Advanced International Journal of Business, Entrepreneurship and SME's
AIJBES
EISSN: 2682-8545
Volume: 8 Issue: 28 (June 2026) PP. 362-371

ADVANCED INTERNATIONAL JOURNAL OF BUSINESS, ENTREPRENEURSHIP AND SMES (AIJBES)
www.gaexcellence.com/aijbes

A MODERATED CONCEPTUAL FRAMEWORK OF AI-DRIVEN EDUCATIONAL GAMES AND THEIR IMPACTS ON LEARNING OUTCOMES: THE ROLES OF TEACHER SUPPORT, LEARNER PREPAREDNESS AND ETHICAL AWARENESS

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Article Info:

Article history:
Received date: 26.04.2026
Revised date: 12.05.2026
Accepted date: 31.05.2026
Published date: 16.06.2026

Abstract:

The use of artificial intelligence in education has become a major influence in the development of "smart" educational games, which have been shown to be effective in creating personalized learning experiences through adaptive technology, immediate student feedback, and individualized levels of engagement. Educational artificial intelligence has the potential to enhance educational outcomes, such as improved academic achievement, increased motivation, and the development of higher-order thinking skills. However, studies have

Advanced International Journal of Business, Entrepreneurship and SME's
AIJBES
EISSN: 2682-8545
Volume: 8 Issue: 28 (June 2026) PP. 362-371

To cite this document:

Jayakumar, R. R., Norizan, S., Marzaini, A. F. M., Krishnan, D., Enggong, T. S., & Choi, J. K. A. (2026). A Moderated Conceptual Framework of Ai-Driven Educational Games and Their Impacts on Learning Outcomes: The Roles of Teacher Support, Learner Preparedness and Ethical Awareness. *Advanced International Journal of Business Entrepreneurship and SMEs, 8* (28), 362-371.

found that previous implementations of AI- driven learning environments are not consistent in their ability to produce similar results across different educational settings. This conceptual paper examines the relationship between educational games powered by artificial intelligence as an independent variable producing changes in educational outcomes as the dependent variables. This study draws on three theoretical frameworks: Constructivist Learning Theory, TAM (Technology Acceptance Model), and SDT (Self-Determination Theory). In addition, it proposes that the relationships between these two variables are moderated by three factors: teacher support, learner preparedness, and ethical awareness. This study will also develop a model, representing an integration of the technological, pedagogical, and psychological aspects of using intelligence in education and provide a framework for determining when and how AI can have a positive effect on educational outcomes.

DOI: 10.35631/AIJBES.828024

Keyword:

Artificial Intelligence; Educational Games; Ethical Awareness; Learner Preparedness; Teacher Support

Introduction

Educational growth is closely connected to advancements in technology (Nunez et al., 2012). There are many ways in which major technological developments have transformed how people deliver information and engage students in learning (Pérez et al. 2012). The current technological revolution is characterized by the emergence of artificial intelligence (AI), which has significantly reshaped the ways teachers teach, and students learn (UNESCO, 2021). AI-driven educational game-based systems, where interactive learning platforms are integrated with an intelligent system that can adapt to the needs of individual users. In Malaysia, this aligns with one of the United Nations' Sustainable Development Goals (SDGs) for Quality Education (SDG 4) emphasizes inclusive and equitable access to education as well as digital technology use to enhance student learning outcomes (Edwards et al., 2024). Recent studies based in Malaysia have also indicated that AI will be used to implement education policy and digital learning systems so personalized learning can occur and provide greater equity within educational systems in compliance with SDG 4 (Jamaluddin et al., 2025).

Traditional educational tools differ from smart educational games in their ability to be adapted through artificial intelligence to provide a unique experience for each student (Nunez et al., 2012). This is possible due to the analysis of student behaviour, the identification of knowledge gaps, the adjustment of the type of information provided to a student, the level of task difficulty, and type of feedback given to a student (UNESCO, 2021). As a result, smart game systems

Advanced International Journal of Business, Entrepreneurship and SME's
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driven by AI are able to serve as "intelligent tutoring systems" and as such provide personalized learning environments that promote greater levels of user engagement and efficiency (Dermeval et al., 2019).

