



Adapting to the Future: ChatGPT as a Means for Supporting Constructivist Learning Environments

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Abstract

ChatGPT, an artificial intelligence (AI) language model, holds significant promise for improving the quality and efficiency of teaching and learning. However, its potential challenges and disruptions in education systems require further investigation for a deeper understanding and mitigation. Given that ChatGPT is already being utilized and complete prohibition is unlikely, it becomes crucial to consider how educators can harness its potential to enhance teaching and learning experiences, assuming successful implementation. This article explores the potential benefits and disruptions within the current education system, and proposes strategies for integrating ChatGPT into educational settings from a constructivist learning perspective. It focuses on four educational system attributes: context, collaboration, conversation, and construction. The article particularly emphasizes the utilization of ChatGPT as a means, rather than an end, to enhance student learning within a constructivist learning environment. This approach aims to address present concerns and challenges effectively.

Keywords Artificial intelligent · ChatGPT · Education system disruption · Constructivist learning environments

Introduction

Artificial Intelligence (AI) applications have gained significant interest recently (Hu, 2023; Huang, 2023). The attention to AI applications has been amplified since the release of ChatGPT in November 2022. ChatGPT is a natural language processing model developed by OpenAI that can answer questions, translate languages, and generate text (OpenAI, 2022). It has become the fastest-growing application in history, with over 100 million subscribers in just two months (Hu, 2023). One of the key features of ChatGPT is its ability to produce human-like responses, setting it apart from other language processing technologies. To achieve this, ChatGPT incorporates generic language models extracted from large parts of the internet and can interact with humans through text or voice interfaces (Wollny et al., 2021). This makes it possible for users to interact with computers in a more natural and intuitive way using natural language processing techniques (Kuhail et al., 2023). ChatGPT

is a language processor that has the potential to improve the quality and efficiency of learning and teaching, but its potential disruptions require further study for deeper understanding and mitigation. Educators must consider how to effectively integrate the tool into teaching and learning, taking into account potential benefits and disruptions to the existing system.

This article aims to explore the potential benefits and disruptions that ChatGPT may introduce to existing education systems and uses a constructivist approach to suggest considerations for effectively applying this emerging technology in educational contexts. By identifying and addressing necessary adaptations, educators can ensure the successful implementation of ChatGPT and maximize its full potential benefits in enhancing teaching and learning experiences. Taking a constructivist perspective, this article provides specific guidance on utilizing ChatGPT as a tool to supplement constructivist learning environments, providing its practical application in educational settings.

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Background

The background section provides broader historical and current context in which ChatGPT has emerged. Throughout the history of education, the emergence of new

technologies has transformed the way students and educators interact with information and learning (Chen et al., 2023; Deng & Yu, 2023; Firat, 2023). The educational landscape has undergone significant disruptions, changes, and improvements in the last decade, and the recent popularity of AI chatbot systems like ChatGPT represent yet another challenge and opportunity for rapid, but necessary, change in traditional educational systems. While ChatGPT may seem like a simple tool in its essence, its influence on education is profound, and the ripple effects have the potential to catalyze further transformative changes. While the impact of AI on the educational landscape has been a topic of discussion for decades, the recent rapid advancements in AI have challenged the traditionally slow-to-adapt educational field, highlighting the possible applications and implications of AI technologies in the field of education (Deng & Yu, 2023; Firat, 2023).

OpenAI's rapidly adopted ChatGPT platform is a large language model that is pre-trained on a massive web-based data set, and can complete complex natural language tasks like computer program coding and human-like text generation in response to simple and complex prompts (Cooper, 2023; Kasneci et al., 2023). Due to its recent surge of mainstream use, ChatGPT has rapidly emerged as a controversial technology with great potential and significant implications for application in various industries, including education. Some researchers have posited that ChatGPT may offer new opportunities for growth in the field of education, such as reimagining how we assess student learning, how we guide students to interact with and evaluate AI-generated information, and how we teach students about the responsible and ethical use of emerging technology (Adiguzel et al., 2023; Farrokhnia et al., 2023). Some have credited this text-generator with the potential to improve productivity and student outcomes (Adiguzel et al., 2023; Farrokhnia et al., 2023; Kasneci et al., 2023), while others have warned against ChatGPT's limitations regarding misinformation and educators' concerns over academic integrity (Naumova, 2023; Supiano, 2023).

