Research in Education, Technology, and Multiculture

ISSN: 3025-6763 | Journal's DOI: 10.61436/rietm

Homepage: https://imrecsjournal.com/journals/index.php/rietm

Generative AI, Gamification, and Student Motivation: A Systematic Literature Review

Muhamad Dody Firmansyah[1*], Tiara Nur Athifa[1], Suwarno Liang[1], Zurina Saaya[2], & Nurul Izrin Md Saleh[2]

[1]Information System Study Program, Universitas Internasional Batam, Indonesia

[2]Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Malaysia

ARTICLE INFO

Article History:

Received: 24 September 2026

Accepted: 24 October 2026

Published: 06 November 2026

Keywords:

Generative AI;
Gamification;
Gamified learning;
Student motivation;
Systematic review of literature

Corresponding Author:

dody.firmansyah@uib.edu

ABSTRACT

This Systematic Literature Review (SLR) synthesizes how Generative Artificial Intelligence (Generative AI) is implemented in learning environments, with and without gamification, and what studies report about students' motivation and engagement. Following the PRISMA 2020 guidelines, structured searches in Scopus, IEEE Xplore, and ScienceDirect identified 792 records, and 116 full-text reports were assessed. Sixty-nine peer-reviewed journal articles were included: 21 on AI-supported gamified or game-based learning and 48 on Generative AI and motivation or engagement without gamification. In the gamified subset, four implementation forms appear (AI characters and role-play partners, LLM feedback and adaptive difficulty, AI-generated assessment items, and Generative AI as a game design tool), and all eight comparison studies reported higher or favorable motivation, engagement, or related outcomes. Across the whole corpus, two meta-analyses and one systematic review report positive overall effects of ChatGPT and Generative AI on engagement or motivation, with moderators and mixed emotional evidence. Individual studies are not uniformly positive: one found that videos outperformed a Generative AI assistant on knowledge gains and curiosity, one found no significant effect on behavioral engagement, and one found that Generative AI use may reduce active learning and motivation. The evidence is concentrated in higher education (48 of 69 articles) and in 2025 (52 of 69); the most frequently stated limitations are small or single-context samples (20 articles) and short interventions with novelty effects (12), and the most frequent recommendations are longer studies (18) and larger and more diverse samples (17). Future research should isolate the AI component's contribution and test it over time.

To cite this article:

Firmansyah, M. D., Athifa, T. N., Liang, S., Saaya, Z., & Saleh, N. I. M. (2026). Generative AI, gamification, and student motivation: A systematic literature review. *Research in Education, Technology, and Multiculture*, *5*(4), 420-436. doi: https://doi.org/10.61436/rietm/v5i4.pp420-436

This is an open access article under the CC BY SA licence (https://creativecommons.org/licenses/by-sa/4.0/).

■ INTRODUCTION

The emergence of Artificial Intelligence (AI) has brought major change to the field of education. AI is no longer just a data analysis tool. It is now a learning agent that can offer more adaptive and tailored learning experiences. An innovative approach that has evolved alongside this trend is gamification, i.e., applying game elements in the learning process to increase student engagement and motivation (Kassenkhan, Moldagulova, & Serbin, 2025). Gamification and Generative AI are coming together to create new opportunities for more interactive, dynamic, and tailored educational experiences (Gianni, Nikolakis, & Antoniadis, 2025). Generative Artificial Intelligence can generate text, assessment items, and automatic feedback to support the learning process. For example, in education, generative models can re-explain material, generate exercises, and provide instant responses that help learners understand difficult concepts. Research shows that this technology enhances accessibility, personalization, and learning efficiency, especially in higher education (Baidoo-Anu & Owusu Ansah, n.d.). In language learning, AI has been shown to improve writing, reading, and grammar through automatic correction and examples of language use (Law, 2024). Teachers also benefit, as AI speeds up material preparation and grading. However, AI use still requires human verification because of the risk of inaccurate information, bias, and potential over-reliance (Wang et al., 2024). Gamification uses game elements such as points, badges, levels, and challenges to make the learning process more engaging. This method enhances students' motivation and involvement

by giving them a sense of achievement and making learning more fun (Kassenkhan et al., 2025). Combining gamification and AI makes it more adaptive. AI can adjust difficulty, automatically award rewards, and deliver feedback that fits each student's ability (Romero Marras et al., 2025). This combination offers a full learning experience and higher engagement. However, poor gamification can increase cognitive load or even lower motivation. Motivation to learn is an important determinant of success in digital learning, as students are expected to learn more autonomously. Self-determination theory states that students are more motivated when they feel in control, competent, and connected to others (Annamalai, Bervell, Mireku, & Andoh, 2025). Students tend to be more motivated when material is personal and relevant to their ability, and digital learning allows greater personalization, for example by adapting difficulty levels or recommending follow-up material (Tasdelen & Bodemer, 2025). External motivation can be increased by gamification elements, such as progress bars, XP and leaderboards, which create a sense of competition and achievement. However, motivation can be lost when students feel overwhelmed, do not understand the instructions, or teachers do not provide enough support. Therefore, technology should aid learning, not replace human interaction (Qian, 2025). Integrating Generative AI and gamification offers a more personalized and engaging learning method. Artificial intelligence automatically produces content, including assessment items and summaries of material, while gamification provides motivational impetus through rewards and challenges; integrating the two helps tailor learning to student ability and increase engagement (Alammary, 2025; Bachiri, Mouncif, & Bouikhalene, 2023). Although effective, this integration faces challenges such as dependence on technology, the accuracy of AI output, and the potential reduction of human interaction (Hadi Mogavi et al., 2024). AI should therefore support educators rather than replace them.

Although gamification has been shown to improve learning motivation, its implementation still faces several challenges. Several studies indicate that a gamification design that is not aligned with students' level of understanding or their preferences may in fact reduce learning motivation (Elsawah, 2025). Meanwhile, the application of AI in education is often still limited to analytical functions, recommendation, or adaptive testing, and has not yet integrated Generative AI to generate items automatically, to provide personalized feedback, or to compose adaptive summaries of learning material (Tafazoli, 2024) .

Previous studies also remain fragmented. Some studies focus on gamification without directly integrating the potential of Generative AI (Romero-Rodríguez, Martínez-Menéndez, Alonso-García, & Victoria-Maldonado, 2024). In contrast, others examine AI in education but do not explicitly highlight its relationship with student learning motivation (Belkina et al., 2025). An initial review of the literature points to several specific gaps: most gamification studies still rely on traditional designs without automatic adaptive elements; few studies examine the direct relationship between Generative AI and learning motivation within gamified learning (Alammary, 2025; Xiao, Li, & Guo, 2025); longitudinal evaluations of the effect of AI on long-term motivation are lacking; structured frameworks for integrating Generative AI into gamification design are scarce; and many studies still position ChatGPT as a learning assistant rather than as part of the gamification mechanism itself. This makes it hard for researchers and practitioners to fully understand how Generative AI should be positioned in gamification design. To this end, this study conducts a Systematic Literature Review (SLR) to identify trends, opportunities, and research gaps related to implementing Generative AI in learning, with and without gamification, and its reported effects on student motivation and engagement. The review is structured around four research questions. RQ1. How is Generative AI implemented in gamified and non-gamified learning, and what is its reported effect on students' learning motivation and engagement? RQ2 examines which games and gamification elements studies combine with AI. RQ3 addresses the limitations reported by the studies. RQ4 concerns the research directions that the studies recommend. This study adds conceptually to the literature on gamification-based learning strategies and their impact on learning motivation (Smiderle, Rigo, Marques, Peçanha de Miranda Coelho, & Jaques, 2020) and offers a conceptual framework for the synergy between Generative AI and gamification (Kassenkhan et al., 2025). The findings are expected to serve as a practical reference for educators and educational technology developers in designing more effective gamification through personalized challenges, adaptive item provision, and generative AI-based feedback (Alammary, 2025; Bachiri et al., 2023). The framework of this research is presented in Figure 1, showing the relationship between the use of Generative AI, gamification elements, and the improvement of students' learning motivation. Generative AI functions as an adaptive content provider,

automatically generating items, explanations, and feedback tailored to student ability. That adaptive content is then reinforced by means of gamification elements such as points, levels, badges, challenges, and reward systems so that the learning process becomes more engaging, more directed, and better matching the needs of each individual student. AI keeps the material relevant and at an appropriate level of difficulty, while gamification provides motivational impetus through a sense of achievement and clearly visible progress.



Figure 1. Conceptual Framework of the Study

METHOD

Research Design and Procedures

The Systematic Literature Review (SLR) method adopted in this study was developed following the PRISMA 2020 guidelines (Page et al., 2021). This method provides a comprehensive, transparent, and structured summary of trends and gaps in implementing Generative AI in learning, with and without gamification. Eligibility was assessed from the full text of each report against the criteria in Table 2, which include a clear description of the research objectives, design, data analysis, and findings. Reports that did not meet every criterion were excluded, and the reason for each exclusion is documented in the Supplementary Material.

