Investigating the Impact of Artificial Intelligence-Powered Gamification on Saudi EFL Learners' Cognitive Load, Motivation, and Long-Term Retention: An Experimental Mixed-Methods Study

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ABSTRACT

Despite growing interest in Artificial Intelligence (AI)-driven educational technologies, limited research has explored how AI-powered gamification influences both the cognitive and affective dimensions of language learning, particularly in EFL contexts. Grounded in Cognitive Load Theory (CLT) and Self-Determination Theory (SDT), this study inspected the impacts of AI-powered gamification on English as a Foreign Language (EFL) learners' cognitive load (CL), motivation, and long-term retention of vocabulary and grammar. By using an experimental mixed-methods design, 85 Saudi EFL learners were randomly assigned to either an experimental group (EG) that engaged with an AI-powered gamified platform or a control group (CG) applying a non-gamified, content-equivalent digital platform. Over a six-week period, both groups received identical instructional content delivered in differing formats. Quantitative data were gathered through a motivation questionnaire, a modified CL scale, and a delayed posttest on vocabulary and grammar retention. Qualitative data were collected from semi-structured interviews. The gained findings demonstrated that the EG significantly outperformed the CG in posttest measures of motivation and long-term retention, while reporting significantly lower levels of CL. Thematic analysis of interview data highlighted key advantages of gamification, including enhanced engagement, reduced mental effort, and improved confidence. Students stressed the motivational impact of game elements, the value of personalized AI feedback, and the perceived effectiveness of the gamified platform in developing language retention. These outcomes offer that AI-powered gamification can serve as a useful instructional instrument for enhancing learning outcomes in EFL contexts by fostering motivation, reducing cognitive strain, and improving the durability of language knowledge. Practically, the findings inform EFL pedagogy in Saudi Arabia by suggesting ways to integrate adaptive technologies into centralized curricula, guide instructional designers in creating engaging digital tools, and support

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policymakers in promoting EdTech adoption to address motivation and retention challenges.

Introduction

The swift advancement of artificial intelligence (AI) alongside educational technology has fundamentally transformed the domain of language learning (Gul & Khan, 2024; Pham & Sampson, 2022). Moreover, the integration of AI with gamified teaching methods has opened up fresh pathways for boosting student motivation (Dahri et al., 2025), improving cognitive processing, and supporting long-term retention. This study investigates the educational potential of AI-gamification as a blended method that integrates adaptive intelligence with game-based learning principles, aiming to overcome persistent challenges in language learning (Jiang et al., 2025), such as low student motivation, high cognitive load, and inadequate retention of language content.

Conventional language learning, especially through online platforms, frequently falls short in terms of interactivity and personalization, potentially hindering learners' engagement and cognitive processing (Al-Seghayer, 2014; Zhang, 2024). These platforms often depend on static content delivery, like pre-recorded lectures or standardized exercises, which restricts the potential for personalized instruction that addresses the unique needs of each learner. Conversely, gamification has emerged as a vibrant approach that integrates game design components, like points, leaderboards, and progress tracking to encourage active engagement and intrinsic motivation (Hong et al., 2024; Smiderle et al., 2020). Nonetheless, conventional methods of gamification frequently exhibit a lack of adaptability, offering standardized experiences that might not cater to the varied profiles of learners (Aldalur & Perez, 2023).

AI emerges as a significant force in overcoming these constraints and enhancing the gamified learning experience. The implementation of intelligent algorithms in gamified systems enables AI-driven platforms to deliver personalized instruction instantaneously (Hu et al., 2025). These innovative technologies have the capability to tailor task difficulty, provide individualized feedback, and recommend suitable content according to the performance profiles of each learner (Tan et al., 2025). This kind of personalization fosters a learner-centered atmosphere that enhances emotional involvement via interactive practice while also facilitating cognitive development through tailored scaffolding (Teepapal, 2025). The implementation of AI-driven gamification can effectively alleviate cognitive overload, sustain motivation, and enhance memory consolidation, particularly in the realms of vocabulary and grammar acquisition.