Although its use presents various challenges, limitations, and ethical considerations, it seems without question that ChatGPT is already here, and it is here to stay—students are already using ChatGPT in personal and educational contexts, despite its challenges. Some administrators and policymakers have moved to block or ban the use of ChatGPT. However, we pose two important questions: Is it even feasible to implement such a ban? And, is banning this technology truly effective? With widespread internet access and the decentralization of information, it would be difficult for schools to completely prevent students from using ChatGPT or other AI in the learning environment. The issue may not be about schools' unwillingness to curb students' use of AI, but rather the practical challenges of

controlling access to such technologies. Without the ability to ban ChatGPT and AI from the learning environment, educators should direct their focus on what they can do to ensure the effective and responsible use of this technology. Given this reality, educators must understand the potential benefits, challenges, and limitations of ChatGPT, and find meaningful ways to use this tool to guide the learning process in the classroom.

The focus of this article is to explore the use of ChatGPT in fostering constructivist learning environments, in which learners actively engage in constructing personally meaningful knowledge (Jonassen et al., 1995). First, we present a brief overview of ChatGPT's recent impact on the education system, including its potential benefits and challenges. Through a constructivist lens, we propose potential implications for the learning context, the process of knowledge construction, and ChatGPT's use as a tool for facilitating collaboration and conversation among learners. Furthermore, we provide practical recommendations for the responsible and effective integration of ChatGPT in education from a constructivist lens.

AI's Impact on Education

The study of Artificial Intelligence (AI) in educational systems is not new, and for decades researchers have postulated about the benefits and consequences of AI technology on the relationships between teachers, learners, and the learning environment. However, the recent rapid adoption of ChatGPT technology into mainstream use during 2022–2023 has hastened the conversation and related research agendas regarding AI utilization in teaching and learning.

Before the development of ChatGPT, prior research has explored the potential of AI-driven chatbots in various educational contexts to impact student satisfaction, motivation, engagement, and learning (Firat, 2023; Hwang & Chang, 2021). Several studies have explored the benefits of utilizing chatbots in educational settings, including their efficacy as tutoring systems, digital assistants, and language learning tools (D'Mello et al., 2012; Hwang & Chang, 2021; Kim et al., 2021; Wu et al., 2020). For example, D'Mello et al. (2012) found that a gaze-reactive intelligent tutoring system improved students' attentional patterns and learning for difficult questions but did not improve engagement or motivation. Chatbot technologies have also been used in educational contexts as personal assistants for time management and productivity (Miller et al., 2019). Wu et al. (2020) suggested that chatbot technology applied as a learning assistant in a K–12 E-learning context could help decrease students' feelings of isolation and detachment in e-learning settings. Similarly, researchers have explored the benefits of chatbots for language learning, which have been shown to increase

practice opportunities and improve learners' speaking skills and proficiency (Kim et al., 2021).

As AI systems continue to evolve in sophistication, it is clear that applications using AI-generated dialog, such as ChatGPT, have the potential to transform how students search for, interact with, and learn information (Winkler & Söllner, 2018). Following the ChatGPT trend over the past year, a rapidly-expanding collection of literature has explored the utility of ChatGPT and discussed the various ways—both positive and negative—that this technology might transform learning and education.

ChatGPT in Education

Potential Benefits for Teaching and Learning

Several recent studies have suggested that using ChatGPT in an educational context creates opportunities for improved teaching and learning (Adiguzel et al., 2023; Cao & Dede, 2023; Cooper, 2023; Farrokhnia et al., 2023; Kasneci et al., 2023). We have organized the potential benefits into three categories: influences on productivity, preparation, and problem-solving within and outside the classroom for both teachers and students.

