

From Barriers to Bridges: AI-Powered Mini-Games for Accessible Game-Based Learning

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Abstract: Game-based learning (GBL) has gained considerable attention within active learning communities, yet its practical implementation remains limited in mainstream educational settings. Key barriers include the complexity of integrating games, licensing costs (often associated with serious games), and the time required for preparation. This study investigates an accessible alternative: subject-independent mini-games that require minimal setup and align with a range of learning objectives. These are supported by AI-powered bots that generate the necessary materials. Using a qualitative design, the study involved semi-structured interviews with educators from diverse fields. Participants evaluated mini-games and reflected on barriers to GBL adoption and whether these can be addressed through the integration of mini-games. Games were also compared in terms of usability, academic rigor, adaptability, and potential to boost participation. Educators further assessed AI tools (Custom GPTs) to adapt mini-games to their classrooms. These tools allowed user-friendly customization without programming or prompting skills. Findings indicate that cost, preparation effort, and lack of awareness are major barriers. Mini-games, especially when paired with AI, offer a bridge to implementing GBL. Implications and future research directions are discussed.

Keywords: Game-Based Learning, Education, Mini-Games, Barriers, Game-Based learning

1. Introduction

In recent years, educators at the college level have been confronted with a range of challenges, including increasingly diverse student populations (De Clerck et al., 2022), larger classroom sizes, and heightened competition for students' attention due to the constant availability of smartphones and laptops (Dontre, 2020). These developments have made it more difficult to maintain student engagement through traditional active learning strategies, such as group presentations, which many educators report are no longer achieving the desired increase in student motivation (Park et al., 2021).

Game-based learning (GBL), commonly defined as the use of games for educational purposes (Edwards et al., 2023), has emerged as a promising approach to address these challenges. GBL has been shown to improve learning outcomes (Clark et al., 2016) and foster higher levels of engagement and critical thinking (Mao et al., 2021). By promoting active, experiential learning, GBL offers opportunities to counteract the attention-related and motivational difficulties faced in modern classrooms.

However, the widespread adoption of GBL in higher education remains limited. In a systematic review, Lester et al. (2022) found that educators cite barriers such as a lack of time to develop new approaches, the cost of game licenses, and classroom setting issues.

One promising, yet underexplored, approach to addressing these barriers is the use of educational "mini-games." Mini-games are short (requiring less than 30 minutes of classroom time), subject-independent, and designed to operate without the need for external technical infrastructure or costly licenses. Their compact design could make them more adaptable and easier to integrate into diverse teaching settings compared to more complex gaming solutions. To date, however, little research has systematically explored the effectiveness of mini-games in overcoming the practical barriers that hinder broader GBL implementation in higher education.

We hypothesize that mini-games, particularly when supported by customized AI tools that automate the creation of educational materials without requiring advanced prompting skills, could mitigate several of the primary barriers to GBL adoption. The purpose of this paper is to identify key barriers to game-based learning, compare and evaluate a selection of AI-supported mini-games, and investigate whether this combination can reduce the challenges associated with implementing GBL across diverse higher education settings.

2. Literature Review

2.1 What is Game-Based Learning (GBL)?

We follow the definition of Edwards et al. (2023), who describe game-based learning as "the use of games in service of educational purposes" (p. 3). In GBL, learning content and objectives are embedded in playful contexts

to increase motivation, engagement, and lasting understanding. In contrast to gamification – where isolated game elements such as points, badges, or leaderboards are applied to non-game contexts (Deterding et al., 2011) – GBL involves complete games or mini-games developed or adapted with explicit educational goals in mind (Edwards et al., 2023; Al-Azawi et al., 2016).

2.2 What are the Benefits of Game-Based Learning (GBL)?

Multiple studies and meta-analyses have demonstrated that game-based learning enhances various aspects of the learning process, including learning and retention (Wouters et al. 2013), motivation, self-efficacy and conscientiousness (Clark et al. 2016) and enjoyment leading to deeper learning (Crocco et al. 2016).