Although there has been a growing use of AI in education, the impact of AI on student achievement varies (Vieriu & Petrea, 2025). Some students show increased levels of motivation and better grades, while many others do not show an increase in their grades as a result of using AI because they may lack the necessary digital literacy; may be poorly guided; or may become overly reliant upon automated systems (Zhai et al., 2024). These variations in outcomes highlight the importance of examining both the behavioural and contextual factors that contribute to the effectiveness of AI-based learning environments (Pedro et al., 2019). This paper addresses this gap by proposing a theoretical model that links AI, educational results and moderating variables.

Literature Review

Game-Based Learning and Constructivist Theory

Game-based learning theory posits that students construct knowledge by engaging with the world around them, rather than simply accepting what is provided (Marone, 2016). Plass et al., (2015) further argue that game-based learning aligns with constructivist learning principles. Games are interactive platforms that allow for experiential learning - learners interact with content using exploration, trial-and-error experimentation and reflection on errors (Kiili, 2005). This type of interactive experience increases engagement and aids in deepening the learners' understanding (Liat & Hayak, 2025).

Studies have shown that when games are well-designed, they can increase student motivation, engagement and retention of knowledge (Mathew et al., 2025). Learners are more likely to persist in activities when opportunities for challenge, curiosity, and feedback are present (Tu et al., 2025). In addition, existing educational games are often limited in their adaptability. As a result, they may fail to effectively meet the diverse needs of learners (Chiotaki et al., 2025), which indicates why it is necessary to incorporate AI technology into educational games to create a more adaptive and personalized learning environment (Dutta et al.,2024; Bharathi et al., 2024).

Artificial Intelligence in Education

Early applications of artificial intelligence in education (for example, intelligent tutoring systems), demonstrated how AI could improve students' outcomes through customized feedback and support (Tu et al., 2025; Bharathi et al., 2024). These early intelligent tutoring systems simulated human tutoring by modifying their instruction based on students' performance. The advancement of recent technology in AI (including machine learning and natural language processing), has provided the opportunity for even greater improvements in what educational systems are able to do (Idika, 2025). For example, AI-driven educational games can generate accurate learner profiles and adapt content accordingly, in addition to providing immediate personalised feedback.

AI-Driven Educational Games and Educational Outcomes

Advanced International Journal of Business, Entrepreneurship and SME's
AIJBES
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AI-driven educational games represent an intersection of the use of games for learning and artificial intelligence. In essence, they present a powerful platform for improving educational outcomes (Gomez et al., 2025). They provide an opportunity to create both motivating and adaptive learning experiences by combining game-based features with AI-driven personalisation. Research has also indicated that these types of games are capable of improving students' academic performance. Through the ability to provide students with targeted instructional strategies based on their specific learning needs; this improves academic achievement (Dahri et al., 2025).

In addition to improving students' academic performance, research has demonstrated that AI-driven educational games may increase student motivation and enhance learner engagement. Games enable students to interactively engage in the learning experience through providing students with personalised feedback and adapting the level of challenge experienced by each student. This increases the likelihood of students being actively engaged in the learning experience. Additionally, AI-driven educational games have the potential to assist in developing higher order thinking skills including problem solving and critical thinking by allowing students to be actively engaged in complex decision-making scenarios (Zhao et al., 2025 & Marengo et al., 2025).

Although there are positive outcomes associated with AI-driven educational games, it is essential to acknowledge that various factors contribute to whether or not these tools will positively influence educational outcomes. Dahri et al., (2025) and Vieriu & Petrea (2025) identify the need to examine moderating variables when assessing the impact that AI-driven educational games have on student learning

Moderating Variables in AI-Enhanced Learning

The relationship between AI-powered educational games and student outcomes is indirect and contingent upon many factors that influence how effectively the educational tool functions. According to Chiu et al., (2025), teacher support is among the moderating factors. By providing learner support and using AI tools within the lesson plan, teachers can assist students with reflection-based learning and provide guidance for students as they navigate through AI-driven learning environments (Ren et al., 2026). Recent studies have shown that teacher digital competence and pedagogical readiness can greatly increase the success of integrating AI into the classroom and therefore enhance student engagement as well as learning outcomes (Long, et al., 2025). The extent to which the use of AI tools aligns with curriculum objectives is also an important factor when determining whether technology-enhanced learning will deliver significant educational benefits (Sapawi & Yusoff, 2025).