Search Process

The systematic search was conducted in three databases: Scopus, IEEE Xplore, and ScienceDirect, all on 17 October 2026. The search strings are shown in Table 1. In Scopus, the search was run in the title, abstract, and keyword fields and limited to publication years 2020–2025, English, articles and reviews, and journals, which returned 648 records. In IEEE Xplore, the string was run as a command search across all metadata and limited to journals and 2020–2025, returning 39 records (860 before the filters). In ScienceDirect, the operator limit of the database required two separate searches: one combining Generative AI terms with gamification terms (23 records) and one combining Generative AI terms with motivation and engagement terms (82 records); both were limited to 2023–2025 and to research and review articles, and the term "Artificial Intelligence in Education" was omitted because of the operator limit. In total, 792 records were identified. ERIC was also searched, but its export could not be completed for the full result set, so ERIC records are not included in the counts. Web of Science and ACM Digital Library could not be accessed through the authors' institution and were not searched.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were established to ensure the relevance and quality of the analyzed articles, as presented in Table 2. A report was included if it examined Generative AI (including LLM-based tools such as ChatGPT) in an educational or training context, or AI combined with gamification, game-based learning, or serious games, and reported findings on learning motivation, engagement, or closely related constructs. The criteria were first applied in a narrower form that required AI combined with gamification; because that version yielded fewer reports than needed to describe the field, they were widened after the first screening wave to include Generative AI studies without gamification, and the full-text assessment was then completed under the widened criteria. Studies on gamification alone were not covered by the search strings and are not part of this review.

Study Selection Process

Literature selection was conducted following the PRISMA stages (identification, screening, retrieval and eligibility) as shown in Figure 2. In the identification stage, 792 records were retrieved from three databases, namely Scopus (n = 648), IEEE Xplore (n = 39), and ScienceDirect (n = 105). After 110 duplicate records were removed, 682 records were screened. Of these, 261 were excluded by keyword rules because they contained neither a game or gamification term nor a Generative AI term together with motivation or engagement terms and an empirical cue; 86 were excluded after reading their title and abstract, and 168 met the keyword rules but were not sought because retrieval was prioritized by a relevance score, leaving 167 reports sought for retrieval. Fifty-one

Table 1. Search Strings Used in Each Database

Database and search string
Scopus: TITLE-ABS-KEY ((“Generative AI” OR “Generative Artificial Intelligence” OR “ChatGPT” OR “large language model*” OR “AI agent*” OR “Artificial Intelligence in Education”) AND (“Gamification” OR “Gamified” OR “Game-based learning” OR “Serious game*” OR “Learning motivation” OR “Student motivation” OR “Student engagement”)) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND LANGUAGE (english) AND (DOCTYPE (ar) OR DOCTYPE (re)) AND SRCTYPE (j)
IEEE Xplore (command search, all metadata, journals, 2020–2025): ((“All Metadata”:“Generative AI”) OR (“All Metadata”:“Generative Artificial Intelligence”) OR (“All Metadata”:“ChatGPT”) OR (“All Metadata”:“large language model”) OR (“All Metadata”:“AI agent”) OR (“All Metadata”:“Artificial Intelligence in Education”)) AND ((“All Metadata”:“Gamification”) OR (“All Metadata”:“Gamified”) OR (“All Metadata”:“Game-based learning”) OR (“All Metadata”:“Serious game”) OR (“All Metadata”:“Learning motivation”) OR (“All Metadata”:“Student motivation”) OR (“All Metadata”:“Student engagement”))
ScienceDirect (title, abstract, or author-specified keywords; 2023–2025; research and review articles). Search 1: (“Generative AI” OR ChatGPT OR “large language model” OR “AI agent”) AND (Gamification OR Gamified OR “Game-based learning” OR “Serious game”). Search 2: (“Generative AI” OR ChatGPT OR “large language model” OR “AI agent”) AND (“Learning motivation” OR “Student motivation” OR “Student engagement”)

Table 2. Inclusion and Exclusion Criteria

Inclusion	**Exclusion**
Peer-reviewed scientific journal articles	Conference proceedings, book chapters, preprints, and study protocols
Published between 2020 and 2025	Published outside this period
Written in English	Written in other languages
Studies learners in an educational or training context	Not an educational or training context
Examines Generative AI (including LLM-based tools and agents) in learning, or AI combined with gamification, game-based learning, or serious games	Non-generative AI without gamification, AI used only as a research tool or as course content, or gamification or games without AI.
Reports findings or evaluation results on learning motivation, engagement, or closely related constructs (e.g., interest, flow, self-efficacy)	Reports no findings on motivation or engagement (e.g., technical-only evaluation, usage frequency only, conceptual or reflective paper without data)
Full text available	Full text not retrievable
Clear description of the methodology	Methodology not described

reports could not be retrieved because the full text was behind a paywall, so 116 reports were assessed for eligibility. In the eligibility phase, 47 reports were excluded: 26 reported no findings on motivation, engagement, or related constructs, 11 did not use AI as part of the learning intervention, four were not set in an educational context, four were conceptual or reflective papers without empirical data, and two were conference proceedings. Therefore, 69 articles fulfilled the requirements and were included in the synthesis. The excluded and unretrieved reports are listed with their reasons in the Supplementary Material (Supplementary Table S2).

Data Extraction and Synthesis

Each article that passed the eligibility stage was assigned an identification code from S1 to S69 and extracted using a structured data extraction form. The extracted data included article identity, research context, research design and number of participants, form of Generative

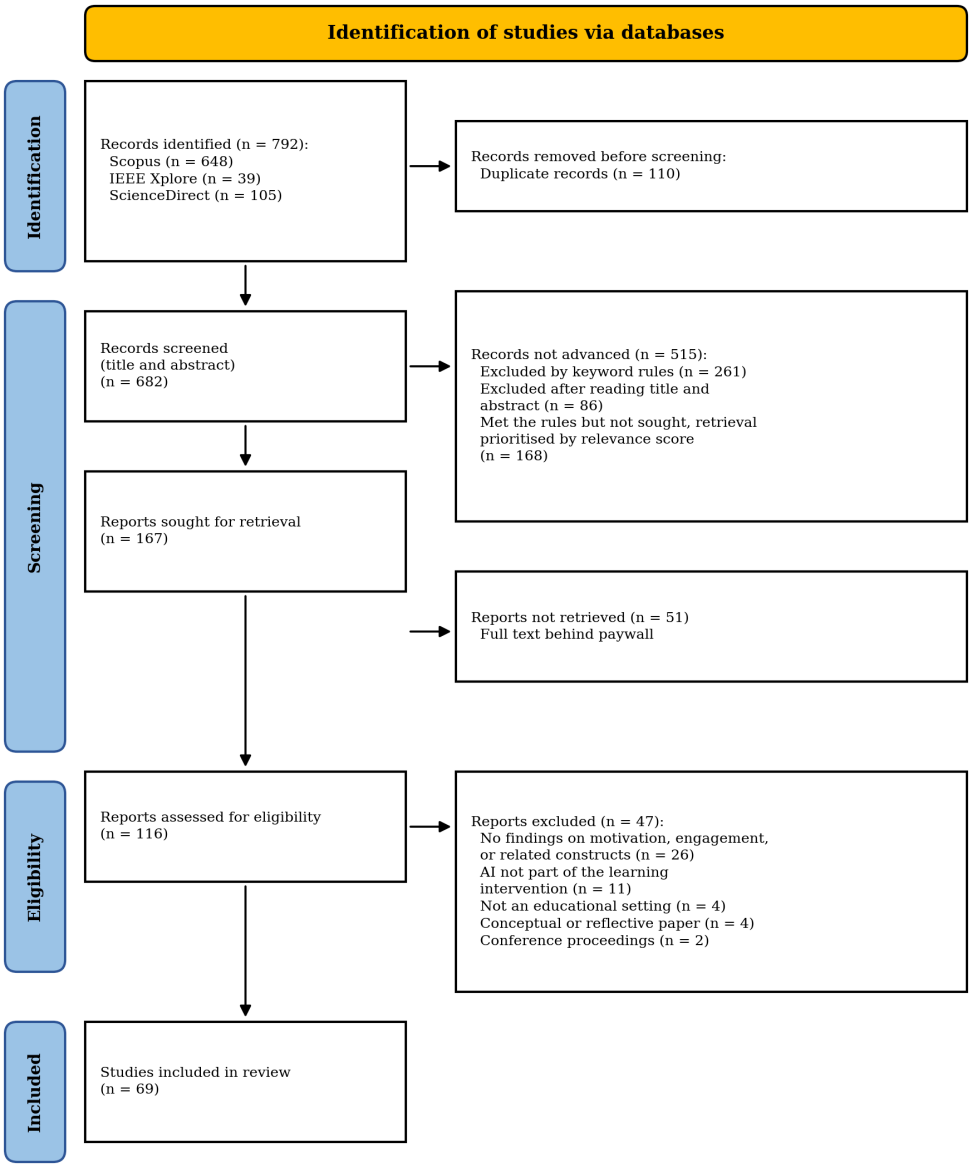


Figure 2. PRISMA Flow Diagram of the Literature Selection Process

AI implementation, gamification elements used, motivation or engagement indicators measured, main findings, and reported limitations. The synthesis was performed thematically. The extraction results were coded based on the four research questions, and the frequency of occurrence was then counted in order to identify dominant patterns. The results of the synthesis are shown in tables and frequency charts in the Results and Discussion section and are accompanied by a narrative interpretation which ties the findings to the theoretical basis presented in the Introduction. The complete extraction form for all 69 articles is provided in the Supplementary Material (Supplementary Table S1).