The impact of GBL on motivation has produced mixed findings. The meta-analysis by Wouters et al. (2013) found no statistically significant effect on motivational outcomes. However, more recent studies have reported increased intrinsic motivation through game-based approaches (Cerra et al., 2022; Huizenga et al., 2017; Jääskää and Rajala., 2022).

2.3 What are the Barriers to Game-Based Learning (GBL)?

Despite the demonstrated benefits of game-based learning the consistent adoption of GBL in higher education remains limited. Several reviews (e.g., Lester et al., 2022; Sousa et al., 2023; Yaman et al., 2024) have identified a range of barriers that continue to restrict the widespread implementation of GBL. These include high preparation effort, substantial classroom time requirements, perceived lack of academic rigor, technical infrastructure challenges, and limited organizational support.

Since many GBL approaches involve technological platforms such as video games, augmented reality, and online simulations (Hamari et al., 2016; Alhumairi et al., 2024), the challenges associated with GBL adoption closely mirror broader technology adoption patterns. To structure the analysis of these barriers, the present study applies the Unified Theory of Acceptance and Use of Technology (UTAUT) model, which identifies four key determinants of technology adoption: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003; Dwivedi et al., 2019). Table 1 presents the identified barriers mapped to these UTAUT constructs, including brief definitions for each construct. Additionally, a category for personal and contextual factors is included to capture broader influences on GBL adoption. The included studies feature both higher education educators and schoolteachers as participants, as the barriers are expected to be similar and there is an insufficient number of studies focusing on college educators.

While other frameworks such as the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and the Theory of Planned Behavior (TPB) (Ajzen, 1991) have been used to explore educational technology adoption, these models emphasize attitudinal and intentional predictors and place less emphasis on contextual or institutional constraints. In contrast, UTAUT's inclusion of facilitating conditions allows for a more comprehensive analysis of external barriers – particularly relevant for understanding why educators may be willing, yet unable, to implement GBL in practice (Yaman et al., 2024).

Table 1: Mapping of Game-Based Learning Barriers to UTAUT Constructs with Definitions

UTAUT Construct and Definition	Barrier	Key References
Performance Expectancy: the degree to which an individual believes that using a system will help improve job performance	Belief that GBL lacks academic rigor	Ariffin 2012; Watson and Yang, 2016
	Insufficient evidence of deep learning outcomes	Ariffin 2012; Watson and Yang, 2016
	Perception that GBL promotes only superficial engagement and students get sidetracked by games	Watson and Yang, 2016
Effort Expectancy: the degree of ease associated with the use of the system	High time investment to find and select appropriate games	Dimitriadou et al., 2021; Babar, 2022
	Difficulty adapting games to specific learning goals	Dimitriadou et al., 2021
	Complexity of understanding and mastering game mechanics	Albuquerque et al., 2010; Babar, 2022; Abou Hashish et al., 2024
	Logistical challenges in classroom management when using games	Watson and Yang, 2016; Abou Hashish et al., 2024

UTAUT Construct and Definition	Barrier	Key References
Social Influence: the degree to which individuals perceive that important others believe they should use the system	Lack of peer encouragement to use GBL	Dimitriadou et al., 2021; Bourgonjon et al., 2013
	Student skepticism about the seriousness and value of GBL activities	Babar, 2022; Watson and Yang, 2016
	Limited administrative or leadership support for GBL initiatives	Dimitriadou et al., 2021; Watson and Yang, 2016
Facilitating Conditions: the degree to which individuals believe that organizational and technical infrastructure exists to support system use	Lack of institutional IT and technical support	Dimitriadou et al., 2021; Ariffin, 2012; Watson and Yang, 2016; Abou Hashish et al., 2024
	Lack of financial support for purchasing games/licenses	Ariffin, 2012; Kaimara et al., 2021; Watson and Yang, 2016; Abou Hashish et al., 2024
	Lack of professional development or training opportunities for educators	Babar, 2022; Watson and Yang, 2016; Abou Hashish et al., 2024
	Lack of knowledge about suitable games	Bourgonjon et al., 2013; Ariffin, 2012
Personal and Contextual Factors: influences related to individual teaching philosophy, role identity, or cultural norms	Traditionalist belief in superiority of lecture-based teaching	Ariffin, 2012
	Fear of losing classroom authority and control	Watson and Yang, 2016
	Cultural perceptions of games as "childish" or inappropriate for higher education	Ariffin, 2012