Nonetheless, in spite of the theoretical potential, there is a notable lack of experimental studies examining the comprehensive effects of AI-enabled gamification on cognitive, motivational, and retention-related outcomes within the realm of foreign language learning, and those that do exist are often inconsistent. To delve deeper into this pedagogical potential, it is essential to anchor the analysis in recognized learning theories. This research draws upon Cognitive Load Theory (CLT), highlighting the constraints of working memory and advocating for instructional designs that minimize extraneous mental effort (Sweller, 1988). Studies indicate that AI-assisted gamification can effectively correspond with CLT by adaptively modifying task complexity to reduce extraneous load and enhance germane processing, thereby maximizing

learning efficiency in online settings (Huber et al., 2023).

The Community of Inquiry framework enhances this approach by emphasizing the interaction among teaching presence, social presence, and cognitive presence, which are essential for creating meaningful online learning experiences (Garrison, 2016). In EFL contexts, the integration of AI-driven gamification can significantly improve teaching presence by providing adaptive feedback and scaffolding. This approach helps to alleviate cognitive overload and fosters a more profound engagement with language content. Furthermore, the concept of social presence, which focuses on fostering interpersonal relationships in online environments, can be enhanced through gamified features such as leaderboards and team-based challenges, effectively tackling the feelings of isolation frequently linked to passive online learning (Cheng, 2023). This integration guarantees that cognitive presence, which involves the construction of knowledge through reflection and discourse, is supported in manners consistent with the interaction hypothesis, wherein negotiated meaning during interactions enhances language acquisition (Long, 1996). Through the integration of these frameworks, the research explores the ways in which AI-gamification alleviates the adverse effects of elevated cognitive load in Saudi EFL contexts, where centralized curricula and substantial class sizes frequently intensify passive learning behaviors.

Furthermore, the study is based on Self-Determination Theory (SDT), which suggests that intrinsic motivation is enhanced when the needs for competence, autonomy, and relatedness of learners are satisfied (Deci & Ryan, 2013). According to Mohamed et al. (2025), the integration of AI in gamification effectively addresses these requirements by offering options, prompt feedback, and significant performance monitoring within digital settings. The motivational factors play a vital role in maintaining learners' engagement and effort, especially in online environments where emergency remote teaching has underscored the differences from intentionally crafted online learning experiences (Hodges et al., 2020). Additionally, the affective filter hypothesis posits that reduced anxiety and positive emotional states are crucial for language input to be transformed into intake, and AI-gamification can help diminish this filter by fostering enjoyable, low-pressure interactions (Krashen, 1982). The regular interactions and adaptive evaluations in AI-enhanced systems further facilitate spaced retrieval and deep encoding, which are essential for long-term retention (Zhai et al., 2024).

In Saudi EFL classrooms, where cultural factors may influence relatedness and autonomy, this theoretical blend addresses documented challenges such as learner anxiety and disengagement. It provides a nuanced perspective on how gamification fosters motivation while integrating social presence to enhance interaction and community building (Edwards & Taasoobshirazi, 2022). In summary, these frameworks offer a unified perspective on the diverse advantages of AI-driven gamification in facilitating successful online language acquisition. Empirical studies in related fields offer additional evidence supporting the potential of AI-enhanced gamification. For example, Jiang et al. (2025) examined the impact of various gamified learning approaches, including classic linear narrative, AI-facilitated task-based learning, and gamified self-directed discovery, on EFL students learning. The results indicated that both AI-mediated and explorative approaches significantly surpassed traditional methods in terms of learner engagement, performance, and overall experience. Importantly, success in these approaches

