

Evaluating AI-powered ChatGPT for intelligent virtual learning environments through conversational intelligence

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ABSTRACT

The rapid advancement of conversational artificial intelligence has transformed virtual learning by enabling intelligent, adaptive, and interactive educational support through natural language communication. Among recent AI technologies, chat generative pre-trained transformer (ChatGPT) has emerged as a powerful conversational intelligence system capable of providing real-time explanations, personalized learning assistance, and contextual academic interactions. This study evaluates the effectiveness of AI-powered ChatGPT in intelligent virtual learning environments through the lens of conversational intelligence. A quantitative survey instrument, developed based on established technology acceptance constructs, was employed to assess users' perceptions of ChatGPT's usefulness, ease of interaction, and educational effectiveness. Using a simple random sampling technique, data were collected from 1,104 participants and analyzed using descriptive statistical methods in SPSS version 25. The results indicate that ChatGPT's conversational capabilities significantly enhance learner engagement, support personalized learning experiences, and improve perceived academic performance through intuitive human-AI interactions. The findings demonstrate that conversational intelligence plays a critical role in improving the effectiveness of intelligent virtual learning environments by facilitating adaptive knowledge delivery and interactive learning support. This study provides valuable insights into the integration of conversational AI technologies for developing next-generation intelligent digital education systems.

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1. INTRODUCTION

Artificial intelligence (AI) has become one of the most transformative technologies of the digital era, driving innovations across healthcare, manufacturing, transportation, finance, and education. Recent advances in machine learning, deep learning, and natural language processing (NLP) have enabled intelligent systems to understand, generate, and respond to human language with increasing contextual awareness, giving rise to a new generation of conversational AI applications [1]-[4]. These technologies have significantly improved human-computer interaction by enabling adaptive communication, automated reasoning, intelligent decision support, and personalized information delivery across various digital platforms [5], [6].

Among recent AI breakthroughs, large language models (LLMs) have emerged as a major milestone in conversational intelligence. Built upon transformer-based neural network architectures and trained on massive text corpora, LLMs are capable of understanding semantic context, generating coherent responses,

performing reasoning tasks, summarizing information, translating languages, and assisting users in solving complex problems through natural language interaction [7]-[10]. Their ability to engage in context-aware dialogue has accelerated the development of intelligent applications in software engineering, customer service, healthcare, and educational technology [11], [12]. chat generative pre-trained transformer (ChatGPT) represents one of the most widely adopted implementations of conversational AI, integrating advanced NLP techniques with deep neural language modeling to provide interactive and human-like communication. Its capabilities extend beyond text generation to include contextual question answering, content summarization, programming assistance, knowledge retrieval, and personalized educational support, making it a versatile intelligent assistant for digital learning environments.

The emergence of ChatGPT has transformed virtual learning by enabling continuous human-AI interaction through conversational intelligence. Unlike conventional e-learning platforms that primarily deliver static learning materials, AI-powered conversational systems provide adaptive explanations, immediate feedback, personalized recommendations, and interactive problem-solving tailored to individual learning needs [13]-[16]. These capabilities support self-directed learning, improve learner engagement, and facilitate knowledge acquisition through dynamic dialogue rather than passive content consumption. Consequently, conversational intelligence has become a fundamental component in the evolution of intelligent virtual learning environments, where AI functions not merely as an information provider but also as an intelligent learning companion capable of supporting personalized educational experiences.

Recent studies have demonstrated the growing potential of conversational AI in higher education. ChatGPT has been successfully applied to intelligent tutoring, programming assistance, academic writing support, language learning, research guidance, automated feedback generation, and collaborative learning activities [17]-[20]. Furthermore, its integration with learning management systems and digital education platforms enables adaptive learning pathways, intelligent content generation, and real-time educational assistance that can enhance learning efficiency and accessibility. Nevertheless, researchers have also identified several challenges associated with conversational AI, including hallucinated responses, information reliability, academic integrity, user trust, ethical concerns, and excessive dependence on AI-generated content [21], [22]. These challenges highlight the importance of systematically evaluating the effectiveness of conversational AI before its widespread deployment in educational settings.