One potential strategy for overcoming these barriers is the use of educational mini-games – short, adaptable games designed to achieve specific learning outcomes within a limited time frame. Mini-games, by their nature, address several key adoption concerns: they typically require less preparation and classroom time than complex simulations, can be adapted across disciplines with minimal effort, and do not necessarily demand advanced technical infrastructure or costly licenses. By providing a flexible, low-barrier entry point into game-based learning, mini-games have the potential to improve performance expectancy, reduce effort expectancy, and ease facilitating condition concerns identified in the UTAUT framework. Despite their promise, mini-games remain an underexplored area in GBL research. In addition to mini-games themselves, the integration of AI-supported tools offers further potential to lower barriers to GBL adoption. Recent studies have shown that AI technologies, particularly generative AI tools like ChatGPT, are reshaping higher education by supporting content creation, personalized learning pathways, and administrative efficiency (Heredia-Carroza and Stoica, 2024; O'Donnell et al., 2024). Specifically, AI can automate the preparation of teaching materials, customize game elements to different disciplines, and simplify the design process, thereby substantially reducing the effort required from educators. By lowering effort expectancy and improving facilitating conditions, AI support could make the implementation of mini-games even more feasible for a wider range of instructors. Despite this growing interest, the specific use of AI to support the design and deployment of educational mini-games remains an underexplored area.

Based on this theoretical foundation, the study poses the following research questions (RQs):

- RQ1: How can the barriers to GBL adoption among college educators be understood through the UTAUT framework?
- RQ2: What types of educational mini-games may help address the identified barriers to GBL adoption?
- RQ3: To what extent can AI-supported tools assist in reducing preparation effort and other barriers associated with the use of mini-games in college teaching?

3. Method

Semi-structured interviews were conducted with 16 educators from a broad range of disciplines, classroom sizes, and age groups. Participants ranged in age from 28 to 65 years and represented disciplines including social sciences, engineering, computer science, and law. A purposive sampling strategy was employed to ensure

diversity across these dimensions. Both authors conducted the interviews via video calls. Participants were informed about the aim of the study and the recording of the interview and provided informed consent prior to participation.

The interviews followed a three-phase structure aligned with the study's research questions. In the first phase, participants discussed their current use of game-based learning (GBL) and perceived barriers to broader adoption, particularly in relation to the constructs identified in the Unified Theory of Acceptance and Use of Technology (UTAUT). In the second phase, participants evaluated four educational mini-games, each designed to align with specific cognitive learning objectives. Table 2 provides an overview of the mini-games and their associated teaching goals. Participants were provided with a description and sample of each game, then assessed each game regarding its perceived benefits, challenges, and suitability for their lectures. The mini-games were developed or adapted by the authors to be applicable across disciplines, require no external software licenses, be playable within a 30-minute classroom timeframe, and address a range of learning goals from basic recall to analytical reasoning.

A custom-developed chatbot, using custom GPT functionality within ChatGPT, was introduced in the third phase of the interviews. The chatbot automates the generation of mini-game content based on user-supplied topics and academic levels. The participants explored the chatbot's outputs and reflected on its potential to lower preparation effort and technical barriers to the use of GBL in their teaching.

All interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis according to Braun and Clarke's (2006) six-phase framework. A combined deductive-inductive coding approach was employed: initial codes were derived deductively from the UTAUT framework to structure the primary analysis, while additional codes and themes were developed inductively where participant insights extended beyond the original constructs. One researcher created an initial coding framework, which was then discussed to resolve discrepancies and refine theme development. Themes were reviewed and collaboratively finalized to produce the final thematic structure.