was assessed through metrics beyond mere in-game engagement or duration of play, indicating that intrinsic learning strategies and learner self-regulation are fundamental concepts. In their research, Safdar et al. (2025) conducted a mixed-methods study focusing on the implementation of AI-based gamification within English Language Teaching (ELT) contexts. The findings revealed that the use of adaptive, AI-supported gamified teaching significantly improved motivation, engagement, and retention among learners. Nonetheless, the research uncovered several drawbacks, including an overdependence on technology, inadequate access to digital resources, and the need for teacher training to effectively implement gamified systems. Xu et al. (2024) developed a gamified AI chatbot system and assessed its effectiveness against a conventional AI chatbot through a quasi-experimental approach, revealing that the gamified version enhanced academic performance, motivation, flow, and problem-solving abilities. Students utilizing the gamified AI system reported improvements in academic performance, heightened motivation, enriched flow experiences, and better problem-solving abilities. While creativity remained intact, behavioral measurements indicated that high-achieving students employed more systematic learning strategies compared to their low-achieving counterparts, who relied on external feedback. In contrast, the former engaged actively with the gamified system.

While not without flaws, the majority of these studies have addressed general education rather than directly investigating the unique cognitive and motivational hurdles faced by language learners. In order to fill this gap, the current study employed an experimental mixed-methods approach that combined quantitative measures with qualitative data. This mixed-methods approach aimed to capture both the quantifiable results of AI-aided gamified learning and the learners' personal experiences and perceptions. To reach this objective, it offers a more intricate and comprehensive account of how adaptive gamification influences cognitive, emotional, and memory-related aspects of the learning experience.

This research primarily seeks to explore how AI-driven gamification influences cognitive load, motivational engagement, and the long-term retention of learners within English language learning contexts. By achieving these research objectives, the study aims to provide meaningful contributions to both theoretical frameworks and practical applications. At the theoretical level, it enhances communicative language teaching by showcasing AI's function in managing extraneous load in digital EFL contexts and broadens SDT by demonstrating how gamified elements fulfill autonomy, competence, and relatedness in collectivist cultures such as Saudi Arabia. At a practical level, it offers evidence-based guidance for educators to incorporate badge systems aimed at grammar mastery, for instructional designers to create adaptive platforms, and for policymakers to advocate for the inclusion of EdTech in national curricula. This study is distinct from other EFL contexts, as it specifically examines Saudi Arabia, which is notable for its swift adoption of educational technology, a centralized EFL curriculum governed by the Ministry of Education, and the well-documented issues related to learner motivation and retention in the face of large class sizes and teacher-centered methodologies (Nouraldeen & Elyas, 2014). The factors at play establish a perfect setting for evaluating the capacity of AI-gamification to promote active, personalized learning within a well-organized framework. In order to steer the inquiry, the subsequent research questions are formulated:

(1) Does AI-powered gamification significantly reduce CL in EFL learners compared to conventional digital instruction?

(2) Does AI-powered gamification significantly improve learners' motivation toward vocabulary and grammar learning?

(3) How does using an AI-powered gamified platform influence EFL learners' long-term retention of vocabulary and grammar?

(4) What are learners' perceptions and experiences regarding the use of AI-powered gamification in their language learning process, particularly in relation to autonomy and cognitive engagement?

Literature review

This section integrates previous studies on AI-driven gamification, examining its relationship with cognitive load, motivation, and retention, particularly in the context of Saudi EFL learners. The integration of AI technologies, including machine learning algorithms and adaptive systems, with game design elements such as points, badges, leaderboards, challenges, and narratives, results in the creation of personalized and engaging learning experiences (Dahri et al., 2025; Jiang et al., 2025). In contrast to conventional gamification that utilizes fixed game mechanics within educational frameworks, AI-enhanced versions adaptively modify difficulty, feedback, and content in accordance with real-time learner data, thereby becoming more attuned to the unique requirements of each individual (Hu et al., 2025; Tan et al., 2025). This construct is rooted in game-based learning principles while utilizing AI to enhance scalability and personalization, thereby converting passive digital platforms into engaging, adaptive ecosystems.