■ RESULT AND DISCUSSION

Overview of the Selected Literature

This review analyzed 69 primary articles that fulfilled the inclusion criteria. An identification code was assigned to each article (S1 to S69; the 21 articles on gamified or game-based learning come first, followed by the 48 articles on Generative AI without gamification, each group in order of year of publication and then alphabetically by first author). The complete extraction for all 69 articles is provided in the Supplementary Material (Supplementary Table S1), and full bibliographic details are provided in the References. The distribution by year of publication is concentrated in the most recent period, as shown in Figure 3: all 69 articles were

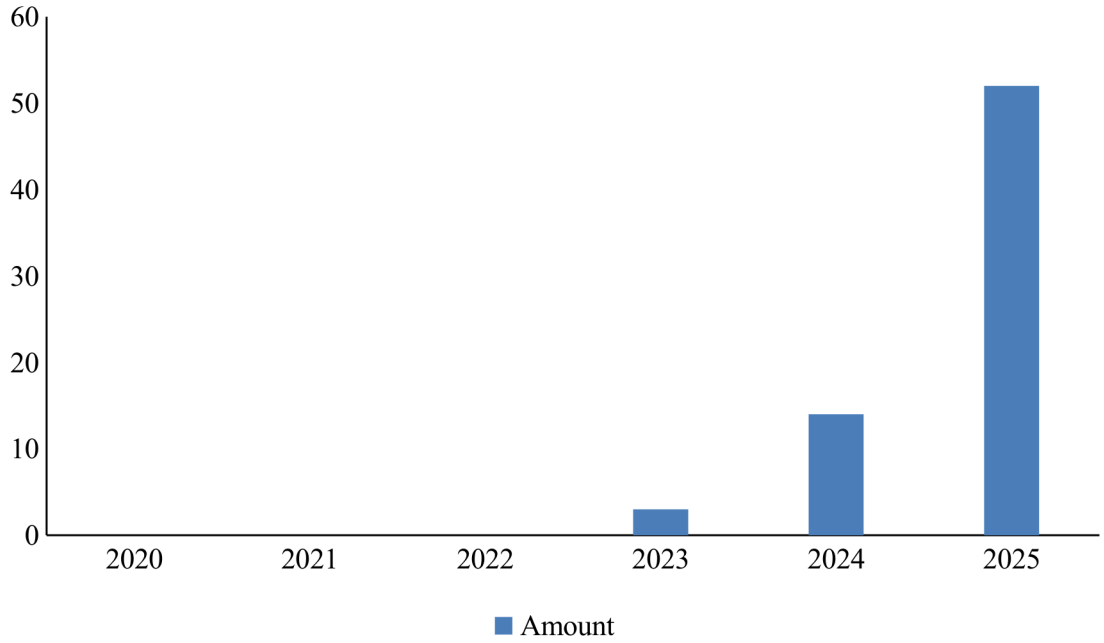


Figure 3. Distribution of the 69 Included Studies by Year of Publication

published between 2023 and 2025, 52 of them (75.4%) in 2025, and none before 2023. This pattern aligns with the release of ChatGPT at the end of 2022 as the turning point when Generative AI entered educational research. It also reflects the search limits: 2020–2025 in Scopus and IEEE Xplore, and 2023–2025 in ScienceDirect.

Two patterns stand out in the corpus's research design and educational level. First, 24 of the 69 articles (34.8%) used a comparison design (experimental, quasi-experimental, or between-groups), 22 (31.9%) were qualitative or mixed-methods studies, 10 (14.5%) were cross-sectional surveys, 6 were development or pilot studies, and 7 were reviews or meta-analyses. Second, 48 articles (69.6%) were set in higher education, 8 at primary or school level, and 13 were cross-level, workplace, non-formal, or did not specify a level. The evidence base is therefore recent and concentrated in university settings, which limits the generalisability of the findings discussed below.

Generative AI implementation and reported impact on motivation and engagement (RQ1)

RQ1 is answered in three steps: the forms of AI implementation across the corpus, evidence from the gamified and game-based studies (Table 3), and evidence from studies without gamification. Table 3 summarises the ten gamified or game-based studies that compared an AI-supported condition with a baseline or reported quantitative or comparative evidence on motivation or engagement: the form of AI implementation, the game or gamification elements, the context, and the reported impact. The extraction for all 69 studies is provided in Supplementary Table S1.

Table 3. Gamified and Game-Based Studies With Comparative or Quantitative Evidence on Motivation and Engagement

Code	Author (Year)	Form of AI Implementation	Gamification Elements	Context / Level	Reported Impact on Motivation
S1	Bachiri et al. (2023)	AI-based automatic question generation (LLM) in a Moodle plugin	Gamified assessment (badges, rewards, instant feedback)	Fifth-graders in a MOOC; N = 100	Higher motivation and learning outcomes than traditional assessment

Code	Author (Year)	Form of AI Implementation	Gamification Elements	Context / Level	Reported Impact on Motivation
S3	Aslan et al. (2024)	Conversational AI agent (teddy bear) with multimodal sensing	Play-based games; AI character	Elementary school; 14 students and 3 educators	High engagement; less screen time, more physical activity and social interaction
S4	Beltozar-Clemente and Díaz-Vega (2024)	ChatGPT-based support	Points, rewards	University physics; N = 188	Higher academic performance and more positive attitudes (interest, self-efficacy, participation, satisfaction)
S6	Alammary (2025)	GenAI system giving instant feedback on answers	Leaderboard, points, instant feedback	Online university courses; 54 baseline and 53 experimental students	Higher participation and response quality; favorable motivational ratings
S8	Durgungoz and Durgungoz (2025)	AI-generated Quizizz quizzes	Points, leaderboard	Online special education module; N = 213	Initial boost in engagement that declined over seven weeks
S10	Gianni et al. (2025)	LLM real-time feedback with personalization	Points, badges, leaderboard, rewards	University course in extended reality; N = 20 (pilot)	22% higher self-reported motivation (pilot)
S11	Intawong et al. (2025)	Generative AI interaction and AI feedback with motion capture	Rewards, narrative, avatars	University students; N = 36	Higher intrinsic motivation and knowledge gains; high usability
S15	Ngu et al. (2025)	GenAI NPC with instant feedback	NPC, simulated situations	Workplace communication skills; N = 91 (three groups)	Higher flow and perceived fidelity than a text-scaffolding control
S16	Nielsen et al. (2025)	LLM-driven NPC guides in VR	VR museum, NPC dialogue	Museum visitors; N = 28 (14 per group)	Higher social presence and engagement than traditional dialogue

Code	Author (Year)	Form of AI Implementation	Gamification Elements	Context / Level	Reported Impact on Motivation
S21	Xiao et al. (2025)	ChatGPT--powered NPCs	Storyline, NPCs	EFL undergraduates; N = 85	Higher intrinsic motivation and situational interest

Among the 21 gamified or game-based studies, four forms of AI implementation recur. The most common places are AI characters, non-player characters (NPCs), or role-play partners inside the game (seven studies): ChatGPT-powered NPCs in a storyline-driven writing game (Xiao et al., 2025) , a conversational AI agent for play-based learning in early childhood (Aslan et al., 2024), LLM-driven digital interviewers and museum guides (Mongkoljaturong, Manitsakulwong, & Moodleah, 2025 ; Nielsen et al., 2025), a GenAI NPC providing simulated workplace interactions (Ngu, Chien, Ho, & Hou, 2025) , and ChatGPT as a role-play counterpart (Daniels, Kelly, Flynn, & Kelly, 2025 ; Stampfl, Geyer, & Deissl-O'meara, 2024). The second form uses LLMs for feedback, scaffolding, or adaptive difficulty (six studies), as in instant AI feedback with a leaderboard in live online classes (Alammary, 2025) , real-time feedback with game-theoretic incentives in extended reality (Gianni et al., 2025) , AI feedback in a metaverse dance platform (Intawong, Worragin, Khanchai, & Puritat, 2025), ChatGPT-supported physics learning (Beltozar-Clemente & Díaz-Vega, 2024) , and difficulty adjustment in a logistics training game (Romero Marras et al., 2025). The third form is AI-generated assessment items for gamified activities (two studies; Bachiri et al., 2023 ; Durgungoz & Durgungoz, 2025), and the fourth is GenAI as a design or development tool, in which educators or students use it to build games or escape rooms (four studies; Evmenova, Regan, Mergen, & Hrisseh, 2025 ; Ho & Lee, 2023 ; Rodríguez-Rivera, Rodríguez-Ferrer, & Manzano-León, 2025 ; Wan, Woo, & Ho, 2025). Two reviews complete this group (Kassenkhan et al., 2025) . Muthuswamy and Absamatov (2025) is counted in the second form because it examines ChatGPT quality, feedback quality, and gamification as predictors in a survey.