Table 2: Mapping of Game-Based Learning Barriers to UTAUT Constructs with Definitions

Title (Link to explanation)	Learning Objective (Bloom's taxonomy) Focus of game	Estimated Time (E = Explanation; P = Playing)	Short Description
Forbidden Words (www.inflos.de/fw)	Remember, Understand Focus: Recall	E: 3 Min P: 10-12 Min	Students have 1 minute to explain as many scientific terms as possible. Each term includes 4 forbidden words that may not be used. Students compete in small teams (3-4 people).
Lie Detector (www.inflos.de/ld)	Understand, Analyze Focus: Recall	E: 4 Min P: 8 Min	Students receive application-based statements. To earn points, they must spot and correct "lies". They compete against the other team and the educator, who tries to sneak in a falsehood.
Thought Experiment Roulette (www.inflos.de/ter)	Analyze Focus: Discussion	E: 2 Min P: 20 Min	Students spin a wheel to select a futuristic thought experiment. In small groups, they analyze the scenario and pitch their ideas to the class. The best-rated pitch wins.
Tic-Tac-Toe (www.inflos.de/ttt)	Understand, Analyze, Evaluate Focus: Discussion	E: 5 Min P: 15 Min	Students play in small teams (3-4 persons) against each other. By explaining terms they can conquer squares. By evaluating complex situations they can steal already conquered squares. Whoever connects 3 neighboring squares first wins.

4. Results

4.1 Educator Attitudes Toward Game-Based Learning

In phase one of the interviews, educators discussed their current experiences with game-based learning (GBL) and the barriers they perceived in implementing it more widely. Most participants had a positive attitude towards using games in higher education. They noted that traditional active learning strategies, like group presentations, were becoming less effective due to reduced student attention spans and engagement. Several

educators acknowledged the need to adopt their teaching methods to align with students' evolving expectations and behaviors.

Participants noted that GBL positively impacts psychological safety, student motivation, and class participation aligning with previous research on educational games (Cerra et al., 2022; Huizenga et al., 2017; Jääskää and Rajala, 2022). However, only one participant used GBL regularly. The most common tools were quizzes on gamified platforms like Kahoot! and Mentimeter, which require minimal preparation and integrate easily into lectures.

4.2 Barriers to GBL Adoption Mapped to UTAUT Constructs

Figure 1 provides an overview of the thematic analysis, organized according to the UTAUT framework. While many of the barriers identified confirm earlier findings, several new insights emerged.

4.2.1 Performance expectancy

Most educators were open to the idea that games could support learning outcomes. However, a few expressed concerns about GBL's rigor and alignment with cognitive goals. Some worried that available games might not meet disciplinary standards or that students might disengage if they struggled with complex game tasks, particularly in simulations. Overall, performance expectancy was not a dominant barrier.

4.2.2 Effort expectancy

Perceived effort emerged as a key barrier. Many participants emphasized the time-intensive nature of designing, adapting, and implementing games. A novel insight was that several educators described a lack of creative capacity as an additional challenge. They reported that developing game content demanded mental focus that they could not spare during already demanding lesson preparation. Most educators in our study were not aware of games that they could implement in the lessons. This creative fatigue and the absence of readily available, discipline-specific game templates appear underrepresented in previous studies.

4.2.3 Facilitating conditions

Nearly all participants identified substantial institutional and logistical constraints. These included a lack of technical support, financial resources and access to professional development opportunities – barriers noted in prior literature (Lester et al, 2022). A major concern was the perceived cost of classroom time. Educators feared that even brief games would cut into core content delivery. Additionally, some instructors taught classes with over 1,000 students, complicating the use of interactive formats. These issues indicate that the “facilitating conditions” barrier is broader than typically portrayed.