Research has examined the relationship among gamification, cognitive load, and motivation. For example, Huber et al. (2023) discovered that incorporating gamified elements can decrease attrition and boost engagement by alleviating cognitive overload via organized tasks and prompt rewards, which is consistent with the principles of CLT that focus on reducing unnecessary load. In the context of language learning, the application of gamification has demonstrated a reduction in cognitive load by segmenting complex vocabulary and grammar into manageable, game-like components. This approach enables learners to concentrate on relevant processing (Vidanaralage et al., 2022). The combination with AI amplifies this effect; Xu et al. (2024) showed that AI-gamified chatbots enhanced motivation and flow by delivering personalized feedback, minimizing mental effort, and fulfilling the needs for competence and autonomy as outlined in SDT.

Studies on AI and motivation emphasize the role of adaptive systems in enhancing intrinsic motivation. According to Mohamed et al. (2025), the integration of AI in gamification promotes self-determination by providing options and monitoring performance, which results in increased engagement within educational environments. In a similar vein, Dahri et al. (2025) employed structural equation modeling to demonstrate that AI gamification has a positive impact on academic achievement by enhancing motivation, with effect sizes reflecting practical

significance. Nevertheless, obstacles remain, including an excessive dependence on technology (Safdar et al., 2025), which may increase cognitive load if not applied with care.

The connection between cognitive load and retention is clear in research indicating that minimizing extraneous load through gamification enhances deeper encoding and supports long-term memory retention. Zhai et al. (2024) cautioned against excessive dependence on AI, which may result in superficial processing; however, when combined with gamified repetition, retention benefits from spaced retrieval. Jiang et al. (2025) conducted a comparison between AI-gamified methods and traditional approaches, revealing that exploratory gamified strategies led to enhanced retention, attributed to active self-regulation. In EFL contexts, Lin et al. (2018) established a connection between game-based vocabulary learning and enhanced emotional experiences, leading to improved outcomes, further intensified by AI personalization.

This literature is especially relevant for Saudi EFL learners, considering the well-documented challenges they face, such as high anxiety, passive methodologies, and low retention in centralized curricula (Al-Seghayer, 2014; Nouraldeen & Elyas, 2014). Saudi Arabia's Vision 2030 highlights the importance of adopting educational technology to modernize the education system. However, challenges such as large class sizes and cultural norms that prioritize relatedness over autonomy pose significant barriers to motivation (Edwards & Taasoobshirazi, 2022). AI-driven gamification tackles these issues by enhancing social presence through collaborative elements and alleviating cognitive load with adaptive support, as demonstrated in comparable Middle Eastern settings (Mohamed et al., 2025). Previous research in general education (e.g., Ratinho & Martins, 2023) indicates that gamification enhances motivation at various levels; however, studies focused on EFL settings are scarce. Almeida et al. (2023) and Zainuddin et al. (2020) have pointed out inconsistencies, particularly concerning possible adverse effects such as demotivation stemming from competition. This research expands upon previous work by incorporating AI to address limitations, offering context-specific evidence for EFL instruction in Saudi Arabia.

Methods

Educational Context: EFL in Saudi Arabia

In Saudi Arabia, EFL instruction is integrated into a national curriculum established by the Ministry of Education, which prioritizes the use of standardized textbooks and teacher-directed lessons in secondary education. Common approaches include repetitive memorization and passive tasks such as reading aloud, which frequently result in learner anxiety, diminished motivation, and inadequate retention, particularly because of large class sizes and a lack of personalized instruction (Al-Seghayer, 2014). Digital infrastructure has seen enhancements through initiatives such as the Tatweer project, which fosters the integration of educational technology. However, obstacles remain in moving from the emergency remote teaching that occurred during COVID-19 to a more structured approach to online learning. This context, marked by collectivist cultural norms that emphasize relatedness while potentially constraining autonomy, positions AI-powered gamification as a promising intervention to boost engagement and tackle these challenges (Nouraldeen & Elyas, 2014).