The 48 studies without gamification fall into four groups. Fourteen concern language learning and writing feedback (Alwehebi, 2025; Bekdaş, 2025; Chan, Lo, & Wong, n.d.; etDong, 2025; Hu, Tian, & Li, 2025; Ma & Chen, 2024; Oktarin, Saputri, Magdalena, Hastomo, & Maximilian, 2024; Rath, 2025; Teng & Huang, 2025; Wang et al., 2024; Xu, Su, & Liu, 2025; Yan & Zhang, 2024; Yeung, 2025; Zhang & Wang, 2025). Seventeen concern subject learning with GenAI tutors, assistants, robots, or systems (Bai, Lui, & Khiatani, 2025; Bland, 2025; Dahri, Al-Rahmi, Alhashmi, & Bashir, 2025; Elhag, Abri, & Fahmy Yousef, 2025; Gaeta, Orciuoli, Pascuzzo, & Peduto, 2025; Hari et al., 2025; Jafarian & Kramer, 2025; Leahy, Ozer, & Cummins, 2025; Li & Chiu, 2025; Li & Lyu, 2025; Li & Lyu, 2025; Mellado & Cubillos, 2025; Santhosh, Dengel, & Ishimaru, 2024; Tasdelen & Bodemer, 2025; Yilmaz & Karaoglan Yilmaz, 2023; Yin et al., 2025; Zhang, 2025). Twelve are survey or perception studies of student GenAI use (Annamalai et al., 2025; Y. Bai & Wang, 2025; Boguslawski, Deer, & Dawson, 2025; Guo, Zhang, Shi, & Coates, 2025; Hmoud, Swaity, Hamad, Karram, & Daher, 2024; Jose, Prasanna, Kushwaha, & Das, 2024; Kaur et al., 2024; Khoso, Honggang, & Darazi, 2025; Pasupuleti et al., 2025; Sumilong, 2025; Tica & Krsmanović, 2024; Yang, 2025). Five are reviews or meta-analyses (Heung & Chiu, 2025; Lin & Tan, 2025; Lo, Hew, & Jong, 2024; Mykhaylenko, Safonova, Ilchenko, Ivashchuk, & Babik, 2024; Xia, Li, Yang, Weng, & Chiu, 2025).

Across the eight gamified or game-based comparison studies, every study reported a higher or favorable result for the AI-supported condition on motivation, engagement, or a related affective outcome: higher motivation and learning outcomes for gamified AI-generated assessment (Bachiri et al., 2023) , high engagement with reduced screen time in an early childhood setting (Aslan et al., 2024), more positive attitudes towards interest, self-efficacy, participation, and satisfaction (Beltozar-Clemente & Díaz-Vega, 2024), higher participation and favorable motivational ratings (Alammary, 2025), higher intrinsic motivation (Intawong et al., 2025), higher flow and perceived fidelity (Ngu et al., 2025) , higher social presence and engagement (Nielsen et al., 2025), and higher intrinsic motivation and situational interest (Xiao et al., 2025) . A pilot with 20 participants reported 22% higher self-reported motivation (Gianni et al., 2025). The picture is less uniform elsewhere: AI-generated gamified quizzes produced an initial boost in engagement that declined over seven weeks (Durgungoz & Durgungoz, 2025).

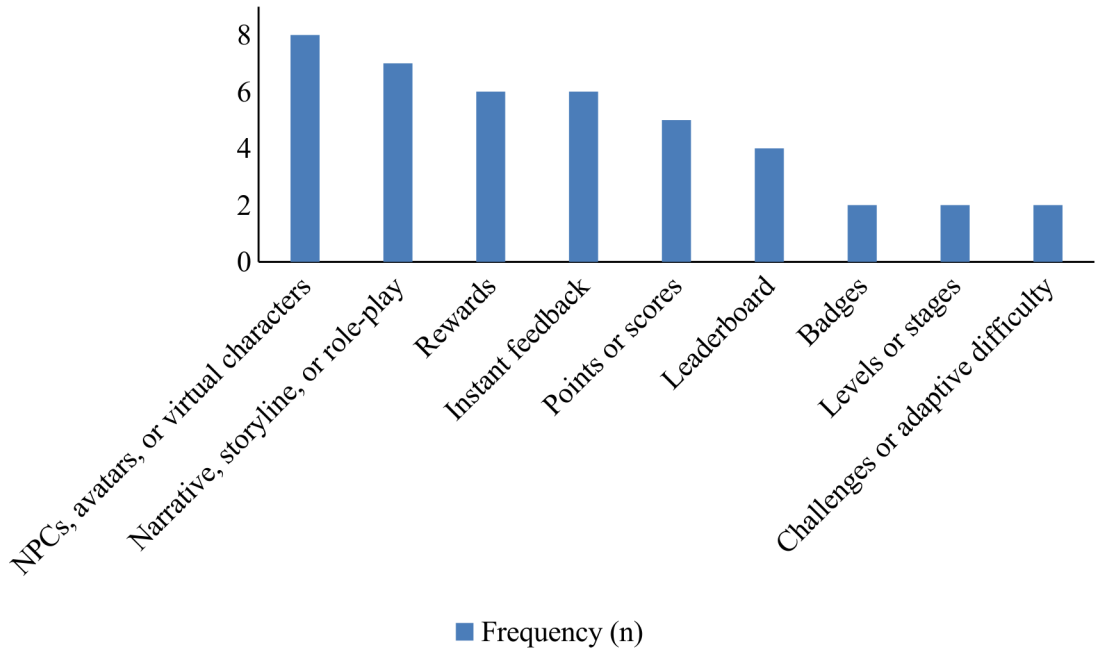


Figure 4. Frequency of Game and Gamification Elements Across the 19 Empirical and Design Studies

These positive results need careful reading. Most comparison conditions are conventional or less interactive baselines, so the AI's effect cannot be separated from the game's or novelty effects. Only three studies kept the game constant and varied the AI component, namely ChatGPT-powered versus conventional NPCs (Xiao et al., 2025) , an LLM-driven versus traditional dialogue system (Nielsen et al., 2025), and GenAI versus video or text scaffolding (Ngu et al., 2025) . In addition, the interventions reported are short, for example, a single 85-minute session (Xiao et al., 2025) or a single session (Aslan et al., 2024) and the samples are small.

Evidence from studies without gamification is larger but less uniform. Three syntheses report positive overall effects: a meta-analysis of experimental studies found significant positive effects of GenAI on university students' motivation and engagement, moderated by subject category, learning strategy, and context of use (Xia et al., 2025); a meta-analysis of 17 empirical studies found a medium overall effect of ChatGPT-based learning on engagement, with a large effect on cognitive engagement (Heung & Chiu, 2025); and a systematic review of 72 studies found robust but narrowly focused evidence on behavioural engagement, mixed evidence on emotional engagement, and evidence of disengagement in the form of academic dishonesty (Lo et al., 2024). Primary studies point in the same direction, with exceptions. Context-personalized GenAI material led to higher intrinsic motivation and interest in primary school mathematics (Tasdelen & Bodemer, 2025), and AI feedback on essay drafts was associated with higher engagement and motivation alongside mixed emotional responses (Chan et al., n.d.); a conversational AI tutor raised mastery goal orientation and self-efficacy in algebra (Li & Lyu, 2025), and ChatGPT improved affective and behavioral engagement in EFL writing but not cognitive engagement (Teng & Huang, 2025). A collaborative-writing chatbot did not significantly affect behavioral engagement, emotional engagement, or group writing performance (Hu et al., 2025); students who followed instructional videos achieved greater knowledge gains and higher curiosity than those who used a Generative AI assistant (Microsoft Copilot) in programming (Mellado & Cubillos, 2025). A large survey found that GenAI use was related to more cognitive and emotional engagement but might also reduce active learning and learning motivation (Guo et al., 2025). The most defensible reading is that Generative AI can raise engagement and motivation in many settings, especially affective and cognitive engagement, but that the effect depends on the design and context and is not guaranteed.

