

The role of chat generative pre-trained transformer in facilitating decision-making and the e-learning process in higher education

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ABSTRACT

Digital technology and artificial intelligence technologies have been progressing rapidly, thus giving rise to intelligent chatbots such as chat generative pre-trained transformer (ChatGPT). These chatbots make searching for information more efficient and provide higher education institutions with assistance in decision-making. The goal of this research is to explore the capabilities of ChatGPT technology and its role in enhancing the e-learning process. Moreover, it seeks to determine whether ChatGPT can provide useful suggestions to improve the decision-making process in higher education. ChatGPT is effective in an e-learning environment for the following reasons: it facilitates personalized learning experiences, offers real-time support, and enhances decision-making by leveraging natural language processing capabilities. As suggested by the findings, ChatGPT has significant potential in higher education, as demonstrated by its ability to improve interactive participation, educational strategies, and educational outcomes. This study highlights the importance of incorporating ChatGPT into higher education settings to improve e-learning and decision-making.

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1. INTRODUCTION

Artificial intelligence (AI) is an area of computer science that involves developing intelligent machines that replicate human thinking and can accomplish tasks that generally entail human-like intelligence. These tasks include the ability to learn, reasoning, adapting, understanding natural language (NL), image recognition, and decision-making [1]. AI concepts, including chatbots, were first developed in the 1950s, when scientists started to explore the concept of AI. ELIZA was the first AI program that was developed to mimic human conversations. Advancements in AI technology in succeeding decades have given rise to chatbots that are able to handle more complex inquiries [2].

Chatbots can automate tasks and provide high-quality customer service, which is why they have become popular in various fields, including health care, consumer services, education, and academic advising. Fast, reliable responses to inquiries are crucial in these fields, which is why chatbots are useful [3]. One of the features that make chatbots effective is natural language processing (NLP), which allows chatbots to understand and interpret human inputs and produce appropriate responses [4]. Chat generative pre-trained transformer (ChatGPT) is an AI-powered chatbot that was developed by openAI and trained on a version of the GPT architecture, known as GPT-3, one of the largest and most powerful language models that are

currently being used [5]. Since its launch in November 2022, ChatGPT has been the subject of intense interest both from the public and the academic community [6]. A particularly notable feature of ChatGPT is its ability to provide human-like responses to text input at a far more advanced level than that of previous AI models by leveraging deep learning techniques [3], [7].

One of the potential applications of AI that has recently attracted growing attention is as an e-learning tool, primarily because it can make education more effective and accessible. ChatGPT has captured widespread attention as one such AI tool, garnering one million users within five days after it was launched. ChatGPT is used widely, allowing people to directly experience the capabilities of AI in the e-learning process. In higher education, ChatGPT allows students to receive support quickly and have a fast, convenient way of generating interconnected information, thus ensuring that they are continuously engaged and motivated during e-learning [8]. E-learning is enhanced through the NLP and speech recognition technology embedded in ChatGPT. The interactive and immersive learning experience provided by chatbots enables students to improve their decision-making capabilities and have more access to reliable information. Implementing ChatGPT in e-learning can potentially transform how education is approached, making it more accessible, engaging, and effective for students of diverse ages and backgrounds [9].

The goal of this study is twofold. First, it aims to explore the role played by ChatGPT in facilitating the decision-making and e-learning process in higher education. Second, it aims to answer the following questions:

- In what way can ChatGPT, as an AI-powered chatbot, contribute to the decision-making process in higher education?
- How can ChatGPT be used to enhance students' e-learning experience in a higher education setting?
- What are the possible advantages and issues that could be faced in the implementation of ChatGPT in the context of e-learning and decision-making?

This paper is structured as follows: a review of the literature on OpenAI, GPT model evolutions, and an overview of ChatGPT's potential applications are presented in section 2. The role of ChatGPT in enhancing e-learning and decision-making processes in higher education is discussed in section 3. The conclusions are given in section 4.