Productivity

ChatGPT allows students and teachers quick and easy access to information and collaborative conversation, which can help improve productivity related to learning. The ease and speed of information access allows students and teachers to quickly explore ideas and resources, which may increase productivity in learning, research, and writing. For example, Cooper (2023) explored ChatGPT's potential effectiveness as a research and writing tool and cited opportunities for use in writing development and editing. Students and researchers can use ChatGPT as a tool for topic exploration, brainstorming, and outline development, saving more time for reading, critical thinking, writing, or experimentation. When used as a tutoring system, ChatGPT can assist students and provide real-time feedback with complex tasks, such as developing writing skills or program coding (Cooper, 2023). This may save students the time and expense of seeking professional feedback, and students may be able to spend more productive time in critical thinking and reflection of the writing or research process. Furthermore, recent studies have highlighted ChatGPT's potential to significantly enhance teacher productivity. Terwiesch (2023) demonstrated that the time spent on academic tasks, such as developing exams, can be halved with the use of ChatGPT. This enhancement equates to doubled operational efficiency.

Kashyap (2023) and Owston (2023) also pinpointed the potential of this tool to significantly reduce teachers' administrative burdens. Importantly, these time savings offer teachers more opportunities for meaningful engagement with their students (Alshater, 2022; Terwiesch, 2023). ChatGPT may also be a useful time management and project management tool because it offers students and teachers personalized assistance with basic writing and communication tasks, it can be used to organize schedules and to-do lists, and it assists in rapid brainstorming and idea generation. ChatGPT has also been shown to be a productive language learning tool, because of its easy access and constant availability (Kim et al., 2021). Even in the absence of a native language speaker, language learners can use ChatGPT to increase their practice time and improve their proficiency and communication skills.

Preparation

Teachers and students can benefit from the use of ChatGPT to aid in instructional preparation, and to identify and fill students' learning gaps. Kasneci et al., 2023 highlighted various ways that large language models like ChatGPT may assist with teaching preparation, such as aiding in the development of lesson plans and instructional activities, increasing engagement during language learning, assisting with basic research and writing development tasks, and creating opportunities for personalized learning. When used for brainstorming, ChatGPT's text output offers an efficient synthesis of information and ideas, which can help teachers save time when creating relevant lesson plans and instructional materials (Farrokhnia et al., 2023; Zhai, 2022). This application may be especially beneficial for novice teachers who may have less experience applying pedagogy in the classroom, and can use ChatGPT as a proactive, collaborative tool to explore and prepare lesson plans or curricula (Farrokhnia et al., 2023). Research has also supported the potential benefits of ChatGPT for improving students' academic preparation, such as providing opportunities for communication and writing practice, enhancing peer communication skills, helping students identify gaps in their understanding of a topic, and providing personalized responses based on specific learning preferences and prompts (Farrokhnia et al., 2023). These features may be especially beneficial in supporting underserved students or students with learning disabilities (Jain et al., 2018).

Problem-Solving

Various studies have supported ChatGPT's potential to facilitate critical thinking and complex learning (Cotton et al., 2023; Farrokhnia et al., 2023). Rudolph et al. (2023)

discussed ChatGPT as an innovative tool for both teaching and learning and suggested that ChatGPT may (and should) serve as a catalyst for developing innovative assessments and learner-centered teaching strategies. Specifically, Rudolph et al. (2023) emphasized that when used as a learning aid, ChatGPT can help facilitate experimentation, collaboration, and learner-centered approaches such as project-based learning and problem-based learning, which encourage knowledge construction through interaction. ChatGPT could assist teachers and learners in designing instruction and exploring information related to projects focused on real-world application. For example, in a high school biology project-based learning classroom focused on the effects of pollution on local ecosystems, teachers can use ChatGPT to curate a list of relevant topics and materials, which can serve as initial resources for students. As the students work together towards a solution and delve deeper into specific subtopics, they can engage ChatGPT for instant insights and real-time information. Students might ask questions like, ‘Which pollutants most affect freshwater lakes?’ or ‘How does urban pollution impact bird reproduction?’ Furthermore, when students brainstorm solutions, ChatGPT can provide insights from global case studies or suggest current technological interventions for further exploration.