Game and gamification elements (RQ2)

Nineteen of the 21 gamified or game-based articles are empirical or design studies and were coded for game and gamification elements; the two reviews are discussed separately, and the 48 studies without gamification report

Table 4. Frequency of Game and Gamification Elements

Gamification Element	Frequency (n)	Percentage (%)	Motivation Indicator Affected	Article Codes
NPCs, avatars, or virtual characters	8	42.1	Social presence, engagement	S3, S9, S11, S13, S15, S16, S17, S21
Narrative, storyline, or role-play	7	36.8	Situational interest, immersion	S5, S7, S9, S11, S16, S17, S21
Rewards	6	31.6	Perceived progress, satisfaction	S1, S4, S9, S10, S11, S18
Instant feedback	6	31.6	Competence, sustained participation	S1, S6, S8, S9, S13, S15
Points or scores	5	26.3	Sense of achievement, participation	S2, S4, S6, S8, S10
Leaderboard	4	21.1	Competitive motivation, participation	S6, S8, S10, S18
Badges	2	10.5	Recognition of competence	S1, S10
Levels or stages	2	10.5	Perceived progress	S2, S9
Challenges or adaptive difficulty	2	10.5	Flow, perceived competence	S17, S18

no game elements. The frequency of each element, together with the motivation indicators it is linked to, is summarised in Table 4 and visualized in Figure 4; the article codes refer to Supplementary Table S1. Because one article can contain several elements, the percentages do not add up to 100%. Elements were coded from the abstract and full text of each article.

Characters and narrative dominate the coded elements. NPCs, avatars, or virtual characters appear in eight studies, and narrative, storyline, or role-play in seven, followed by rewards and instant feedback (six studies each), points or scores (five), leaderboards (four), badges and levels (two each), and challenges with adaptive difficulty (two). This differs from the classical gamification toolkit of points, badges, and leaderboards. When Generative AI is used, the most frequent mechanism is a conversational character or story, which LLMs enable because they can respond to open-ended input. Instant feedback is closely tied to the AI component, because the model produces it on demand (Alammary, 2025 ; Bachiri et al., 2023 ; Durgungoz & Durgungoz, 2025 ; Ngu et al., 2025).

The evidence on which element drives motivation is thin. Alammary, 2025 combined a leaderboard, cumulative scores, and instant AI feedback and found higher participation, but did not test the elements separately. Durgungoz & Durgungoz (2025) used points and a leaderboard through gamified quizzes and found an engagement boost that faded, suggesting that competition- or score-based elements may be vulnerable to novelty. Xiao et al. (2025) and Nielsen et al. (2025) isolated the AI character and found higher intrinsic motivation, interest, presence, and engagement, which suggests that a responsive character may contribute more than a reward layer. This remains an interpretation, because none of the studies manipulated one gamification element at a time. The two reviews list points, leaderboards, badges, rewards, and narrative as the elements commonly paired with AI (Kassenkhan et al., 2025; Sheejamol, Chacko, & Kumar, 2025).

Challenges and limitations (RQ3)

Limitations were coded only where the authors stated them explicitly. Two categories, small or single-context samples and short interventions with novelty effects or lack of longitudinal data, were coded for all 69 articles; for the 48 articles without gamification, this was done by keyword search of the limitations and future-research sections followed by manual verification of every matched passage, and articles without such a statement are not coded. Four further categories were coded manually for the 21 gamified or game-based articles only. Frequencies are visualized in Figure 5, and the

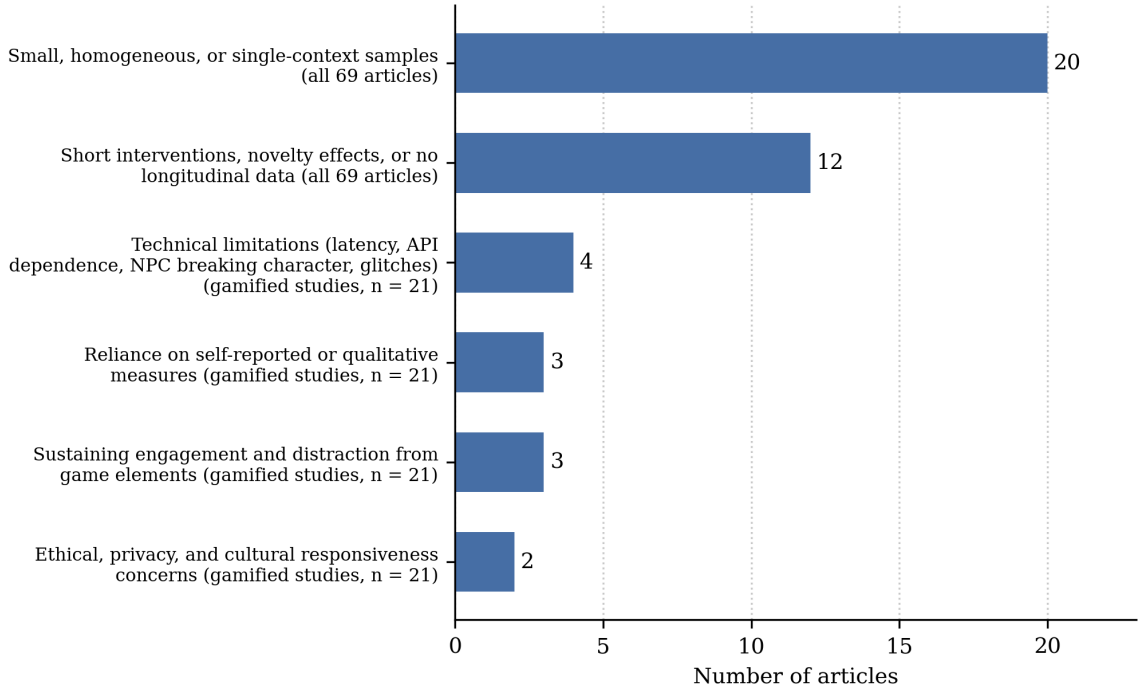


Figure 5. Frequency of the Limitations Reported in the Included Studies

article codes are given in Supplementary Table S3.

The most frequent limitation is methodological: small, homogeneous, or single-context samples are reported in 20 of the 69 articles, including 36 participants from one discipline (Intawong et al., 2025), 20 participants in a feasibility pilot (Gianni et al., 2025), 32 participants in a chatbot quasi-experiment (Dahri et al., 2025) , and a survey restricted to students in southern India (Jose et al., 2024) . Short interventions, novelty effects, or the absence of longitudinal data are reported in 12 articles, for example, a single class session of about 45 minutes (Li & Lyu, 2025), an eight-week treatment (Elhag et al., 2025) and a single session (Aslan et al., 2024). Because motivation is susceptible to novelty effects, positive findings from such interventions cannot yet show that Generative AI raises motivation in a sustained way. Within the 21 gamified or game-based articles, four report technical limitations, including latency and dependence on online APIs (Mongkoljaturong et al., 2025), users breaking the character of an LLM-driven NPC (Nielsen et al., 2025), and motion sickness and glitches (Intawong et al., 2025); three rely on self-reported or qualitative measures (Rodríguez-Rivera et al., 2025; Stampfl et al., 2024 ; Wan et al., 2025); three report problems with sustaining engagement or with game elements distracting from learning (Bachiri et al., 2023; Daniels et al., 2025; Durgungoz & Durgungoz, 2025); and two raise ethical, privacy, or cultural responsiveness concerns (Daniels et al., 2025; Gianni et al., 2025).

Two observations follow from this pattern. First, the limitations mainly concern the strength of the evidence rather than the AI itself, which fits the early stage of this literature. Second, the problem of AI accuracy and hallucination, which dominates discussions of Generative AI in education in general (Wang et al., 2024), is not a frequent theme in the gamified studies. Only Durgungoz & Durgungoz (2025) examined it directly and found that a notable share of AI-generated quiz questions needed modification or exclusion. Such errors would directly affect scores or rewards in a gamified system, yet none of the other gamified studies tested this risk explicitly.

Recommendations for future research (RQ4)

The research directions proposed by the studies were coded in the same way as the limitations: two categories (longer and longitudinal studies, and larger and more diverse samples) for all 69 articles, with manual verification of each matched passage for the 48 articles without gamification, and three further categories manually for the 21 gamified or game-based articles only. Frequencies are visualized in Figure 6, and the article codes are given in Supplementary Table S3.

