students' reflections on their experiences. Furthermore, a passive process is unable to assess the effectiveness of collaborative learning activities.

Conclusion

Using ChatGPT and other large language models (LLMs) in higher education presents various advantages and challenges. On the one hand, ChatGPT can assist students in generating ideas for their assessments, research, analysis, and writing tasks, potentially improving their learning experiences. On the other hand, the risk of academic misconduct, bias, falsified information, and inadequate assessment design can impede the development of crucial graduate skills and promote superficial learning. Therefore, tertiary educators and students must exercise caution when using this technology for academic purposes to ensure its ethical, reliable, and effective use.

To achieve this, higher education institutions must prioritise educating students on the responsible and ethical use of ChatGPT and other generative AI tools. Academics can also devise new assessment strategies that ChatGPT cannot easily replicate, such as evaluating learning processes rather than outcomes. Moreover, tertiary educators must address bias and falsified information in ChatGPT to ensure students construct accurate knowledge and engage in collaborative learning and discussion. Including AI literacy as part of graduate skills could enhance students' employability and readiness for the rapidly evolving job market. Finally, we strongly argue that using ChatGPT in higher education requires a balance between preventing academic misconduct and promoting academic freedom and innovation while prioritising the development of key graduate skills. By doing so, ChatGPT can become a useful tool that enhances, rather than hinders, students' learning experiences.

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