Although previous investigations have extensively discussed the opportunities and challenges of ChatGPT in education, most studies have adopted qualitative or conceptual approaches emphasizing pedagogical implications rather than evaluating ChatGPT from the perspective of conversational intelligence and intelligent virtual learning systems [17]-[23]. Quantitative evidence regarding how conversational AI capabilities influence intelligent virtual learning environments remains relatively limited, particularly in developing countries where AI adoption in higher education is still evolving. Moreover, few studies have examined the effectiveness of ChatGPT as an AI-powered conversational system capable of facilitating adaptive human-AI interaction within digital learning ecosystems.

To address this research gap, this study evaluates AI-powered ChatGPT for intelligent virtual learning environments through the perspective of conversational intelligence. Specifically, the study investigates how the conversational capabilities of ChatGPT—including perceived usefulness, ease of interaction, and user attitudes—contribute to effective virtual learning experiences. The evaluation adopts the technology acceptance model (TAM) as the analytical framework because of its established capability to assess the adoption and effectiveness of intelligent information systems and educational technologies [24], [25]. By providing empirical evidence from a large-scale quantitative investigation, this study contributes to the understanding of conversational AI in digital education and offers practical insights for designing next-generation AI-enabled intelligent virtual learning environments.

2. METHOD

2.1. Research design

This study employed a quantitative research design to evaluate the effectiveness of AI-powered ChatGPT in intelligent virtual learning environments through conversational intelligence. A cross-sectional survey approach was adopted to investigate users' perceptions of ChatGPT's conversational capabilities, including perceived usefulness, perceived ease of interaction, attitude toward the system, and its effectiveness in supporting virtual learning. The proposed evaluation framework was derived from the TAM, which has been widely applied to assess the adoption and effectiveness of intelligent information systems and educational technologies [8], [15], [16].

2.2. Participants and sampling

The study was conducted at the University of Professional Studies, Accra (UPSA), Ghana. The target population consisted of undergraduate students enrolled in the third and fourth years of study,

representing active users of virtual learning technologies. Since the population exceeded 8,000 students, a simple random sampling technique was employed to ensure that each participant had an equal probability of selection [15]. A total of 1,104 valid responses were collected and included in the final analysis.

2.3. Questionnaire development

The research instrument was developed by adapting validated measurement items from previous studies based on the TAM [15], [16]. The questionnaire consisted of two sections. The first section collected demographic information, including gender, age, and academic level. The second section evaluated four research constructs: perceived usefulness, perceived ease of use, attitude toward ChatGPT, and the effectiveness of ChatGPT in intelligent virtual learning environments. All measurement items were designed to assess users' interactions with ChatGPT as an AI-powered conversational intelligence system. Responses were measured using a two-point agreement scale ranging from 1 (Disagree) to 2 (Agree), following the measurement approach adopted in previous studies [15], [16]. The questionnaire items are presented in Table 1.

Table 1. Research constructs and questionnaire items

Construct	Code	Questionnaire item
Perceived Usefulness	PU1	ChatGPT improves my learning performance.
	PU2	ChatGPT increases my learning productivity.
	PU3	ChatGPT helps me understand course materials.
	PU4	ChatGPT improves learning efficiency.
	PU5	ChatGPT supports problem-solving during learning.
	PU6	ChatGPT enhances my overall learning experience.
Perceived Ease of Use	PEOU1	ChatGPT is easy to learn and operate.
	PEOU2	Interacting with ChatGPT is clear and understandable.
	PEOU3	ChatGPT responds quickly to my queries.
	PEOU4	It is easy to obtain information using ChatGPT.
	PEOU5	ChatGPT requires little effort to use.
	PEOU6	Overall, ChatGPT is user-friendly.
Attitude toward ChatGPT	AT1	I have a positive attitude toward using ChatGPT.
	AT2	Using ChatGPT is beneficial for learning.
	AT3	I enjoy using ChatGPT during virtual learning.
	AT4	ChatGPT motivates me to learn independently.
	AT5	I intend to continue using ChatGPT.
	AT6	I would recommend ChatGPT to other learners.
Effectiveness of ChatGPT	EC1	ChatGPT improves my academic performance.
	EC2	ChatGPT supports personalized learning.
	EC3	ChatGPT enhances engagement during virtual learning.
	EC4	ChatGPT improves communication and interaction.
	EC5	ChatGPT helps me complete learning tasks efficiently.
	EC6	Overall, ChatGPT is effective in intelligent virtual learning.