Current Challenges and Education Systems Disruptions

Despite the numerous potential benefits of ChatGPT as a teaching and learning tool, researchers have also highlighted causes for discussion and concern about possible disruptions to the field of education, as this still unregulated technology presents issues with academic integrity, data privacy, and other ethical concerns (Cooper, 2023; Firat, 2023; Thorp, 2023). These disruptions may include shifts in ways of teaching and learning, changes in student-teacher interactions, changes in assessment practices and policies, and ethical considerations regarding the use of ChatGPT in education. In light of ChatGPT’s disruption of traditional educational structures, it is important to remember that this technology is already in use, and it is unlikely that educators and policymakers can fully ban the use of this technology in educational environments. In this section, we delve into the three primary challenges and potential disruptions to education systems that may arise from ChatGPT’s emergence: Academic integrity issues, misinformation risks, and threats to critical thinking.

Issues with Academic Integrity

A rash of studies have cautioned about the potential ethical implications posed by ChatGPT, such as risks to academic

integrity and the originality of students’ work (Kasneci et al., 2023; Rasul et al., 2023; Supiano, 2023). Educators are concerned that students can rely on ChatGPT’s text generation functions to effortlessly complete essays, online exams, and other written assignments, which would bypass the learning process and raise issues of plagiarism and cheating. Using ChatGPT in this manner to produce an outcome rather than as a tool to assist in the learning process can negatively affect student learning outcomes, critical thinking, and problem-solving skills (Kasneci et al., 2023). When used as a substitute for learning rather than a learning supplement, ChatGPT’s ability to provide rapid information could limit students’ abilities to solve problems or develop their own conclusions. To mitigate cheating, educators should focus on integrating this technology into the learning environment in a way that promotes collaboration, critical thinking, and problem solving, rather than replacing these skills.

Risks of Misinformation

A number of studies have described information accuracy as a significant limitation of ChatGPT, citing frequent misinformation and potential for biased output (Firat, 2023; Kasneci et al., 2023; Naumova, 2023; Rasul et al., 2023; Thorp, 2023). As a language-generating model, ChatGPT is able to generate plausible output based on learned patterns, but it does not possess a deeper understanding of the output generated (Farrokhnia et al., 2023). While it can produce acceptable answers to complex problems, users and researchers have noted that it lacks depth and conceptual understanding (Farrokhnia et al., 2023; Gao et al., 2022). Another limitation is that ChatGPT lacks real-time internet access, so its responses are limited to the dataset it was trained on, which delimits its scope of information up to the year 2021 (Sallam, 2023). Due to these limitations, ChatGPT outputs frequently lack evidence-based responses or supporting references which is particularly problematic in science-based education (Cooper, 2023). If learners or teachers rely on this tool too heavily during instruction, propagating false information will severely limit the learning process and prevent students from developing higher-order thinking. Educators, administrators, and students should be aware of ChatGPT’s information limitations, and be prepared to evaluate the credibility and quality of ChatGPT-generated responses.

Threats to Critical Thinking

Many educators still hold the decades-old concern that AI technologies and language learning systems may replace traditional teaching and instruction in the near future (Lea, 2020). The emergence of ChatGPT has rekindled those anxieties among educators, who pose concerns about the role of teachers in the future, and how AI advancements will

impact the job market in education (Adiguzel et al., 2023). However, the current challenges and limitations of ChatGPT highlight the critical need for human instructors who can evaluate the limitations of this technological tool, implement it responsibly in the classroom, and guide students in its effective implementation. The ChatGPT platform itself lacks higher-order thinking abilities, and this lack of discernment may pose threats to students' development of critical thinking skills. If students depend on ChatGPT to produce exam and assignment content, bypassing the learning process can have negative consequences for knowledge construction and critical thinking skill development. According to Farrokhnia et al. (2023), overuse of ChatGPT oversimplifies the process of obtaining information, which could decrease students' motivation to learn, and have negative consequences for critical thinking, creativity, and problem-solving skills over time. Overdependence on ChatGPT can also have negative consequences for educators who rely on its use for writing or developing lesson plans, including reduced creativity and diminished quality of connections with students (Farrokhnia et al., 2023). While it is unlikely that AI will fully replace human educators in the near future, we are currently at a critical juncture in the field of education, and teachers must be aware of ChatGPT's challenges and how to mitigate them in the classroom.