Design and Sample

This study utilized a mixed-methods approach to examine the impact of AI-enhanced gamification on learners' collaborative learning, motivation, and long-term retention of vocabulary and grammar. This design was selected to connect quantitative outcomes with qualitative insights, facilitating a thorough understanding of measurable effects and experiential perceptions, with integration taking place during data interpretation to confirm findings. The sample consisted of 85 EFL learners, aged 15 to 20, including 40 females and 45 males, all from Saudi Arabia. The participants consisted of native Arabic speakers who possessed intermediate proficiency in English, as assessed by the Oxford Placement Test (M = 32.1, SD = 4.3). The participants were ninth-grade secondary school students who had different levels of prior exposure to digital tools, yet none reported any specific experience with AI or gamification. While digital literacy was not formally evaluated, it was assumed to be moderate due to national EdTech initiatives. Participants were selected using convenience sampling, and they were randomly assigned to either the experimental group (EG, n = 41), which received educational instruction through an AI-enhanced gamified learning interface, or the control group (CG, n = 44), which engaged with a content-equivalent interface that lacked gamification. For this single-institution study, convenience sampling was deemed suitable to maintain logistical feasibility and manage variables, although it does impose limitations on generalizability. Randomization was executed using a random number generator within the sampled group to closely mimic true experimental conditions, despite existing constraints. The decision to utilize convenience sampling from a specific geographic area was mainly influenced by practical and methodological factors. The research was conducted within a clearly defined educational context, which allowed for tighter control over potential confounding variables, including variations in curriculum, differences among teachers, and institutional policies, thereby enhancing internal validity.

Furthermore, Saudi Arabia serves as a notably significant context due to its swift integration of educational technologies and a standardized EFL curriculum, which offers a fairly uniform linguistic and instructional environment for investigating the impacts of AI-driven gamification. Although this emphasis might restrict the external validity of the results, the study's randomized group assignment, standardized instructional materials, and uniform teaching conditions contributed to ensuring that the differences observed could be linked directly to the intervention rather than to unrelated factors. The results provide significant initial insights for similar EFL environments, suggesting that future investigations should aim to replicate the study in a wider range of cultural and educational contexts. In order to facilitate effective class management and uphold instructional quality, particularly in light of the relatively large class sizes, the initial group was split into two sub-classes, resulting in a total of four manageable classes. Every sub-class consisted of around 20–23 students and was instructed by the same teacher utilizing standard instructional materials, pacing, and content. This contributed to enhancing opportunities for personalized interaction, guaranteed consistent delivery, and promoted equitable access to both treatment and control conditions. Both the EG and CG received instruction over a six-week period, focusing on comparable vocabulary and grammar content.

In line with ethical research standards, informed consent was obtained from all participants and

their legal guardians. Written informed consent was secured from guardians, while participants provided verbal consent, with the assurance that they could withdraw at any point without facing any penalties. To maintain data anonymity, pseudonyms were employed during transcription, and recordings were stored in a secure manner. Approval for institutional ethics was obtained in line with the educational research regulations in Saudi Arabia. In order to mitigate possible confounds arising from baseline technology familiarity, a pre-intervention survey was conducted to evaluate general digital exposure. However, no significant differences between groups were identified; thus, statistical controls such as covariance were deemed unnecessary since pretest equivalence had been established.

Instruments

The motivation questionnaire, adapted from Wu (2018), was designed to assess learners' motivation within AI-Powered gamification learning environments. The instrument comprises 24 items categorized into four primary dimensions: attention, relevance, confidence, and satisfaction, with each dimension containing six items. The items are evaluated using a five-point Likert scale ranging from 'Very Low' to 'Very High', thereby stimulating learners' interest, engagement, and self-confidence throughout the learning experience. For instance, a statement reflecting confidence is "I felt assured in my capability to accomplish the tasks effectively." According to Wu (2018), the tool demonstrated strong internal consistency, evidenced by a Cronbach's alpha coefficient of 0.91. The questionnaire has been effectively utilized in various EFL and online learning environments (Zhang et al., 2020; Zhang et al., 2024), thereby validating its appropriateness for use in the present study.