2.4. Data collection procedure

The questionnaire was distributed electronically using an online survey platform. Participants voluntarily completed the survey after being informed of the study's objectives. The online distribution facilitated efficient data collection while ensuring broad accessibility among students who regularly participated in virtual learning environments. Completed questionnaires were screened for completeness before being included in the statistical analysis.

2.5. Research framework

The proposed research framework is illustrated in Figure 1. The framework evaluates the effectiveness of ChatGPT as an AI-powered conversational intelligence system in intelligent virtual learning environments. Three independent variables-perceived usefulness, perceived ease of use, and attitude toward ChatGPT-are hypothesized to influence the effectiveness of ChatGPT in supporting virtual learning. These constructs represent users' perceptions of the system's ability to provide adaptive interaction, intuitive communication, and meaningful educational support through conversational AI [8], [15], [16].

2.6. Data analysis

The collected data were analyzed using IBM SPSS Statistics version 25. Descriptive statistical analysis was performed to summarize respondents' demographic characteristics and evaluate the distribution of responses for each research construct. Frequency distributions, percentages, means, and standard deviations were calculated to assess participants' perceptions of ChatGPT's conversational capabilities and its

effectiveness in intelligent virtual learning environments. The statistical results were subsequently interpreted to evaluate the role of conversational intelligence in supporting adaptive and interactive digital learning.

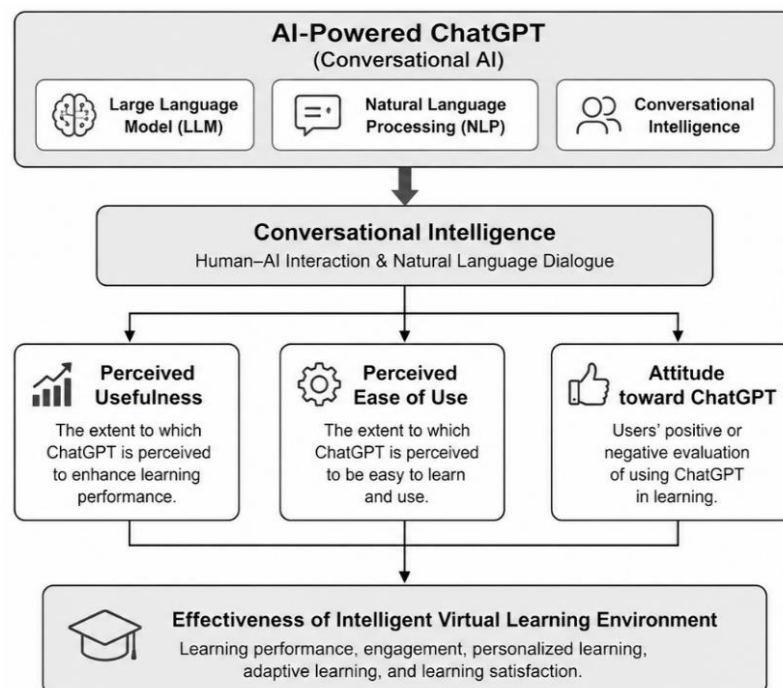


Figure 1. Proposed framework for evaluating AI-powered ChatGPT in intelligent virtual learning environments through conversational intelligence

3. RESULTS AND DISCUSSION

This section presents the results of the empirical evaluation of AI-powered ChatGPT in intelligent virtual learning environments through conversational intelligence. The analysis is organized according to the four research constructs: attitude toward ChatGPT, perceived usefulness, perceived ease of use, and effectiveness of ChatGPT in intelligent virtual learning. These constructs provide a comprehensive evaluation of users' experiences with ChatGPT as an AI-powered conversational intelligence system. The survey responses were analyzed using IBM SPSS Statistics version 25, and the findings are presented using descriptive statistics, including frequency distributions and percentages. The discussion interprets the results in relation to conversational intelligence, human-AI interaction, and intelligent virtual learning environments.