The emergence of ChatGPT represents a significant disruption and catalyst for systemic change in the field of education. It has become imperative for educators and administrators to learn how to adapt the way we approach teaching and learning. Thus, it is critical to consider how we can harness the potential of ChatGPT in a productive and ethical manner, while also addressing the challenges associated with its effective use in education.

Systems Thinking View

While these disruptions may be viewed in isolation, it is essential to comprehensively address the potential disruptions as they are all interconnected within the education system. Systems thinking is a holistic approach that attempts to understand complex systems from a big picture perspective and emphasizes the ways in which the interrelated parts of a system contribute to successful functioning (Shaked & Schechter, 2019). This holistic perspective recognizes that changes to one part of a system may have an effect on all of the other interconnected parts. Therefore, we must understand the interactions among ChatGPT and the individual elements, such as educators, learners, instructional approaches, and assessments, as well as the overall impact of ChatGPT as a transformational learning tool within the larger educational system. The educational system, like technology, is constantly evolving and responding to challenges and disruptions. Therefore, adopting a systems thinking

perspective encourages an understanding of how learners interact with ChatGPT technology in the learning environment, which will help educators and administrators respond and adapt to technological changes, and continue to implement systemic improvements.

Constructivism and Constructivist Learning Tools

In constructivist theories, students learn through a dynamic knowledge-creation process shaped by the surrounding learning environment, tools, and experiences (Ertmer & Newby, 1993; Rasul et al., 2023). Constructivism examines how students process information to create their own interpretations and mental models based on their interactions within the learning environment, rather than passively receiving information from an instructor (Ertmer & Newby, 1993; Rasul et al., 2023; Schunk, 2012). Thus, constructivist educators aim to facilitate active learning that is relevant to students' needs and goals by providing relevant tools, content, and resources to develop critical thinking and problem-solving skills (Rasul et al. 2023). Educational technology has been shown to be an effective tool when integrated within a constructivist learning environment, and has been shown to influence how students access, interpret, and process information to develop knowledge (Rasul et al., 2023). Learning technologies can assist in knowledge transfer by allowing students to maintain autonomy over their own learning process while simultaneously creating opportunities for interactive, engaging learning experiences in which students explore, experiment, and solve problems in the educational environment (Başer & Mutlu, 2011; Makewa, 2019).

As discussed, many educators have concerns over students' use of ChatGPT to simply generate answers or written essays, rather than invest their time in the learning process. Students using ChatGPT's language output as an outcome for assignment completion, rather than a means to supplement the learning process, would passively acquire and reproduce information, but would lack quality learning and critical thinking or problem-solving skills. This scenario illustrates the concerns of bypassing quality learning and critical thinking, similar to traditional teacher-centered instruction where knowledge is passively transmitted from a teacher (or, in this case, from AI) to the students. More critically, this example also highlights potential issues of academic dishonesty or plagiarism arising from the improper use of ChatGPT. However, according to Jonassen et al. (1995) "the important epistemological assumption of constructivism is that knowledge is a function of how the individual creates meaning from his or her experiences; it is not a function of what someone else says is true" (p. 11). Therefore, we propose that through the constructivist paradigm, the student serves as the central role

of learning, with ChatGPT as a tool to support their learning process. Students and instructors can go beyond passively consuming the output of ChatGPT, to actively using it as an interactive practice tool to help learners co-construct knowledge in the classroom. Rather than simply absorbing and reproducing ChatGPT's outputs, students in a constructivist learning system must interact with and interpret the information gathered from conversations with ChatGPT, in order to construct their own meaning. Therefore, the careful and intentional use of ChatGPT as a learning tool has the potential to facilitate a constructivist learning environment by providing a dynamic platform through which students can ask questions, explore complex topics, receive just-in-time support and immediate feedback, and actively develop their knowledge and understanding.