In order to evaluate the cognitive effort that students invest during their learning experiences; the research employed an adapted form of the Cognitive Load Scale (CLS) originally created by Paas et al. (2016). In this study, the researcher modified the scale from its original dichotomous format to a five-point Likert scale (1 = Very Low, 5 = Very High) in order to enhance sensitivity and the range of responses provided by the participants. The instrument comprises 10 items that address three primary dimensions of cognitive load: Intrinsic Cognitive Load (ICL), which reflects the inherent complexity of the learning material; Extraneous Cognitive Load (ECL), which measures the unnecessary mental effort arising from instructional design; and Germane Cognitive Load (GCL), which assesses the cognitive effort involved in deep learning and the development of mental models. For instance, an ECL item is "The manner in which the information was presented rendered it difficult to comprehend." Every dimension comprises several items, with scores that vary from 10 to 50, where elevated scores reflect a greater perception of cognitive effort. To assess the validity of the modified scale, content validity was established through evaluation by three specialists in educational measurement. The modified CLS retained its robust construct validity, supported by earlier studies confirming its three-factor structure, and demonstrated high internal consistency in the current research, with a Cronbach's alpha of 0.89. The instrument was given on two occasions throughout the intervention to monitor variations in students' perceived collaborative learning across various instructional activities.

The third tool utilized in this study was a semi-structured interview, conducted with the EG participants to gain deeper insights into their experiences of learning through the AI-based

gamified platform. The purpose of the interview was to gather insights from learners about their views on motivation, cognitive engagement, and how they perceive the effects of gamification on their learning of vocabulary and grammar. The interviews took place in a calm and unbiased environment and persisted until data saturation was achieved, following 14 student interviews, at which point no additional themes or insights appeared, thereby guaranteeing the depth and thoroughness of the qualitative data. All interviews were audio-recorded with the consent of the participants and subsequently transcribed meticulously to ensure accuracy. The transcribed data were then coded and analyzed through thematic analysis, adhering to the guidelines set forth by Braun and Clarke (2006), in order to uncover common patterns in learners' motivational and cognitive experiences. This qualitative aspect offered a deep contextual insight that enhanced and corroborated the quantitative findings derived from the CLS and the Long-Term Retention Test.

Alongside the interviews, a Long-Term Retention Test was employed to assess students' enduring mastery of vocabulary and grammatical structures addressed throughout the course. The assessment was conducted three weeks post-instruction to evaluate the sustained retention of the specific linguistic material. The assessment comprised 65 items, featuring both multiple-choice and short-answer questions, all meticulously aligned with the instructional materials addressed throughout the six-week course. The assessment was conducted in English, supplemented by Arabic instructions to uphold construct validity. To guarantee transparency and replicability, the test items were developed by researchers but created in accordance with established test-design principles frequently found in EFL assessment literature (e.g., Hughes, 2020). While the instrument was not sourced from a standardized or commercially available item bank, its content validity was guaranteed through expert review. A panel consisting of three experienced EFL instructors and two applied linguistics researchers assessed the test for content representativeness, linguistic appropriateness, and alignment with course objectives. Their feedback guided several iterations of revisions to guarantee the relevance of the constructs and enhance clarity.