2. LITERATURE REVIEW

2.1. OpenAI and GPT models

OpenAI is a research institution whose goal is to develop advanced AI systems that are reliable and secure and provide beneficial services to the public [10]. Their primary goal is to develop what they refer to as "friendly AI", which can work in collaboration with people to solve complex problems and benefit society [11]. OpenAI was founded in December 2015 by leading figures in technology, including Sam Altman and Elon Musk [12]. Since it was established, OpenAI has become one of the world's top AI research laboratories whose staff of engineers, researchers, and scientists are focused on advancing the state of the art in AI [13]. OpenAI achieved an important step forward in machine learning with its June 2018 release of the language model GPT-1. GPT-1 was pre-trained on a large corpus of text data and could respond to a given input or prompt in a human-like manner [14]. The total parameters of GPT-1 numbered 117 million. Thus, GPT-1 was considered a large model when it was released, and it was trained using a deep learning method called transformer on large amounts of data acquired from the internet [15].

GPT-1 was not as advanced as later versions, yet it was remarkable in that it showed the potential of using large-scale pre-training to improve language generation tasks. Moreover, GPT-1 was a benchmark for NLP scholars, serving as a major advancement in the development of language models, and laid the foundation for the development of more advanced models [16]. GPT-2 was considerably more advanced than GPT-1 and had 1.5 billion parameters, thus being one of the largest language models when it was released in 2019. GPT-2 was trained on a large text corpus that included websites, books, and other written materials through language modeling. Similar to its predecessor, GPT-2 was designed to predict the next word in a sentence, which it determines based on the previous words in the sequence [17]. Aside from having an improved ability to generate longer and more coherent text sequences, GPT-2 could also adapt to new tasks better. Various downstream tasks could be completed with GPT-2's pre-training, including sentiment analysis, question answering, and text classification [18].

GPT-2 obtained state-of-the-art results on various tasks, most notably in generating high-quality NL text. Distinguishing between human-written text and the model's output was difficult because the model was able to produce realistic and coherent text [19]. GPT-2 has remarkable text generating capabilities, which is why concerns have been raised about its possible misuse, such as producing fake news or propaganda. Therefore, OpenAI chose not to release its full version, instead offering a scaled-down version with limited functions.

GPT-3 was released by OpenAI in June 2020. With 175 billion parameters, GPT-3 so far stands as the largest language model ever developed. GPT-3 builds upon the success of GPT-2 by advancing its

capabilities in several ways. GPT-3 is also trained through language modeling on a vast corpus of text, including books, web pages, and other written content, thus allowing the model to understand statistical patterns and relationships within the language data, which then enables it to generate meaningful, coherent, and contextually appropriate text [20], [21].

With its new capabilities, GPT-3 is able to expand language generation, generating text in various styles and completing NLP tasks. It performs remarkably well in few-shot and zero-shot learning, and it yields impressive results in article writing, code generation, and music composition [22]. Concerns about the possible misuse of GPT-3 were still raised. GPT-3 is widely used in chatbots, virtual assistants, and automated writing tools, thus being a key achievement in NLP [23]. A preview version of a new AI chatbot, GPT-3.5 (known as ChatGPT) was made publicly available for free on November 30, 2022. OpenAI's estimated value increased significantly as a result of this release and was pegged at US\$29 billion [24]. ChatGPT was pre-trained on a large of text data, which consisted of books, articles, and websites, through language modeling [25]. Pre-training helps ChatGPT identify connections and patterns between words and phrases in NL, thereby gaining the ability to generate coherent and reasonable responses during a conversation [26].

Deep learning has been scaled up significantly after the March 13, 2023, release of GPT-4, a large multimodal language model that can receive inputs in the form of images and text and output text [27]. GPT-4 has not achieved human-level proficiency in real-world scenarios. Nevertheless, its performance on academic and professional evaluation metrics is promising [14]. As of this writing (April 2023), OpenAI has not provided any information on the data, training techniques, or computing resources of GPT-5, which will be launched in November 2023.