ChatGPT as a Constructivist Learning Tool

Research has demonstrated that AI can be utilized through different theoretical frameworks to support learning in education. Ouyang and Jiao (2021) proposed three paradigms for AI implementation: an AI-empowered paradigm aligned with behaviorism, an AI-empowered paradigm aligned with connectivism, and an AI-supported paradigm aligned with cognitive and social constructivism. These paradigms primarily explore the interaction between AI and humans as learners, highlighting the importance of learner-centered, data-driven, and personalized learning in the future development of AI in education. The constructivist perspective emphasizes the significance of actively engaging learners in the construction of knowledge, fostering collaborative interactions, and promoting meaningful conversations within the learning process. As stated by Jonassen et al. (1995), “constructivist environments engage learners in knowledge construction through collaborative activities that embed learning in a meaningful context and through reflection on what has been learned through conversation with other learners” (p.13). As educators determine how to effectively integrate ChatGPT in the learning system, they should consider its alignment with the learning context, and how this tool can facilitate collaborative and interactive conversations to supplement knowledge construction (Jonassen et al., 1995).

According to Jonassen et al. (1995), constructivist learning systems consist of four key attributes: the context in which the learning is situated, the process of constructing knowledge, collaboration throughout the learning process, and conversation between learners and tools within the learning environment. In the following section, we propose recommendations and strategies for educators to integrate ChatGPT according to these four systems elements: context, construction, collaboration, and conversation (Jonassen et al., 1995).

Meaningful Learning Context

A constructivist learning system views knowledge construction as context dependent (Bruner, 1966; Jonassen et al., 1995; Vygotsky & Cole, 1978). Context refers to the characteristics of the real-world environment in which the learning task would typically take place. Applying instructional tools to a constructivist learning setting is an opportunity for teachers to focus on facilitating students' learning or competency through attainment-based assessment, rather than traditional test-based or essay-based assessments. Active learning strategies, task-based learning approaches, or learner-centered learning approaches often prove more effective for meaningful knowledge construction, as they closely simulate real-world problems and engage students in finding a solution or producing an artifact. In this way, ChatGPT can serve as an effective tool to support knowledge construction, aiding students in exploring and deepening their understanding during their learning process. This approach can also address ethical concerns associated with using ChatGPT merely to generate answers for tests or essays. In the context of learner-centered learning approaches such as project-based learning, problem-based learning, and inquiry-based learning, ChatGPT can serve as a valuable tool to provide instructional support or overlays when students encounter learning gaps (Reigeluth, 2012). One limitation of learner-centered learning approaches is the lack of real-time support from the instructor, particularly in online learning environments (Reigeluth, 2012). Unlike traditional search engines that present a vast array of information, ChatGPT offers students an interactive, personalized, and just-in-time support mechanism. It has the capacity to contextually understand students' questions and provide real-time, tailored responses. This unique feature is particularly beneficial when peers or instructors are unavailable, guiding students to delve deeper into topics and aiding in the refinement of their ideas in their learning process as they work towards producing their project outcomes. When teachers guide students in the responsible use of ChatGPT by providing meaningful learning contexts such as using the tool to supplement a learner-centered approach, students can be better positioned to use ChatGPT in a more meaningful way for autonomous knowledge-building. In such environments, the tool enhances exploration and deep understanding. Conversely, in teacher-centered settings without constructive guidance, the risk is that students might use such tools to retrieve test answers or assemble essays.

Collaboration Activities

Collaboration plays a vital role in the learning process, fostering the development, testing, and evaluation of various