4.2.4 Social influence

Social norms were less frequently mentioned but remained relevant. Several educators mentioned that GBL is not the norm in their discipline. This led to a lack of knowledge about appropriate games. Two educators mentioned that students might view games as “childish”. Interestingly, some participants supported using games but hesitated due to concerns about students' perceptions. This suggests a bidirectional social influence both among peers and from learners, which has been underexplored in previous UTAUT applications.

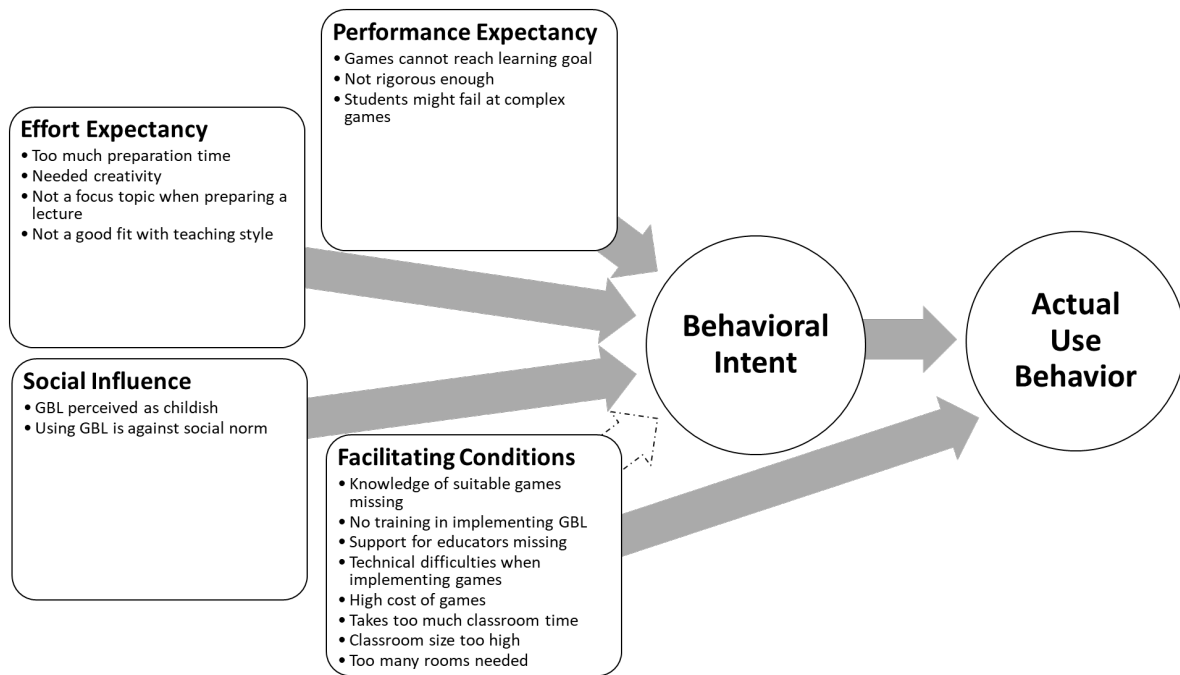


Figure 1: Findings of interviews in UTAUT model (focus on barriers; modified from Venkatesh et al., 2003)

4.3 Evaluation of Mini-Games

In the second interview phase, participants were introduced to four short-format mini-games designed by the authors. Each game was presented with a brief explanation and an example. Participants then evaluated the games with regard to suitability, benefits and challenges. Table 3 summarizes the feedback.