GPT models are exceptionally proficient in various NLP tasks such as text generation, question answering, language translation, and sentiment analysis. As a result, they have set new standards of excellence. They have also been implemented successfully in real-world scenarios such as customer service, content creation, and chatbots. Table 1 presents a comparison of the previously mentioned GPT models.

Table 1. GPT model comparison [14]

Model	Model architecture	Used parameters	Release year	Reference year
GPT-1	Transformer decoder (12 levels, 12 heads), followed by linear SoftMax with book corpus: 4.5 GB.	117 million	2018	2023 [15]
GPT-2	The model is based on GPT-1 architecture; however, it includes modified normalization techniques and has been trained on Web Text, which is a dataset composed of 40 GB of text data.	1.5 billion	2019	2021 [17]
GPT-3	The model is an adaptation of GPT-2, but with modifications that enable greater scaling. It has been trained on a massive plaintext corpus of 570 GB.	175 billion	2020	2022 [20]
ChatGPT	The model was developed based on GPT-3.5 architecture, which has been fine-tuned through supervised learning and reinforcement learning techniques, leveraging human feedback for the latter (RLHF).	175 billion	2022	2023 [24]
GPT-4	The model has been trained to perform well in text prediction and RLHF, and it can process inputs in the form of images and text, including data from third-party sources.	100 trillion	2023	2023 [27]

2.2. Potential applications of ChatGPT

With the breadth of ChatGPT's usage scenarios and the opportunity to improve productivity in different industries, novel discussions are centering around ChatGPT applications. In this section, the most significant applications of ChatGPT are highlighted and divided into three domains, which span a vast range of topics in which ChatGPT can offer valuable assistance. Figure 1 presents a few potential applications of ChatGPT.

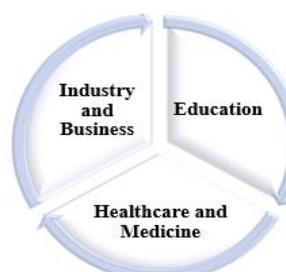


Figure 1. Potential applications of ChatGPT

2.2.1. Industry and business

ChatGPT can be used to generate market analysis summaries and industrial reports automatically; examine the sentiment of customer feedback to inform product development and marketing strategies; provide tailored investment advice based on personal risk profiles and industry objectives, thus facilitating the development of business proposals, marketing materials, and other written materials; and augment customer service operations, thus ensuring quick, accurate, context-specific responses to customer inquiries [14]. Below are just some of the potential applications of ChatGPT in industry and business.

- a. Chatbots for customer services: customer service chatbots that can answer customer inquiries, offer product suggestions, and facilitate transactions can be built using ChatGPT technology [6].
- b. Analysis and prediction of market trends: with ChatGPT, large amounts of financial data can be analyzed, patterns and trends can be recognized, and insights into market conditions and trends can be derived [28].
- c. Investment management: ChatGPT can help develop investment management systems. By analyzing financial data and presenting informed suggestions, ChatGPT can help investors and businesses make sound investment decisions [29].
- d. Fraud detection: ChatGPT can help create systems that can discover financial crimes and fraudulent behavior. Financial institutions will be able to mitigate potential financial crises through the ability of ChatGPT to analyze transaction data and recognize suspicious patterns [30].
- e. Risk management: ChatGPT can aid the development of risk management systems in industrial and business sectors. It can analyze financial data and pinpoint potential risks, thus helping businesses and institutions formulate plans to avoid those risks [31].
- f. Reporting in the industrial and business sectors: ChatGPT facilitates the development of systems that streamline reporting in the business and industrial sectors by analyzing industrial data and providing key statistics on production performance. Figure 2 presents the potential industry and business applications of ChatGPT.