beliefs and hypotheses within educational settings (Jonassen et al., 1995). By engaging in collaborative efforts, learners have the opportunity to articulate their underlying thought processes and strategies, which in turn enables them to construct new knowledge and adapt existing knowledge structures. Therefore, when viewed through a constructivist lens, ChatGPT has the potential to assist in knowledge creation in a constructivist learning environment in a number of roles, including tutors, assistants, and partners for learning (Deng & Yu, 2023). According to Rasul et al. (2023), ChatGPT’s conversational and feedback functions can facilitate the learning process by “scaffolding students’ prior knowledge and experiences to help them construct new knowledge” (p. 3). Through an appropriate set of prompts, ChatGPT’s algorithms are trained to build on previously existing information to generate new knowledge (Kasneci et al., 2023; Rasul et al., 2023). ChatGPT can also serve as a virtual participant and collaborative partner in group discussions, offering insights, asking probing questions, and contributing to the exploration of ideas. For example, groups of learners can interact with ChatGPT as they would with a fellow group member, allowing for a more comprehensive and diverse exchange of perspectives. When learners are brainstorming or generating ideas, ChatGPT can assist by offering prompts, proposing related concepts, or suggesting alternative approaches. This opportunity for collaboration fosters a creative and exploratory environment in which learners can expand their thinking and uncover innovative solutions to current real-world problems.

Conversation with Others

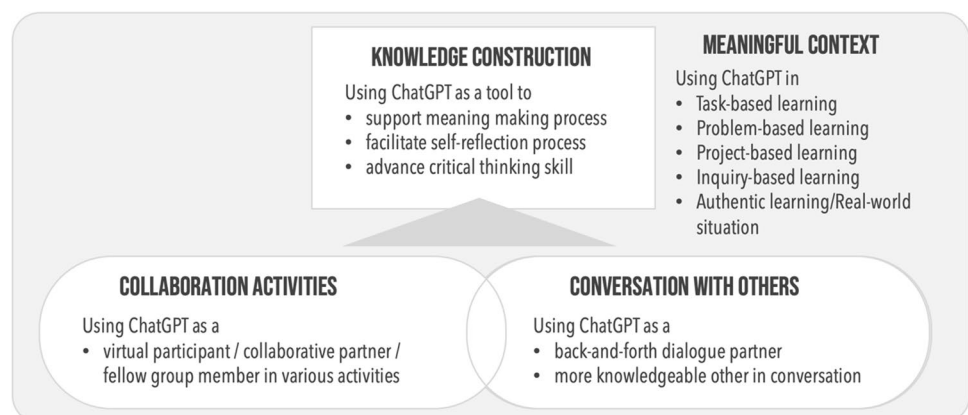
Conversation naturally accompanies collaboration, as individuals and groups engage in discussions to collectively devise strategies for addressing specific problems in real-world contexts (Jonassen et al., 1995). Learners reflect on their existing knowledge, identify what additional information is needed, evaluate the feasibility of different approaches, and assess their potential effectiveness.

Conversation holds significant importance in the process of constructing meaning, as language serves as a crucial medium through which knowledge is conveyed and shared among individuals (Bruner, 1990). Through conversational interactions, ChatGPT can prompt learners to move beyond traditionally transactional means of passively acquiring information, toward the interpretive process of reflecting on their learning experiences, critically analyzing their progress, and articulating their thoughts. This reflective dialogue can deepen understanding and promote metacognitive skills.

For example, learners can engage in a back-and-forth dialogue with ChatGPT, discussing problems, seeking guidance, and jointly exploring potential strategies or solutions. Rasul et al. (2023) suggest that in this way ChatGPT can serve as a “More Knowledgeable Other” in students’ learning process by engaging them in conversation and providing feedback about knowledge gaps, which can guide students through an adaptive learning process. Furthermore, learners can use ChatGPT as a sounding board for their ideas and receive instant feedback. ChatGPT can simulate a peer-like interaction, providing constructive comments, suggestions, and alternative viewpoints to help learners refine their thinking and enhance their work.

It is important to note that many of the concerns surrounding ChatGPT and academic integrity revolve around its use as an end product, rather than as a tool to develop and expand mental models in the learning process. When ChatGPT is used as an end product, such as for generating essay content, ethical concerns come into play. Specifically, there is an increased risk of student cheating and plagiarism when utilizing ChatGPT-generated content, given the lack of reliable ways to detect AI-generated material (Supiano, 2023). To address the challenge of potential cheating, it is crucial to use this tool as a means toward learning rather than just an end result. By focusing on the learning process and incorporating critical thinking skills, educators can mitigate the potential issues associated with ChatGPT output.