Additionally, to demonstrate psychometric quality, the test was piloted with a similar group of EFL learners who were not part of the main study. Item analysis was performed to evaluate item difficulty and discrimination indices, resulting in the final version retaining only those items that satisfied acceptable psychometric thresholds. The reliability analysis conducted with the Kuder-Richardson Formula 21 (KR-21) produced a coefficient of 0.88, which signifies a strong level of internal consistency and measurement stability. As a result, although the instrument lacked commercial standardization, its methodical development, expert validation, and reliability testing offer robust evidence for its effectiveness in evaluating the long-term effects of AI-assisted gamified teaching on students' retention of vocabulary and grammar. The Motivation Questionnaire and CL Scale underwent translation into Arabic through back-translation methods and were subsequently piloted with 20 Saudi EFL learners to ensure comprehension and validity within the target demographic.

Data Collection Procedures

The data acquisition process was carefully carried out over a ten-week period. This organized approach unfolded in three distinct phases: Pre-Intervention Standardization, the Six-Week

Instructional Intervention, and Post-Intervention Data Capture.

Phase I: Pre-Intervention Standardization and Control

The initial measures aimed to standardize the conditions and separate the independent variable. Following the acquisition of informed consent and the random assignment of 85 Saudi EFL learners into the EG (n=41) and the CG (n=44), we proceeded to administer the baseline measures for motivation and cognitive load to statistically validate the initial equivalence of the groups. Importantly, all research personnel and the instructor participated in thorough standardization processes. The only instructor tasked with teaching both groups engaged in a rigorous two-day professional development workshop. The primary objective was not to provide pedagogical training, but to ensure procedural fidelity: the instructor was instructed to confine their direct pedagogical involvement to technical assistance and minimal, neutral motivational support. This measure was essential for protecting the AI-driven gamification as the only causal factor, thus removing the confounding influence of varying human instructional quality. Moreover, every participant underwent a required, uniform 30-minute technical orientation for their designated platform, guaranteeing that the ensuing results would be indicative of the instructional elements rather than discrepancies in technical proficiency.

Phase II: The Six-Week Instructional Intervention (Weeks 2–7)

The primary intervention was carried out over a span of six academic weeks, meticulously following the principle of content and dosage equivalence. Both groups received the same range of vocabulary and grammar topics through a minimum of three 45-minute synchronous sessions each week, totaling 135 minutes weekly. During this time, the method of instructional delivery stood out as the key distinguishing element.

In the EG, the learning environment utilized AI and gamification to ensure theoretical alignment with CLT and SDT. The AI employed machine learning (ML) algorithms, particularly a Reinforcement Learning (RL) agent, which continuously assessed metrics such as response accuracy and latency to facilitate adaptive instructional scaffolding. To enhance vocabulary acquisition, words were integrated into interactive, AI-driven conversational simulations aimed at increasing germane cognitive load (deep processing). At the same time, the system offered prompt, tailored, and impartial feedback aimed at significantly minimizing unnecessary cognitive load through the simplification of error explanations. The incorporation of gamification enhanced grammar instruction by embedding tasks within narrative-driven quests that offered rewards such as digital badges, points, and opportunities for leveling up, thereby effectively addressing the needs for competence and autonomy as outlined in SDT.

In clear opposition, the CG engaged with the same material through a traditional, non-adaptive Learning Management System (LMS). This design embodied a conventional, unchanging approach to digital pedagogy. The vocabulary included fixed word lists and conventional fill-in-the-blank tasks. The instruction of grammar was conducted through a clear, fundamental method, accompanied by systematic practice and assessment. Importantly, the feedback in the CG was often postponed, typically provided through broad class discussions or automated grading after sessions, which completely missed the immediate personalization and emotional-motivational aspects present in the EG platform. To maintain fidelity in time-on-task, the

research team performed weekly checks on procedural fidelity by analyzing log data generated by the platform, confirming that the rates of task completion and login durations were consistent across both conditions.