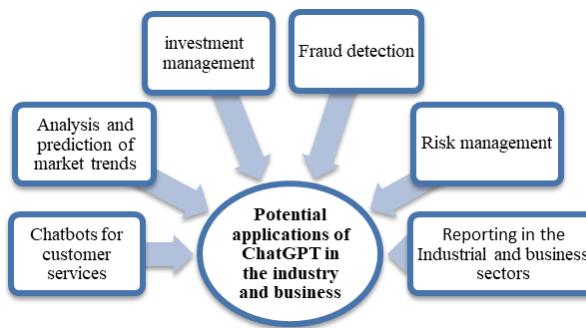


Figure 2. Potential applications of ChatGPT in industry and business

2.2.2. Health care and medicine

ChatGPT has promising potential applications in health care and medicine, as shown:

- a. Patient education and support: ChatGPT can function as a virtual health care assistant, offering patients precise information and clear, logical explanations about a disease; diagnosing a disease based on the provided symptoms; recommending treatment approaches; providing drug instructions; and suggesting measures that can improve a patient's well-being. By answering commonly asked questions, ChatGPT can be a source of emotional and psychological support to patients, which can help improve patient participation, understanding, and adherence to treatment plans [32].
- b. Medical training and education: ChatGPT can conduct case-based simulations, acting as a virtual patient or medical expert, thereby facilitating medical training, diagnosis, and treatment. It can aid students in clinical decision-making and in diagnosing diseases, recommend treatments based on patient data, enhance students' knowledge of medical procedures, and help them identify potential medical conditions before these conditions worsen. The use of ChatGPT can complement traditional teaching methods and broaden the opportunities for practical learning [33].
- c. Clinical decision support: ChatGPT can help clinicians and the medical team deliver a better patient experience and health outcomes by lowering the risk of medication and diagnostic errors, enhancing quality of care by doing away with unnecessary testing, boosting patient safety, and providing informed recommendations, evidence, and assistance in clinical decision-making. ChatGPT can analyze patient data, recommend diagnostic tests and treatment options, and provide guidance informed by the latest medical research, thereby reducing costs and improving efficiency, outcomes, and patient satisfaction [34].

- d. Telemedicine and remote health care: When incorporated into telemedicine platforms, ChatGPT can be used to offer remote diagnosis, medical advice, and support for patients. As a result, high-quality and efficient telehealth services can be achieved [35]. ChatGPT can also support patient care by enabling the gathering and analysis of patient data and using that information to formulate a diagnosis and furnish health care professionals with initial assessments, aside from improving health care access to patients in rural or remote areas, managing chronic conditions, and delivering timely health care services, particularly during emergency situations [36].
- e. Health monitoring and personalized care: ChatGPT can be a virtual health companion that monitors individuals' health data [37], diagnoses health conditions, and delivers unified treatment and care plans. It can also make customized lifestyle recommendations, provide nutrition and exercise advice, send reminders about medications, and offer disease prevention strategies. These features can empower individuals, putting them in control of their self-care and helping them make informed health decisions. Aside from that, ChatGPT compiles information into a concise, structured format that can be used conveniently by health care professionals, which makes it easier for them to focus on analyzing data and formulating appropriate treatment strategies [38]. These applications showcase ChatGPT's potential to help improve health care delivery, medical education, and patient experiences. When these applications are implemented, steps should be taken to ensure their proper integration, validation, and compliance with health care regulations and ethical guidelines [35], [39]. Figure 3 presents the potential applications of ChatGPT in health care and medicine.

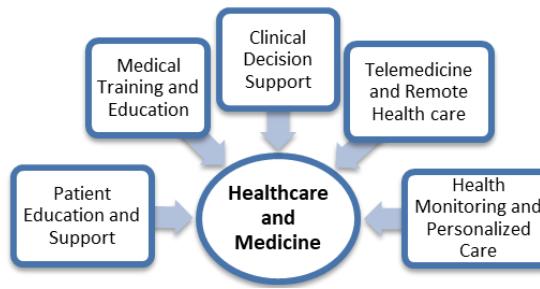


Figure 3. Potential applications of ChatGPT in health care and medicine

2.2.3. Education

Through its many applications, ChatGPT, as a potent language model, can potentially revolutionize the field of education in the following ways:

- a. Personalized learning: the individual needs of students can be addressed through personalized and interactive learning experiences with the use of ChatGPT. ChatGPT can be used to obtain individualized explanations and answer questions on a topic, assist students with homework, present additional resources based on each individual learner's needs, and conduct virtual tutoring. This type of adaptive learning can enhance understanding and student engagement [40].
- b. Tutoring and assistance with homework: ChatGPT can serve as a virtual tutor that helps students with assignments and offers guidance on different topics. It can clarify concepts, provide illustrative examples to ensure understanding, and solve problems step by step, thus supporting students as they learn independently and offering assistance outside of the classroom [41], [42].
- c. Language learning: language learning is facilitated by ChatGPT in several ways: it encourages students to practice engaging in conversations, it ensures correct grammar and pronunciation; and it shows students the correct phonetic writing of words. With its ability to simulate real-life conversations and offer vocabulary suggestions, ChatGPT provides an interactive language learning experience that works hand in hand with traditional education and ensures consistent language practice [43].
- d. Research and information retrieval: aside from equipping students with the skills and knowledge they need to improve their learning ability, ChatGPT assists students in their research through its capacity for information retrieval and knowledge management. Students can refine their research topics with the use of ChatGPT, as it provides guidance and suggestions to help them formulate research questions that can help them retrieve relevant information based on user queries. Moreover, ChatGPT can recommend reliable sources, which can help students as they examine the available information on their chosen topic [44].
- e. Virtual mentoring and career guidance: ChatGPT can serve as a virtual mentor that dispenses advice and guidance on careers and educational paths, presents students with options that are available to them, and

empowers them to embark on a future aligned with their aspirations and goals. ChatGPT can also be a source of information about relevant courses and educational programs. In addition, ChatGPT can help students create well-crafted resumes that can help them secure the right job that suits their qualifications [45], [46]. Figure 4 shows the potential applications of ChatGPT in education.

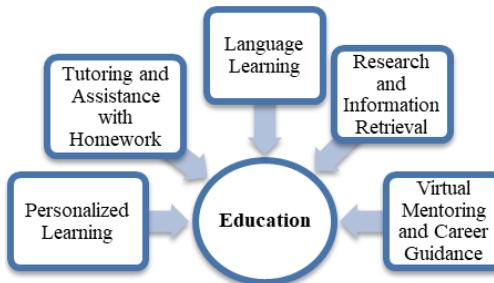


Figure 4. Potential applications of ChatGPT in education

3. ROLE OF CHATGPT IN ENHANCING E-LEARNING AND DECISION-MAKING PROCESSES IN HIGHER EDUCATION

As technology develops at a rapid pace, various challenges in higher education have emerged, and students and professors must address and respond to these challenges and turn them into opportunities. Better visualization, more efficient and effective performance, the ability to store large amounts of data, and information retrieval are supported by the use of modern technology and AI-based tools. However, teachers face a unique challenge, namely, students using technology and AI tools, including ChatGPT, to complete their tasks and assignments faster and more easily instead of flexing their individual knowledge and skills. Thus, the expected learning goals and outcomes are not achieved properly [47]–[49]. This section explores the role played by ChatGPT in improving the e-learning experience and facilitating the decision-making process in higher education.