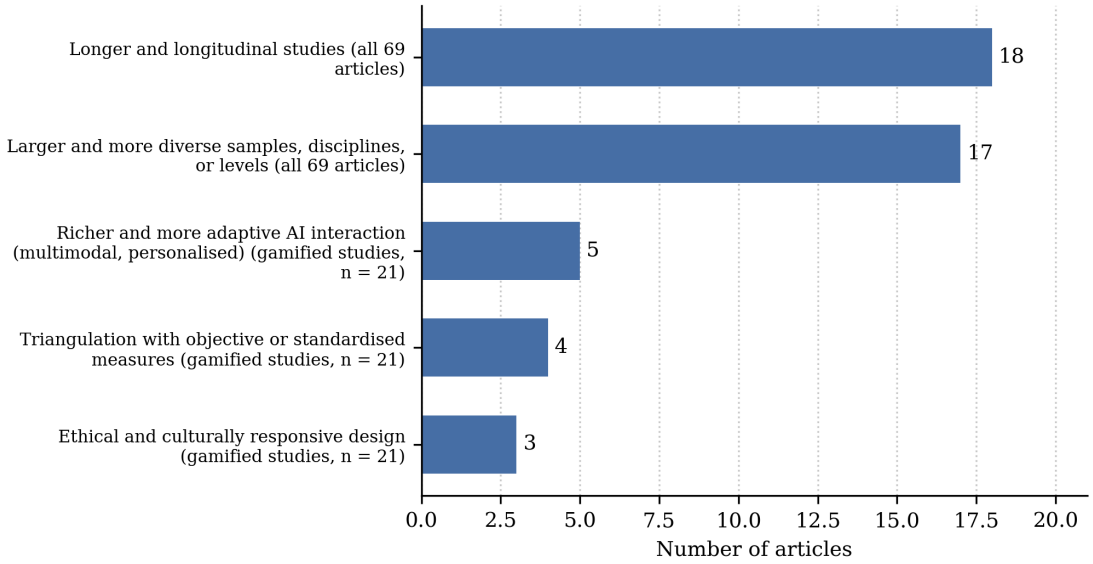


Figure 6. Frequency of the Recommended Research Directions Across the Included Studies

Longer and longitudinal studies are recommended in 18 of the 69 articles, and larger and more diverse samples, disciplines, or educational levels in 17. Within the gamified or game-based articles, five call for richer and more adaptive AI interaction, such as multimodal generative AI (Xiao et al., 2025) , better speech recognition and a hybrid architecture (Mongkoljaturong et al., 2025) , and more adaptive difficulty (Romero Marras et al., 2025); four call for triangulation with objective or standardized measures (Daniels et al., 2025 ; Mongkoljaturong et al., 2025 ; Stampfl et al., 2024 ; Wan et al., 2025); and three call for ethical and culturally responsive design (Daniels et al., 2025 ; Gianni et al., 2025 ; Kassenkhan et al., 2025).

The two most frequent recommendations are interrelated. The call for longer studies responds to the short interventions and novelty effects reported in the limitations, and the call for larger and more diverse samples responds to the concentration of evidence in small, university-based studies. Together, they point to the same requirement: studies that are large enough and long enough to separate the effect of the design from the effect of initial enthusiasm.

A related but rarer recommendation concerns isolating the AI component. Only three of the 21 gamified or game-based studies kept the game constant and varied the AI (Ngu et al., 2025; Nielsen et al., 2025; Xiao et al., 2025). Designs like this would show whether motivational gains come from the AI, the game, or novelty, and none of the included articles explicitly recommended them as a priority. Hence, this is an inference from the pattern of designs rather than a stated direction.

The findings on the first research question show a consistent but still preliminary picture. All eight gamified or game-based comparison studies and the Gianni et al. (2025) pilot reported higher or favorable motivation, engagement, or related affective outcomes for AI-supported games, and the meta-analytic evidence across non-gamified settings is also positive on average, but individual studies include null and negative results, and one gamified study found that the engagement boost faded over seven weeks (Durgungoz & Durgungoz, 2025). The most defensible conclusion is that Generative AI can raise short-term motivation and engagement in many settings, not that it sustains motivation or that it works in every design.

A theoretical reading is possible but should be treated as an interpretation. Self-determination theory proposes that motivation is higher when learners feel competent, autonomous, and related to others (Annamalai et al., 2025) . Instant feedback can support competence, a responsive character can support relatedness, and personalized tasks can support autonomy and interest (Tasdelen & Bodemer, 2025). The included studies measured outcomes such as intrinsic motivation, interest, flow, presence, and engagement, but few measured these three needs directly, so the mechanism remains largely untested.

The results on the second research question suggest that, in the Generative AI era, the central game mechanism has shifted from points and rankings to characters and stories. This aligns

with LLMs' ability to enable open dialogue, but it also creates risks. Users could break the character of an NPC (Nielsen et al., 2025), and latency and API dependence limit usability (Mongkoljaturong et al., 2025) and game elements could distract from learning (Bachiri et al., 2023). Earlier work on gamification also found that poorly designed competitive elements can cause fatigue (Elsawah, 2025) and that responses depend on learner characteristics (Smiderle et al., 2020) so conversational characters should not be assumed to be free of these risks.

Compared with earlier reviews, the present corpus shows that integrating AI and gamification is no longer only a proposal, because eight comparison studies and several pilots now exist. Reviews of gamification and AI describe personalization as the main promise (Kassenkhan et al., 2025 ; Sheejamol et al., 2025), but the empirical base is still thin and mostly short-term. Most gamified studies position Generative AI as a character, feedback provider, or design tool rather than as the engine of the gamification mechanism itself, and structured frameworks for integration remain scarce.

The same tendency appears in research outside this review's corpus (Wang et al., 2024) mapped AI in education through a bibliometric analysis of 2,223 articles and a content analysis of 125 papers, and highlighted several underexplored research areas. Because that review focuses on AI applications in education more broadly and does not treat gamification as a motivational mechanism, it aligns with the view that AI and gamification are still more often studied as separate fields.

The practical implication is that designers should specify what the AI component is meant to contribute, whether it is dialogue, feedback, content generation, or adaptive difficulty, and evaluate that contribution against a version of the same game without it. For educators, the engagement decline reported by Durgungoz & Durgungoz (2025) and the null and negative results in some non-gamified studies suggest planning for variety over several weeks and monitoring engagement rather than relying on the novelty of an AI tool.

Limitations of This Review

This review has several limitations. First, the search covered three databases (Scopus, IEEE Xplore, and ScienceDirect) on a single date. ScienceDirect was limited to 2023–2025 and required two split searches; ERIC was searched but could not be exported completely; and Web of Science and ACM Digital Library could not be accessed, so studies indexed only in those sources are not represented. Second, the eligibility criteria were widened after the first screening wave; records were excluded by keyword rules rather than by reading, and a relevance score prioritized retrieval of full texts: 168 records that met the keyword rules were not sought, and 51 sought reports could not be retrieved because of paywalls, so relevant studies may be missing. Third, screening, data extraction, and coding were carried out with the assistance of an AI model and were not independently duplicated by a second human rater; no formal inter-rater reliability statistic was calculated. No numerical quality score was assigned to the included studies. Fourth, the direction of the reported effect was synthesized narratively for the gamified studies, the meta-analyses, and illustrative primary studies, and was not coded for every one of the 69 articles. Fifth, limitations and recommendations were coded only from explicit statements by the authors; for the 48 articles without gamification, only two categories were coded, so articles without such statements and other categories are not represented in Figures 5 and 6. Sixth, the evidence base is heterogeneous and concentrated in higher education, and most interventions were short.

■ CONCLUSION

This systematic literature review of 69 primary articles finds that Generative AI is used in learning in many forms, and that in the 21 gamified or game-based studies four forms recur: AI characters, NPCs, or role-play partners; LLM feedback, scaffolding, or adaptive difficulty; AI-generated assessment items for gamified activities; and GenAI as a design tool for educational games. All eight gamified or game-based comparison studies reported higher or more favorable motivation, engagement, or related affective outcomes for the AI-supported condition, and meta-analytic evidence across non-gamified settings is also positive on average. However, some studies report null or negative results, and most evidence comes from small, short, university-based studies. Only three gamified studies kept the game constant while varying the AI. The most frequently coded game elements are characters and narrative, followed by rewards, instant feedback, and points. The most common limitations are small or single-context samples and short interventions with novelty effects, and the most common recommendations are longer studies and larger, more diverse samples.

The principal contribution of this review is to show that evidence on Generative AI, with and without gamification, is growing quickly but is still preliminary: the positive short-term results

cannot yet be attributed to the AI component itself or shown to last. Future research should therefore compare the same learning design with and without the AI component, run longer studies with larger and more diverse samples, and report objective measures alongside self-reports.

DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the preparation of this revision, the author(s) used Claude (Anthropic) to assist with screening of database records, extraction and coding of data from full texts, drafting and editing of text, generation of figures, and formatting of references, and used ChatGPT earlier for sentence structure and grammar checking. The author(s) reviewed and revised the content as necessary and accept full responsibility for the final content of the article.