Fig. 1 ChatGPT as a constructivist learning tool



Knowledge Construction

The construction of knowledge involves an active process of expressing and contemplating ideas within a given context. The knowledge that is formed originates from the individual's mind and is influenced by their experiences and interpretations of the context (Jonassen et al., 1995). These experiences can also occur in real-world situations. Learning environments adhere to constructivist principles when they enable individuals or groups to generate their own understanding and significance from their experiences, rather than merely adopting the teacher's interpretation or prescribed content.

ChatGPT can be used as a tool to aid learners' knowledge construction as it possesses self-improvement or self-learning capability. Unlike other AI chatbots, ChatGPT employs a sophisticated language processing model called generative pre-training (GPT). GPT utilizes reinforcement learning with human feedback to enhance its language generation (Mann, 2023). This enables ChatGPT to adapt and refine its responses based on input from human evaluators (Shen et al., 2023). ChatGPT continuously benefits from the expansion of its training data, allowing it to remain updated and enhance its accuracy over time (Rudolph et al., 2023). Of course, teaching assessments may need to change and be more geared towards critical thinking and reflection on the knowledge construction process. It is important to be mindful that ChatGPT's generated content may not always be reliable, requiring critical thinking and evaluation. Educators should engage students in discussions about the limitations, misinformation, and data bias inherent to ChatGPT. Teaching students to assess information critically, think critically, and evaluate validity can help them navigate and make informed decisions when using ChatGPT. Teachers can also redesign assessments to focus on the use of ChatGPT as a tool to assist in knowledge development, rather than merely an output generator. For example, ChatGPT output can be used for brainstorming, creating outlines, or as a "find the mistake" exercise that requires students to critically appraise the information generated in conversation with ChatGPT, and then provide their personal conclusions or reflections based on the outcome of the conversation (Nau-mova, 2023). Educators may design assessments that prompt students to analyze their dialog with ChatGPT, evaluate how they arrived at a certain conclusion, explain why they did or did not accept ChatGPT's output, and reflect on the process of prompting and evaluating the conversation and how they reached their own conclusion.

Students and teachers need to develop a critical eye to recognize elements of ChatGPT dialog or content that are not correct or represent superficial information. Training students to vet ChatGPT's information output for validity and concision can be an effective critical thinking activity, which may also mitigate potential cheating issues. By

implementing ChatGPT as a collaborative cognitive tool in the learning environment, educators can aim to enhance active learner engagement and facilitate students' involvement in the process of constructing knowledge, which empowers them to take an active role in shaping their understanding and participating in the learning process (Bruner, 1990; Duffy & Jonassen, 2013; Jonassen, 1999).

Figure 1 summarizes the use of ChatGPT as a constructivist learning tool according to the four education systems elements: context, construction, collaboration, and conversation.

Conclusions

In this article, we have adopted a constructivist learning perspective to propose recommendations and strategies for educators to integrate ChatGPT, focusing on four educational system attributes: context, collaboration, conversation, and construction (Jonassen et al., 1995). Despite the challenges, limitations, and ethical issues associated with using ChatGPT, its presence and growth in both personal and educational contexts are undeniable. However, while applying the strategies discussed in this paper, it is essential to remain aware of the fact that we have only touched upon a limited number of benefits and challenges. Continuous exploration and critical evaluation are crucial as the landscape of AI in education continues to evolve. Thus, it is essential to contemplate how educators can leverage the potential of ChatGPT to enhance teaching and learning experiences, assuming successful implementation. Importantly, we should regard ChatGPT as a means to support the learning process in education, rather than as an end in itself to create or produce artifacts.

Future research should focus on examining how the strategies suggested in this article can incorporate ChatGPT into constructivist learning environments in various settings. Conducting experimental studies to evaluate the effectiveness and efficiency of these strategies will help create a detailed and comprehensive guideline for using ChatGPT in education from a constructivist approach. This will advance the knowledge base of using ChatGPT in education. The guideline will serve as a valuable resource for educators seeking to integrate ChatGPT into their instructional practices, ensuring alignment with pedagogical principles and enhancing the learning experience for students.

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