Table 3: Summary of Mini-Game Evaluations

Game Title (Link to explanation)	Positive Feedback	Negative Feedback
Forbidden Words (www.inflos.de/fw)	Activates recall and understanding of technical terms; effective for harmonizing vocabulary in advanced courses; easy to understand	Too basic for graduate-level instruction; seen as time-wasting if focus is on higher-order goals
Lie Detector (www.inflos.de/ld)	Can engage large classes; low setup complexity; teacher remains in control	Participation anxiety in large cohorts; relies heavily on vocal contributions
Thought Experiment Roulette (www.inflos.de/ter)	Promotes analytical thinking and perspective-taking; supports higher cognitive objectives	Not suitable for quantitative subjects; preparation and assessment perceived as effortful; game mechanics seen as less playful
Tic-Tac-Toe (www.inflos.de/ttt)	Supports differentiated learning; students engage with content at varying depths	Considered “childish” by some; rule complexity can lead to onboarding issues

Evaluations of each game varied based on participants’ teaching disciplines and class formats. All games were perceived as beneficial by some educators and critical by others, demonstrating the importance of contextual alignment. Several participants stated that simply being exposed to a list of suitable, ready-to-use games significantly changed their willingness to adopt GBL. One educator remarked: “Just seeing these options makes it feel more doable.”

4.4 Evaluation of AI Support Tool

In the final phase, participants tested an AI-supported chatbot developed using the custom GPT functionality of ChatGPT. The tool generates mini-game materials based on user-provided topics and academic levels. Across all interviews, the tool was received positively. Educators described it as a “significant support” in overcoming effort-related barriers. Most were surprised by the quality and relevance of the outputs. Several participants expressed interest in gaining immediate access to use the tool in upcoming lectures.

Participants emphasized that the tool's main value lay in reducing preparation time and mental load, especially for instructors with limited experience in designing educational games. This finding strongly supports the importance of AI-supported tools: they can significantly reduce effort expectancy and lower the barriers associated with GBL implementation. As such, AI-supported tools appear to offer a practical bridge to game-based learning for educators.

5. Discussion / Conclusion

This study explored barriers to game-based learning (GBL) in higher education and evaluated the potential of mini-games and AI-supported tools to overcome these challenges. While many of the barriers echoed prior research (e.g., Lester et al., 2022; Ariffin et al., 2014; Watson and Yang, 2016), a previously overlooked aspect was the widespread openness among educators toward using games in the classroom – despite limited current usage. In previous studies, high levels of perceived effort were considered a main obstacle. However, we identified that many educators did not only consider the implementation of our mini games to require a lot of effort instead, they were simply not aware that suitable games were available for their area of study. For many participants, GBL did not surface as a natural component of course planning. Thus, a practical application and avenue for future research would be the provision of a larger set of curated mini games to a wider range of professors to analyze implementation behavior, and not only implementation intentions. Future studies could also focus on barriers beyond the scope of this paper, such as curricular rigidity, which might be an issue in some disciplines.

The application of the UTAUT framework helped clarify the relative weight of specific barriers. While performance expectancy concerns (e.g., perceived lack of rigor) were present, they were less prominent than effort expectancy and facilitating conditions. The importance of institutional constraints – such as limited classroom time, large class sizes, and absence of technical or professional development support – was especially clear. This highlights a theoretical contribution of the study: by using UTAUT, the analysis emphasizes the role of structural and contextual barriers, which are often underrepresented in studies grounded in the Theory of Planned Behavior (TPB) or the Theory of Reasoned Action (TRA), which focus more on attitudinal factors (Fishbein & Ajzen, 1975; Ajzen, 1991). Contrary to the original UTAUT framework, facilitating conditions already impacted behavioral intent in our study, not only actual usage behavior.

Mini-games emerged as a promising tool to bridge the implementation gap. Their low time demands, absence of licensing requirements, and adaptability across disciplines directly addressed educator concerns. Notably, simply providing a curated list of ready-to-use mini-games caused many participants to reconsider their stance on GBL and begin planning for implementation. The evaluation results showed that perceived usefulness and fit varied significantly by discipline, group size, level and teaching style, reinforcing the importance of context-sensitive design.