- Personalized learning experience: ChatGPT can support personalized learning that caters to the diverse abilities and needs of students in higher education, turning students from being passive recipients of information into active social contributors. ChatGPT can tailor learning to each student by analyzing and understanding student interactions and activating an online feedback system any time throughout the academic year. Students with special needs can use ChatGPT to assist them with projects and reports, determine their knowledge gaps, and obtain suggestions for relevant educational materials. As a result, their skills are developed, the students are motivated, and they receive appropriate support with their studies [50].
- Instant and interactive support: students, teachers, and administrators receive instant support and feedback through ChatGPT. Students receive feedback about their performance in achieving their learning goals or outcomes, thus helping increase learning effectiveness and student integration into learning situations and experiences. They can also receive immediate assistance and explanations for complex concepts, ask course topic-related questions, or request additional resources. Teachers can use chatbots to provide personal feedback, address common questions, or create interactive quizzes. Administrators can achieve more streamlined administrative processes, such as course enrollment, scheduling, and accessing educational materials, by using chatbots, thus having an effective impact on the field of education. Reduced response times also improve the overall efficiency of an institution [51].
- Intelligent decision-making: the ability of ChatGPT to gather and analyze large amounts of data rapidly can facilitate proper decision-making in higher education. With its analytical capabilities, ChatGPT gathers data on student performance, learning analytics, and institutional data. The data are then used to generate crucial insights that teachers and students can benefit from. Through these insights, people can make decisions on aspects such as curriculum design, instructional strategies, and student interventions that are based on proper evidence. Leveraging chatbot recommendations will allow educators to personalize their instruction, evaluate students' learning styles to identify the ones who need assistance, and prescribe relevant solutions. Decision-makers can maximize the insights to improve resource allocation, institutional policies, and overall educational quality. With its intelligent decision-making capabilities, ChatGPT can boost the chances of student success, reducing the likelihood of dropouts and improving organizational effectiveness [52], [53].
- NL interaction and engagement: ChatGPT's NLP capabilities enable it to provide natural and engaging interactions. Students can converse with ChatGPT, ask for questions and explanations, and take part in discussions using their preferred communication method and in their own language. In response, ChatGPT

can generate interesting and relevant responses based on the context. This exchange stimulates the creative process of students and allows them to cultivate their critical thinking and communication skills [54].

e. Continuous improvement and adaptability: ChatGPT employs user interactions and feedback to learn constantly and improve. ChatGPT can adapt its responses, improve its interpretation of user queries, and deliver accurate, timely, and relevant information with the help of its built-in machine learning algorithms. As a result, it can better meet specific learning needs and preferences. ChatGPT undergoes regular updates and improvements, thereby allowing it to stay relevant, effective, secure, and adaptable to changes, technological advancements, and user requirements. As a result, it can help improve the e-learning environment in higher education [55].

With its powerful NLP capabilities, ChatGPT will be able to transform higher education by producing personalized learning experiences, offering immediate support, facilitating intelligent decision-making, enabling NL interaction, and continuously improving performance (Figure 5). Utilizing ChatGPT will enable institutions to enhance engagement and outcomes, and make informed decisions, thus laying the groundwork for a personalized, interactive, and efficient educational journey.

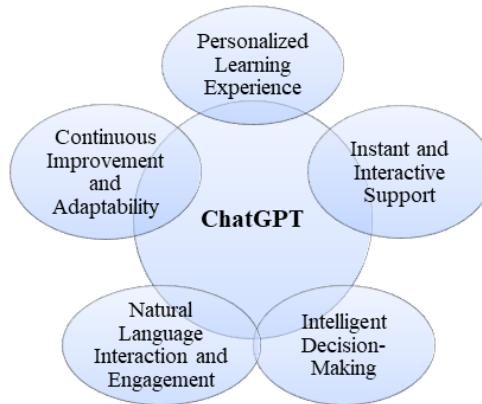


Figure 5. ChatGPT enhancements in e-learning and decision-making in higher education

4. CONCLUSION

The crucial role of AI and NLP technologies, such as ChatGPT, in enhancing the e-learning process and the decision-making process in higher education is undeniable. ChatGPT has many functions that can be applied in higher education research, processing, analysis, and interpretation of large amounts of data, scenario generation, and model evaluation. Thus, it can provide researchers, policymakers, and practitioners with important insights that aid in producing and sharing knowledge for crafting policies, strategies, and action plans. This research aims to identify what the role of ChatGPT technology is in enhancing the e-learning process and decision-making in higher education. Findings show that ChatGPT is effective in the e-learning environment by extending personal support and feedback to students, which will allow them to hone their critical thinking and analytical skills. ChatGPT can also help teachers provide targeted support and resources to enhance students' performance, identify students' learning pain points, and craft targeted activities geared toward their improvement. The findings underscore that ChatGPT has strong potential application in higher education, thus potentially improving quality management strategies in higher education and enhancing overall educational outcomes. In sum, ChatGPT needs to be incorporated in higher education institutions because doing so will refine the e-learning process and facilitate decision-making.

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