3.1. Attitude toward ChatGPT

This subsection evaluates users' attitudes toward ChatGPT as an AI-powered conversational intelligence system in virtual learning environments. Attitude reflects users' overall acceptance and willingness to interact with ChatGPT for educational activities. The survey results are summarized in Table 2. The results indicate a generally positive attitude toward ChatGPT. Most respondents agreed that ChatGPT is a valuable tool for virtual learning, is compatible with the smart devices they use, and provides an engaging learning experience. Furthermore, many respondents reported that ChatGPT enhanced collaboration with peers and instructors while supporting the completion of learning tasks. Only a relatively small proportion of respondents expressed uncertainty regarding the use of ChatGPT or considered it uninteresting.

These findings demonstrate that conversational intelligence contributes to positive human-AI interaction by enabling intuitive communication, contextual responses, and continuous learning support. The ability of ChatGPT to provide immediate and interactive assistance encourages learner engagement and promotes greater acceptance of AI-powered educational technologies. The findings are consistent with previous studies reporting that perceived usefulness and ease of interaction significantly influence users' attitudes toward intelligent learning systems [15]-[18].

Table 2. Respondents' attitudes toward AI-powered ChatGPT in intelligent virtual learning environments

Code	questionnaire item	Disagree (%)	Agree (%)
AT1	ChatGPT is a useful tool for virtual learning.	26.1	73.9
AT2	The use of ChatGPT is becoming a common trend in virtual learning.	38.8	61.2
AT3	ChatGPT is compatible with the smart devices used for virtual learning.	31.2	68.8
AT4	Learning with ChatGPT provides an engaging virtual learning experience.	21.2	78.8
AT5	ChatGPT enhances collaboration with peers and instructors.	26.8	73.2
AT6	ChatGPT supports the completion of academic assignments.	35.3	64.7
AT7	ChatGPT helps me better understand course materials.	42.4	57.6
AT8*	I am not interested in using ChatGPT because it is not engaging.	66.8	33.2
AT9*	I do not know how to use ChatGPT.	77.7	22.3

*Negative statements.

3.2. Perceived usefulness

Perceived usefulness refers to the extent to which users believe that ChatGPT enhances their learning performance and improves the efficiency of virtual learning activities. The results presented in Table 3 demonstrate that most respondents perceived ChatGPT as an effective educational support tool. The majority of participants agreed that ChatGPT improves learning performance, increases learning efficiency, reduces the time required to complete academic tasks, and provides meaningful assistance during virtual learning. These findings indicate that users recognize the practical benefits of conversational AI in facilitating information retrieval, academic support, and personalized learning experiences.

Table 3. Respondents' perceived usefulness of AI-powered ChatGPT in intelligent virtual learning

Code	Questionnaire item	Disagree (%)	Agree (%)
PU1	ChatGPT improves learning performance during virtual learning.	22.0	78.0
PU2	ChatGPT increases learning efficiency during virtual learning.	41.1	58.9
PU3	ChatGPT reduces the time required to complete academic tasks.	23.7	76.3
PU4	ChatGPT is a useful tool for supporting virtual learning activities.	26.4	73.6

The high level of perceived usefulness suggests that ChatGPT functions as an intelligent learning assistant capable of delivering adaptive educational support through natural language interaction. By providing rapid access to information and context-aware responses, conversational intelligence enhances learning productivity and contributes to more effective virtual learning environments. These findings are consistent with previous research demonstrating that perceived usefulness is a key determinant of AI technology adoption and effective educational technology utilization [19]-[23].

3.3. Perceived ease of use

Perceived ease of use evaluates users' perceptions of the effort required to interact with ChatGPT during virtual learning. Table 4 presents the responses related to the usability and accessibility of the conversational AI system. The results reveal that most respondents considered ChatGPT easy to learn, simple to operate, and flexible for educational purposes. Participants also indicated that the interaction process was clear and understandable, enabling them to communicate naturally with the system while obtaining relevant information with minimal effort.