AI-supported tools offered additional value by reducing preparation effort – a major factor in effort expectancy. Participants responded positively to the AI tool, with many expressing surprise at the quality of the outputs and a desire to integrate it into future teaching. These findings suggest that combining mini-games with low-effort AI tools may offer a scalable strategy to promote broader GBL adoption in higher education. In the study, participants only had short exposure to the different chatbots. It would be interesting in future studies to analyze the interaction between educators and the bots and the evaluation of the game experiences by students. A special focus should be placed on learning outcomes, educator satisfaction with the tools and ease of use. Practically, institutions should consider developing discipline-specific GBL repositories, providing access to generative AI tools that automate game content creation, and offering structured training on the pedagogical benefits of GBL. These interventions could accelerate cultural change by normalizing GBL and making it part of routine instructional design.

This study includes several limitations that will be addressed in future research projects. First, the perspective of students is not considered explicitly. While the authors have tested all presented games in classroom settings and have anecdotal evidence that mini-games may increase motivation and participation, these effects have not yet been evaluated scientifically. In addition, the qualitative nature of the study limits generalizability. The small sample size did not allow for full representation of all disciplines or teaching formats. Notably, several differences emerged between educators from the social sciences and those from engineering disciplines, as well as between instructors teaching small seminars versus large lectures. These variations warrant further investigation to understand how contextual factors and disciplines influence GBL adoption and perceptions of usefulness. Finally, while the AI tool was well received in interviews, its evaluation remains perceptual. Due to

social desirability bias, interviewees might have provided a too-positive evaluation of the games and tool. Future studies should explore how educators use such tools in practice and whether their reported ease of use translates into sustained adoption.

Ethics Statement: This study followed institutional ethical guidelines. Participants gave informed consent, no sensitive data were collected, and participation was voluntary. Formal ethics clearance was therefore not required.

AI Statement: Artificial intelligence tools supported several stages of this research. Two mini-games – *Lie Detector* and *Thought Experiment Roulette* – were developed with the aid of generative AI for ideation and content refinement. AI-based academic tools (Consensus, Elicit) were used to identify relevant studies and search for gaps in the literature review. Additionally, ChatGPT and DeepL enhanced the clarity and fluency of the writing, particularly for non-native English speakers. Reference formatting was also AI-assisted. All outputs generated by AI tools were reviewed and edited by the authors to ensure accuracy, relevance, and compliance with academic standards.

References

- Abou Hashish, E.A., Al Najjar, H., Alharbi, M., Alotaibi, M. and Alqahtany, M.M. (2024). Faculty and students perspectives towards game-based learning in health sciences higher education. *Heliyon* 10(12), e32898.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), pp.179–211.
- Al-Azawi, R., Al-Faliti, F. and Al-Blushi, M. (2016). Educational gamification vs. game-based learning: Comparative study. *International Journal of Innovation, Management and Technology*, 7(4), pp.131–136.
- Albuquerque, A., Melo, M. and Lima, J. (2010). Challenges in serious game design and development: Educators' perspectives. *Simulation & Gaming*, 41(5), pp.680–697.
- Alhumairi, M., Ebrahimi, M. and Alzahrani, A. (2024). Integrating augmented reality into game-based learning: Challenges and opportunities. *Journal of Educational Technology Development and Exchange*, 17(1), pp.45–60.
- Ariffin, M.M. (2012). Towards Digital Game-Based Learning (DGBL) in Higher Education (HE): The Educators' Perception. *Developing Country Studies*, 2(11), 15–21.
- Babar, M.Y. (2022). EAL instructors' attitudes towards game-based learning adoption in education: An exploration of obstacles. *Journal of English Language Studies*, 1(1), pp.1–12.
- Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J. and Valcke, M. (2013). Acceptance of game-based learning by secondary school teachers. *Computers & Education*, 67, pp.21–35.
- Cerra, D., Manzano-León, A. and Rodríguez-Ferrer, J.M. (2022). Effects of using game-based learning to improve academic performance and motivation in engineering studies. *Education and Information Technologies*, 27, pp.1–20.
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, pp.77–101.
- Clark, D.B., Tanner-Smith, E.E. and Killingsworth, S.S. (2016). Digital games, design, and learning: A systematic review and meta-analysis. *Review of Educational Research*, 86(1), pp.79–122.
- Crocco, F., Offenholley, K. and Hernandez, C. (2016). A proof-of-concept study of game-based learning in higher education. *Simulation & Gaming*, 47(4), pp.403–422.
- De Clerck, D., Alexander, D., Hussaini, N., John, S., Jain, S.A. and Sarkar, B. (2022). Game-based learning in higher education: An effective pedagogical tool for enhanced competency building. *Acquiring 21st Century Literacy Skills Through Game-Based Learning*. IGI Global.
- Deterding, S., Dixon, D., Khaled, R., Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining Gamification. *MindTrek '11: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, pp. 9–15.
- Dimitriadou, A., Djafarova, N., Turetken, O., Verkuyl, M. and Ferworn, A. (2021). Challenges in Serious Game Design and Development: Educators' Experiences. *Simulation & Gaming* 52, pp.132–152.
- Dontre, A.J. (2020). The influence of technology on academic distraction: A review. *Human Behavior and Emerging Technologies*, 3(3), pp.379–390.
- Dwivedi, Y.K., Rana, N.P., Jeyaraj, A., Clement, M. and Williams, M.D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, 21(3), pp.719–734.
- Edwards, C., Perry, B., Janzen, K. and Peters, M. (2023). Game-based learning in higher education: A systematic review of recent literature. *Journal of Educational Technology*, 20(2), pp.35–50.
- Fishbein, M. and Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley.
- Hamari, J., Shernoff, D.J., Rowe, E., Coller, B., Asbell-Clarke, J. and Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in Human Behavior* 54, pp.170–179.
- Heredia-Carroza, J. and Stoica, R. (2024). Artificial intelligence in higher education: A literature review. *Journal of Public Administration, Finance and Law*, (30), pp.97–108.