Learner preparedness (AI self-efficacy) is one of the most important moderating factors influencing how learners interact within AI-enhanced environments. Self-efficacy is defined as an individual's belief that they have the capability to successfully execute specific tasks with specific technologies (Ren et al., 2026). Accordingly, individuals who possess high levels of self-efficacy are more likely to engage with AI systems and utilize their functions to enhance learning. Conversely, those who possess low levels of self-efficacy will perceive interaction with AI tools as stressful or at least resistant to participating. Therefore, these students' reluctance to participate will limit their potential benefit from the application of AI in their learning. Moreover, it has recently been documented in various studies that students'

Advanced International Journal of Business, Entrepreneurship and SME's
AIJBES
EISSN: 2682-8545
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confidence in the utilization of digital and AI based technologies will directly affect their motivation to accept and continue utilizing intelligent learning systems (Paredes-Aguirre, 2026). Finally, it has also been demonstrated through several studies that providing learners with directed instruction and directed access to AI systems has resulted in increased learner self-efficacy and improved learning outcomes for learners in technology-enhanced learning environments (Karama, 2026).

Lastly, ethical awareness is also a moderating factor in AI-enhanced learning environments. When designing AI-based educational games, educators and developers will encounter multiple ethical concerns with respect to data privacy, algorithmic bias, and overreliance on technology. Consequently, those who are aware of these ethical implications of using AI will be more likely to use it responsibly and evaluate critical information provided by AI-based learning environments (Febrianti et al., 2026) thus ensuring that AI does not generate negative outcomes while enhancing student learning experiences. Furthermore, recent studies have demonstrated that there is a positive relationship between ethical literacy in AI and students' critical thinking skills and digital responsibility when navigating complex systems (Floridi et al., 2018). Additionally, according to Alnsour et al., (2025) integrating ethical guidelines and governance frameworks for AI into school settings promotes the trustworthy and transparent use of AI technologies which ultimately supports safe and equitable learning environments. A conceptual framework presented in Figure 1.

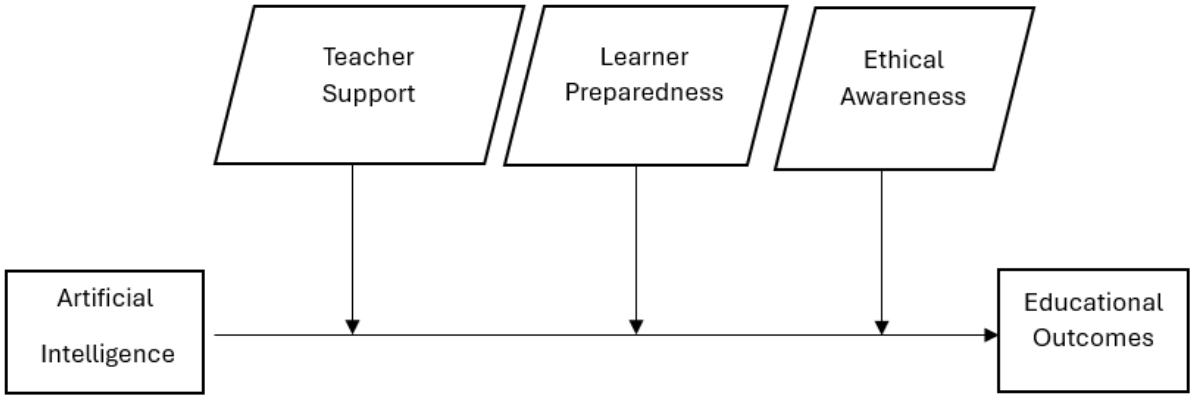

Figure 1: Conceptual Framework

Discussion

In addition to its many other advantages, the inclusion of artificial intelligence into educational games presents an exciting opportunity to enhance learning. However, to provide optimal learning experiences through AI-powered educational games, and to enhance students' motivation, higher-order thinking skills, and overall academic performance, appropriate personalization of each student's learning experience is essential. Although this paper identifies numerous ways in which AI-based educational game development can be used to create an environment where students have the capacity to learn effectively, it also emphasizes that whether such technologies can produce effective learning outcomes depends on a variety of behavioral and environmental factors (Gomez et al., 2024; Vieriu et al., 2025).