Table 4. Respondents' perceived ease of use of AI-powered ChatGPT in intelligent virtual learning

Code	Questionnaire item	Disagree (%)	Agree (%)
PEOU1	ChatGPT makes virtual learning activities easier.	24.7	75.3
PEOU2	ChatGPT is clear and easy to understand during virtual learning.	27.0	73.0
PEOU3	Interacting with ChatGPT is flexible during virtual learning.	31.6	68.4
PEOU4	It is easy to become familiar with using ChatGPT for virtual learning.	35.4	64.6

These findings confirm that the intuitive conversational interface provided by ChatGPT improves the overall user experience. The integration of conversational intelligence and NLP enables seamless human-AI communication, reducing the cognitive effort required to access educational resources. Consequently, ease of interaction contributes to increased confidence in using AI-powered learning technologies and supports the broader adoption of intelligent virtual learning environments [23]-[25].

3.4. Effectiveness of ChatGPT in intelligent virtual learning

This subsection evaluates the overall effectiveness of ChatGPT in supporting intelligent virtual learning environments. The corresponding results are summarized in Table 5. The findings indicate that ChatGPT positively influences multiple aspects of learning. Most respondents agreed that the platform makes revision activities more engaging, improves academic performance, increases learning confidence, and supports continuous academic improvement. In contrast, relatively few respondents believed that ChatGPT was ineffective or represented a waste of time.

Table 5. Respondents' perceptions of the effectiveness of AI-powered ChatGPT in intelligent virtual learning

Code	Questionnaire item	Disagree (%)	Agree (%)
EC1	ChatGPT makes revision activities more engaging.	26.8	73.2
EC2	ChatGPT contributes to improved academic performance.	30.6	69.4
EC3	ChatGPT increases my confidence during virtual learning.	37.7	62.3
EC4	ChatGPT supports continuous improvement in my learning.	30.8	69.2
EC5	ChatGPT helps me achieve better learning outcomes.	37.8	62.2
EC6	ChatGPT enables more effective completion of learning tasks.	39.0	61.0
EC7*	Using ChatGPT in virtual learning is a waste of time.	75.2	24.8

These results demonstrate that conversational intelligence significantly enhances intelligent virtual learning by enabling adaptive educational support, personalized learning assistance, and interactive knowledge acquisition. Through natural language communication and context-aware responses, ChatGPT facilitates meaningful human-AI interaction that promotes learner engagement, confidence, and academic performance. Overall, the findings confirm that AI-powered ChatGPT represents an effective intelligent learning assistant capable of supporting next-generation virtual learning environments while complementing traditional educational practices.

4. CONCLUSION

This study evaluated the effectiveness of AI-powered ChatGPT in intelligent virtual learning environments through the perspective of conversational intelligence. The findings demonstrate that ChatGPT provides an effective conversational AI platform that supports adaptive learning by enabling intuitive human-AI interaction, contextual information retrieval, and personalized academic assistance. The empirical results indicate that perceived usefulness, perceived ease of use, and users' attitudes toward ChatGPT positively influence its effectiveness in enhancing virtual learning experiences. These findings confirm that conversational intelligence plays a significant role in improving learner engagement, learning efficiency, academic performance, and self-directed learning within digital education environments. From a practical perspective, the study provides evidence that AI-powered conversational systems can complement conventional virtual learning by offering timely feedback, interactive learning support, and personalized educational guidance. The findings also provide valuable insights for higher education institutions, educators, and policymakers in designing strategies for the responsible integration of conversational AI into intelligent virtual learning environments while promoting effective and ethical human-AI collaboration. Although this study provides important empirical evidence regarding the educational effectiveness of ChatGPT, it is limited to respondents from a single higher education institution and employs descriptive statistical analysis. Future research should include more diverse educational settings, larger and cross-cultural datasets, and advanced analytical approaches such as structural equation modeling or machine learning to further investigate the relationships among conversational intelligence, user acceptance, and learning outcomes in AI-enabled educational systems.

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