- Huizenga, J.C., Admiraal, W., Akkerman, S. and ten Dam, G. (2017). Teacher perceptions of the value of game-based learning in secondary education. *Computers & Education*, 110, pp.105–115.
- Jääskää, J. and Rajala, J. (2022). Educational motivation through game-based learning: A case study on serious games in xMOOC. *Bachelor's thesis*, Tampere University.
- Kaimara, P., Fokides, E. and Linda, S. (2021). Factors affecting game-based learning experience: The case of a university course. *Advances in Game-Based Learning*, pp.123–138. Springer.
- Lester, J.N., Diekema, A.R., Carbone, L. and Roberts, C.A. (2022). Game-based learning in higher education: A systematic review. *Educational Research Review*, 35, 100436.
- Mao, L., Zhang, L., Xu, Y. and Guo, R. (2021). The effects of digital game-based learning on student engagement and critical thinking: A meta-analysis. *Educational Technology Research and Development*, 69, pp.1863–1889.
- Oblinger, D.G. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education*, 2004(1).
- O'Donnell, F., Porter, M. and Fitzgerald, D.R. (2024). The role of artificial intelligence in higher education. *Irish Journal of Technology Enhanced Learning*, 9(1), pp.45–60.
- Park, H., Kim, Y., Lee, J. and Jeong, H. (2021). Enhancing student motivation through game-based learning: A study in large university classrooms. *Computers & Education*, 165, 104146.
- Sousa, C., Neves, P.P. and Luz, F.C. (2023). Implementation of game-based learning in educational contexts: Challenges and intervention strategies. *Electronic Journal of e-Learning*, 21(1), pp.1–15.
- Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), pp.425–478.
- Watson, W.R. and Yang, S. (2016). Games in schools: Teachers' perceptions of barriers to game-based learning. *Journal of Interactive Learning Research*, 27(2), pp.153–170.
- Wouters, P., van Nimwegen, C., van Oostendorp, H. and van der Spek, E.D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology*, 105(2), pp.249–265.
- Yaman, H., Sousa, C. and Luz, F.C. (2024). Barriers and hindrances to the effective use of games in education: Systematic literature review and intervention strategies. *Proceedings of the 18th European Conference on Games Based Learning*, pp.615–623.