REFERENCES

Alammary, A. (2025). VClass Engager: A Generative AI-Based System for Enhancing Student Engagement in Synchronous Online Classes. *Electronics (Switzerland)*, *14*(21). https://doi.org/10.3390/electronics14214154

Alwehebi, K. A. I. (2025). ChatGPT as a Learning Strategy: A Study on High School EFL Students' Engagement in Language Acquisition in Saudi Arabia. *Journal of Language Teaching and Research*, *16*(5), 1622–1627. https://doi.org/10.17507/jltr.1605.19

Annamalai, N., Bervell, B., Mireku, D. O., & Andoh, R. P. K. (2025). Artificial intelligence in higher education: Modelling students' motivation for continuous use of ChatGPT based on a modified self-determination theory. *Computers and Education: Artificial Intelligence*, *8*. https://doi.org/10.1016/j.caeai.2024.100346

Aslan, S., Durham, L. M., Alyuz, N., Okur, E., Sharma, S., Savur, C., & Nachman, L. (2024). Immersive multimodal pedagogical conversational artificial intelligence for early childhood education: An exploratory case study in the wild. *Computers and Education: Artificial Intelligence*, *6*. https://doi.org/10.1016/j.caeai.2024.100220

Bachiri, Y. A., Mouncif, H., & Bouikhalene, B. (2023). Artificial Intelligence Empowers Gamification: Optimizing Student Engagement and Learning Outcomes in E-learning and MOOCs. *International Journal of Engineering Pedagogy*, *13*(8), 4–19. https://doi.org/10.3991/IJEP.V13I8.40853

Bai, H., Lui, W. C., & Khiatani, P. V. (2025). Promoting student engagement with GPTutor: An intelligent tutoring system powered by generative AI. *International Journal of Educational Technology in Higher Education*, *22*(1). https://doi.org/10.1186/s41239-025-00571-9

Bai, Y., & Wang, S. (2025). Impact of generative AI interaction and output quality on university students' learning outcomes: a technology-mediated and motivation-driven approach. *Scientific Reports*, *15*(1). https://doi.org/10.1038/s41598-025-08697-6

Baidoo-Anu, D., & Owusu Ansah, L. (n.d.). Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning. In *Journal of AI* (Vol. 52).

Belkina, M., Daniel, S., Nikolic, S., Haque, R., Lyden, S., Neal, P., … Hassan, G. M. (2025, June 1). Implementing generative AI (GenAI) in higher education: A systematic review of case studies. *Computers and Education: Artificial Intelligence*, Vol. 8. Elsevier B.V. https://doi.org/10.1016/j.caeai.2025.100407

Beltozar-Clemente, S., & Díaz-Vega, E. (2024). Physics XP: Integration of ChatGPT and Gamification to Improve Academic Performance and Motivation in Physics 1 Course. *International Journal of Engineering Pedagogy*, *14*(6), 82–92. https://doi.org/10.3991/ijep.v14i6.47127

Bland, T. (2025). Enhancing Medical Student Engagement Through Cinematic Clinical Narratives: Multimodal Generative AI–Based Mixed Methods Study. *JMIR Medical Education*, *11*. https://doi.org/10.2196/63865

Boguslawski, S., Deer, R., & Dawson, M. G. (2025). Programming education and learner motivation in the age of generative AI: student and educator perspectives. *Information and Learning Science*, *126*(1–2), 91–109. https://doi.org/10.1108/ILS-10-2023-0163

Chan, S., Lo, N., & Wong, A. (n.d.). Generative AI and Essay Writing: Impacts of Automated Feedback on Revision Performance and Engagement. In *rEFLections* (Vol. 31).

Dahri, N. A., Al-Rahmi, W. M., Alhashmi, K. A., & Bashir, F. (2025). Enhancing Mobile Learning with AI-Powered Chatbots: Investigating ChatGPT's Impact on Student Engagement and Academic Performance. *International Journal of Interactive Mobile Technologies*, *19*(11),

17–38. https://doi.org/10.3991/ijim.v19i11.54643

Daniels, M., Kelly, É., Flynn, S., & Kelly, J. (2025). Advancing project leadership education through AI-enhanced game-based learning. *Project Leadership and Society*, *6*. https://doi.org/10.1016/j.plas.2025.100189

Dong, L. (2025). Development and validation of a multidimensional ChatGPT feedback engagement scale in second language writing. *System*, *135*. https://doi.org/10.1016/j.system.2025.103875

Durgungoz, A., & Durgungoz, F. C. (2025). Exploring effortless AI-generated gamified quizzes in an online special education module: evaluating question quality, student engagement, and its potential to identify at-risk students. *Education and Information Technologies*, *30*(17), 25335–25357. https://doi.org/10.1007/s10639-025-13765-5

Elhag, A., Abri, A. M., & Fahmy Yousef, A. M. (2025). The Effect of Generative AI Tools (Chatgpt, Gemini, Etc.) on Students' Achievement and Their Motivation Towards Learning. *Journal of Technology and Science Education*, *15*(3), 746–759. https://doi.org/10.3926/jotse.3410

Elsawah, W. (2025). Exploring the effectiveness of gamification in adult education: A learner-centric qualitative case study in a Dubai training context. *International Journal of Educational Research Open*, *9*. https://doi.org/10.1016/j.ijedro.2025.100465

Evmenova, A. S., Regan, K., Mergen, R., & Hrisseh, R. (2025). Educational Games and the Potential of AI to Transform Writing Across the Curriculum. *Education Sciences*, *15*(5). https://doi.org/10.3390/educsci15050567

Gaeta, A., Orciuoli, F., Pascuzzo, A., & Peduto, A. (2025). Enhancing traditional ITS architectures with large language models for generating motivational feedback. *Computers and Education: Artificial Intelligence*, *9*. https://doi.org/10.1016/j.caeai.2025.100433

Gianni, A. M., Nikolakis, N., & Antoniadis, N. (2025). An LLM-based learning framework for adaptive feedback mechanisms in gamified XR. *Computers and Education: X Reality*, *7*. https://doi.org/10.1016/j.cexr.2025.100116

Guo, F., Zhang, L., Shi, T., & Coates, H. (2025). Whether and When Could Generative AI Improve College Student Learning Engagement? *Behavioral Sciences*, *15*(8). https://doi.org/10.3390/bs15081011

Hadi Mogavi, R., Deng, C., Juho Kim, J., Zhou, P., D. Kwon, Y., Hosny Saleh Metwally, A., … Hui, P. (2024). ChatGPT in education: A blessing or a curse? A qualitative study exploring early adopters' utilization and perceptions. *Computers in Human Behavior: Artificial Humans*, *2*(1), 100027. https://doi.org/10.1016/j.chbah.2023.100027

Heung, Y. M. E., & Chiu, T. K. F. (2025, June 1). How ChatGPT impacts student engagement from a systematic review and meta-analysis study. *Computers and Education: Artificial Intelligence*, Vol. 8. Elsevier B.V. https://doi.org/10.1016/j.caeai.2025.100361

Hmoud, M., Swaity, H., Hamad, N., Karram, O., & Daher, W. (2024). Higher Education Students' Task Motivation in the Generative Artificial Intelligence Context: The Case of ChatGPT. *Information (Switzerland)*, *15*(1). https://doi.org/10.3390/info15010033

Ho, W., & Lee, D. (2023). Enhancing engineering education in the Roblox Metaverse: utilizing ChatGPT for game development for electrical machine course. *International Journal on Advanced Science, Engineering & Information Technology*, *13*(3), 1052–1058.

Hu, W., Tian, J., & Li, Y. (2025). Enhancing student engagement in online collaborative writing through a generative AI-based conversational agent. *Internet and Higher Education*, *65*. https://doi.org/10.1016/j.iheduc.2024.100979

Intawong, K., Worragin, P., Khanchai, S., & Puritat, K. (2025). Transformative Metaverse Pedagogy for Intangible Heritage: A Gamified Platform for Learning Lanna Dance in Immersive Cultural Education. *Education Sciences*, *15*(6). https://doi.org/10.3390/educsci15060736

Jafarian, N. R., & Kramer, A. W. (2025). AI-assisted audio-learning improves academic achievement through motivation and reading engagement. *Computers and Education: Artificial Intelligence*, *8*. https://doi.org/10.1016/j.caeai.2024.100357

Jose, E. M. K., Prasanna, A., Kushwaha, B. P., & Das, M. (2024). Can generative AI motivate management students? The role of perceived value and information literacy. *International Journal of Management Education*, *22*(3). https://doi.org/10.1016/j.ijme.2024.101082

Kassenkhan, A. M., Moldagulova, A. N., & Serbin, V. V. (2025). Gamification and Artificial Intelligence in Education:

A Review of Innovative Approaches to Fostering Critical Thinking. *IEEE Access*, *13*, 98699–98728. https://doi.org/10.1109/ACCESS.2025.3576147