The research findings discussed above identify several factors that act as moderators of the relationship between AI-based learning and educational outcomes. One of these factors is

teacher support. Teachers perform several roles when they implement AI-based learning programs including assisting students as they navigate these new learning environments, helping them develop a positive perception of AI-based tools, and creating the conditions necessary for meaningful learning (Filiz et al., 2025). Another factor identified in this study is how ready students are to take advantage of AI-based learning. Specifically, this is measured in terms of students' perceptions about their own capability to utilize AI-based systems (Ren et al., 2026). When students have confidence in their abilities to use AI-based tools, they are more likely to interact with these systems in a way that facilitates improved learning outcomes. Therefore, developing students' digital literacy skills as well as providing them with some form of instruction to prepare them to work effectively with AI-based systems are two very important responsibilities of teachers.

Lastly, ethical awareness is another important variable in AI implementation in education (Abuzir, 2025). Because AI systems generate a tremendous amount of information and because so much of this data is based on what learners do while working within an AI system, it is very important for learners to understand the ethical implications of using AI-based learning systems (Mustafa et al., 2025). Examples include data privacy concerns, bias, and responsible use. If educators and policymakers encourage ethical awareness among users of AI-based educational technologies, all stakeholders can contribute more positively to educational outcomes.

Conclusion

The integration of AI into education can significantly improve the way we learn. AI technology could be used to deliver customized and dynamic learning experiences to students through smart, personalized educational games. The educational applications of this technology have many advantages – they help to develop higher order thinking, motivate learners and enhance their overall academic performance. While there is evidence suggesting the positive effects of using AI-powered educational games as tools to support learning, there are no guarantees that smart educational games will produce positive effects or if all students will benefit equally; several moderating factors exist which affect the effectiveness of smart educational game use. These include teacher support, student willingness to engage with the technology, and students' awareness of ethical considerations in AI use.

The purpose of this conceptual paper was to develop a comprehensive theoretical model which would synthesize and integrate the moderating factors previously identified in the literature. In developing this model, the authors sought to increase our understanding of how AI impacts learning. This was accomplished by drawing upon three well established theories of learning: Constructivist Learning Theory, the Technology Acceptance Model, and Self-Determination Theory. Therefore, the authors developed a multi-dimensional model for examining AI's influence in education.

To further explore the model, future researchers need to test the model empirically using quantitative methodologies to validate the relationship between variables. Further exploration of the model may also be achieved when conducting longitudinal studies. This type of study would allow researchers to examine the impact of AI-driven educational games on learning over time. A key aspect of ensuring that AI technologies are successfully adopted and used effectively and ethically in education is collaboration among teachers, policy makers and developers. In summary, AI based educational games hold much promise for improving education. For example, AI based educational games can provide unique opportunities for

students to learn at their own pace. Specifically, some students may require additional instruction while others may require less instructional support. However, successful implementation of AI-based educational games requires a balance between the technological capabilities and human and ethical considerations.

Acknowledgements:	Special appreciation is extended to colleagues and peers who contributed valuable insights and constructive feedback, which greatly enhanced the quality of this paper.
Funding Statement:	No Funding.
Conflict of Interest Statement:	The authors declare that there is no conflict of interest regarding the publication of this paper. All authors have contributed to this work and approved the final version of the manuscript for submission to the Advanced International Journal of Business, Entrepreneurship and SMEs (AIJBES).
Ethics Statement:	This study did not involve any human participants, animals, or sensitive data requiring ethical approval. The authors confirm that the research was conducted in accordance with accepted academic integrity and ethical publishing standards.
Author Contribution Statement:	All authors contributed significantly to the development of this manuscript. Raja Rajeswari and Saifulrizan were responsible for the conceptualization, methodology, and overall supervision of the study. Anwar Farhan, Devika, Tina and Judith contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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