Khoso, A. K., Honggang, W., & Darazi, M. A. (2025). Empowering creativity and engagement: The impact of generative artificial intelligence usage on Chinese EFL students' language learning experience. *Computers in Human Behavior Reports*, *18*. https://doi.org/10.1016/j.chbr.2025.100627

Leahy, K., Ozer, E., & Cummins, E. P. (2025). AI-ENGAGE: A Multicentre Intervention to Support Teaching and Learning Engagement with Generative Artificial Intelligence Tools. *Education Sciences*, *15*(7). https://doi.org/10.3390/educsci15070807

Li, C., & Lyu, B. (2025). Investigating the motivational and knowledge affordances of conversational AI using induction, concretization, and exemplification in math learning. *British Journal of Educational Technology*, *56*(5), 1814–1841. https://doi.org/10.1111/bjet.13612

Lo, C. K., Hew, K. F., & Jong, M. S. yung. (2024). The influence of ChatGPT on student engagement: A systematic review and future research agenda. *Computers and Education*, *219*. https://doi.org/10.1016/j.compedu.2024.105100

Mellado, R., & Cubillos, C. (2025). Can Generative Artificial Intelligence Outperform Self-Instructional Learning in Computer Programming?: Impact on Motivation and Knowledge Acquisition. *Applied Sciences (Switzerland)*, *15*(11). https://doi.org/10.3390/app15115867

Mongkoljaturong, K., Manitsakulwong, M., & Moodleah, S. (2025). AI-Powered MetaHuman Interviewer: Serious Game for Student Job Interview Skills. *IEEE Access*, *13*, 205505–205520. https://doi.org/10.1109/ACCESS.2025.3640017

Mykhaylenko, V., Safonova, N., Ilchenko, R., Ivashchuk, A., & Babik, I. (2024). Using artificial intelligence to personalise curricula and increase motivation to learn, taking into account psychological aspects. *Data and Metadata*, *3*. https://doi.org/10.56294/dm2024.241

Ngu, P. C., Chien, C. C., Ho, Y. T., & Hou, H. T. (2025). A generative AI educational game framework with multi-scaffolding supports workplace competency development. *Computers and Education*, *239*. https://doi.org/10.1016/j.compedu.2025.105421

Oktarin, I. B., Saputri, M. E. E., Magdalena, B., Hastomo, T., & Maximilian, A. (2024). Leveraging ChatGPT to enhance students' writing skills, engagement, and feedback literacy. *Edelweiss Applied Science and Technology*, *8*(4), 2306–2319. https://doi.org/10.55214/25768484.v8i4.1600

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021, March 29). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, Vol. 372. BMJ Publishing Group. https://doi.org/10.1136/bmj.n71

Pasupuleti, R. S., Jangam, D. C., Bhimavarapu, A., Gunnam, V. R., Sikhakolli, V. R., & Thiyyagura, D. (2025). The Role of Learning Motivation Factors in Deepseek Generative AI Adoption among Higher Education Students in India. *Electronic Journal of E-Learning*, *23*(4), 1–14. https://doi.org/10.34190/ejel.23.4.4245

Qian, Y. (2025). Pedagogical Applications of Generative AI in Higher Education: A Systematic Review of the Field. *TechTrends*, *69*(5), 1105–1120. https://doi.org/10.1007/s11528-025-01100-1

Rath, A. (2025). Leveraging ChatGPT to support terminology learning in oral anatomy: a mixed-methods study among linguistically diverse dental students. *BMC Medical Education*, *25*(1). https://doi.org/10.1186/s12909-025-07968-0

Rodríguez-Rivera, P., Rodríguez-Ferrer, J. M., & Manzano-León, A. (2025). Designing Digital Escape Rooms with Generative AI in University Contexts: A Qualitative Study. *Multimodal Technologies and Interaction*, *9*(3). https://doi.org/10.3390/mti9030020

Romero-Rodríguez, J. M., Martínez-Menéndez, A., Alonso-García, S., & Victoria-Maldonado, J. J. (2024). The reality of the gamification methodology in Primary Education: A systematic review. *International Journal of Educational Research*, *128*. https://doi.org/10.1016/j.ijer.2024.102481

Santhosh, J., Dengel, A., & Ishimaru, S. (2024). Gaze-Driven Adaptive Learning System with ChatGPT-Generated Summaries. *IEEE Access*, *12*, 173714–173733. https://doi.org/10.1109/ACCESS.2024.3503059

Sheejamol, P. T., Chacko, A. M., & Kumar, S. D. M. (2025). Beyond the One-Size-Fits-All: A Systematic Review of Personalized and Gamified e-Learning for Neurodivergent Learners. *Electronic Journal of E-Learning*, *23*(3), 101–119. https://doi.org/10.34190/ejel.23.3.4051

Smiderle, R., Rigo, S. J., Marques, L. B., Peçanha de Miranda Coelho, J. A., & Jaques, P.

A. (2020). The impact of gamification on students' learning, engagement and behavior based on their personality traits. *Smart Learning Environments*, *7*(1). https://doi.org/10.1186/s40561-019-0098-x

Stampfl, R., Geyer, B., & Deissl-O'meara, M. (2024). Revolutionising Role-Playing Games with ChatGPT. In *Advances in Artificial Intelligence and Machine Learning; Research* (Vol. 4). Retrieved from https://www.oajaiml.com/

Sumilong, M. J. (2025). Instructional affect and learner motivation in generative AI-restrictive and permissive classrooms. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1626802

Tafazoli, D. (2024). Exploring the potential of generative AI in democratizing English language education. *Computers and Education: Artificial Intelligence*, *7*. https://doi.org/10.1016/j.caeai.2024.100275

Tasdelen, O., & Bodemer, D. (2025). Generative AI in the Classroom: Effects of Context-Personalized Learning Material and Tasks on Motivation and Performance. *International Journal of Artificial Intelligence in Education*, *35*(5), 3049–3070. https://doi.org/10.1007/s40593-025-00491-9

Teng, M. F., & Huang, J. (2025). Incorporating ChatGPT for EFL Writing and Its Effects on Writing Engagement. *International Journal of Computer-Assisted Language Learning and Teaching*, *15*(1). https://doi.org/10.4018/IJCALLT.367874

Tica, L., & Krsmanović, I. (2024). Overcoming the Writer's Block? Exploring Students' Motivation and Perspectives on Using ChatGPT as a Writing Assistance Tool in ESP. *ELOPE: English Language Overseas Perspectives and Enquiries*, *21*(1), 129–149. https://doi.org/10.4312/ELOPE.21.1.129-149

Wan, K., Woo, Y. Y., & Ho, G. T. S. (2025). Enhancing service-learning through Generative AI: A mixed-methods study on educational Game design in a finance course. *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2025.2592370

Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024, October 15). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications*, Vol. 252. Elsevier Ltd. https://doi.org/10.1016/j.eswa.2024.124167

Xia, Q., Li, W., Yang, Y., Weng, X., & Chiu, T. K. F. (2025, December 1). A systematic review and meta-analysis of the effectiveness of Generative Artificial Intelligence (GenAI) on students' motivation and engagement. *Computers and Education: Artificial Intelligence*, Vol. 9. Elsevier B.V. https://doi.org/10.1016/j.caeai.2025.100455

Xiao, Y., Li, D., & Guo, K. (2025). Using ChatGPT to bring non-player characters to life: Effects on students' storyline-driven game-based writing learning. *Computers and Education*, *238*. https://doi.org/10.1016/j.compedu.2025.105414

Xu, S., Su, Y., & Liu, K. (2025). Investigating student engagement with AI-driven feedback in translation revision: A mixed-methods study. *Education and Information Technologies*, *30*(12), 16969–16995. https://doi.org/10.1007/s10639-025-13457-0

Yang, H. (2025). Harnessing generative AI: Exploring its impact on cognitive engagement, emotional engagement, learning retention, reward sensitivity, and motivation through reinforcement theory. *Learning and Motivation*, *90*. https://doi.org/10.1016/j.lmot.2025.102136

Yeung, S. (2025). University students' engagement with generative AI-supported automated writing evaluation (AWE) feedback. *Journal of Second Language Writing*, *68*. https://doi.org/10.1016/j.jslw.2025.101203

Yilmaz, R., & Karaoglan Yilmaz, F. G. (2023). The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. *Computers and Education: Artificial Intelligence*, *4*. https://doi.org/10.1016/j.caeai.2023.100147

Yin, X., Ye, J., Yu, S., Li, H., Liu, Q., & Zhao, G. (2025). The association between groups' interactions with the Visual-GenAI learning analytics feedback and student engagement in CSCL. *Computers and Education*, *239*. https://doi.org/10.1016/j.compedu.2025.105434

Zhang, M. (2025). Optimizing academic engagement and mental health through AI: an experimental study on LLM integration in higher education. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1641212