Phase III: Post-Intervention Data Acquisition (Weeks 8–10)

The concluding phase entailed the systematic gathering of both quantitative and qualitative data to comprehensively tackle all research inquiries. At the end of the six-week treatment period (End of Week 7), the instruments were re-administered simultaneously to assess the direct, immediate affective and cognitive effects. A three-week washout period was strategically incorporated before administering the Long-Term Retention Test. This important time interval acted as a significant methodological safeguard, reducing the influence of short-term memory and ensuring that the test results accurately represented the true, lasting consolidation of knowledge, thus providing a more reliable assessment of the intervention's long-term effectiveness. Ultimately, alongside the post-testing, semi-structured interviews were carried out with a deliberately chosen sub-sample of 12 EG participants. The interview protocol aimed to draw out detailed experiential narratives concerning particular AI features and their impact on the needs of autonomy, competence, and relatedness based on SDT principles. The incorporation of qualitative data was crucial for delivering the required thick description and theoretical rationale for the quantitative results. All interview data were transcribed verbatim right after collection to enable thorough thematic analysis later on.

Data Analysis

The data analysis utilized a concurrent mixed-methods approach, combining the quantitative results obtained from inferential statistics with the detailed, contextual insights acquired through thematic analysis. The quantitative data underwent thorough analysis utilizing SPSS software (Version 28). To begin with, descriptive statistics (M and SD) were computed to provide a summary of the post-intervention scores for both the EG and the CG. Prior to conducting inferential tests, the assumptions necessary for parametric testing were thoroughly examined. We verified the normality of the distributions for all dependent variables by analyzing Skewness and Kurtosis values and conducting the Shapiro-Wilk test; all distributions were determined to be within acceptable limits for subsequent parametric analysis. Subsequently, Levene's Test of Equality of Variances was employed to confirm the homogeneity of variances. Given that Levene's test indicated no statistically significant difference in variance ($p>.05$) among the dependent variables, we confidently moved forward with the Independent Samples t-test. The analysis centered around this test, which aimed to assess the statistical significance of the mean differences between the EG and CG across all three dependent variables. To evaluate the practical significance of any notable findings, Cohen's d effect sizes were calculated for each comparison.

The qualitative component, which includes the verbatim transcripts from the 15 semi-structured interviews with EG participants, was analyzed through Thematic Analysis (TA), following the six-phase procedure outlined by Braun and Clarke (2006). This organized yet adaptable approach enabled us to transcend superficial observations and uncover profound patterns of meaning related to the learners' personal experiences. The sequence of analysis unfolded in a

systematic manner: Initially, immersion in the data was accomplished through repeated readings to ensure thorough familiarization. Secondly, the process of Generating Initial Codes entailed deconstructing the data through an inductive method to identify fundamental characteristics. Fourth, the process of Reviewing Themes guaranteed that the potential themes faithfully reflected the complete dataset. Fifth, the process of defining and naming themes led to the identification of three core themes that are clearly connected to the theoretical framework. Ultimately, the themes were integrated with illustrative quotations from participants to offer the rich description needed to support the quantitative findings. To ensure the credibility and reliability of the findings, two essential strategies were implemented: the lead researcher kept a comprehensive reflexive journal to record and address interpretive bias, and intercoder reliability was systematically confirmed by having a second expert code 25% of the transcripts. The resulting Cohen's Kappa (κ) of .82 demonstrated substantial agreement, thereby formally validating the analytical process and ensuring the credibility of the qualitative insights employed for triangulation.

Results and discussion

The findings are structured into two main sections: quantitative outcomes derived from pretest and posttest statistical evaluations, and qualitative insights obtained from participant interviews. Before performing inferential analyses, the normality of the data was evaluated through the Kolmogorov–Smirnov (K-S) test. The findings demonstrated that all variables (motivation, CL, and retention) exhibited a normal distribution ($p > .05$), thereby validating the application of parametric tests. As a result, independent samples t-tests were performed to assess whether significant differences existed between the EG and CG prior to and following the intervention. The following tables and explanations summarize these findings in detail.

Table 1.

Pretest Group Statistics for Motivation, CL, and Retention

Group	Motivation Mean (SD)	CL Mean (SD)	Retention Mean (SD)
CG	45.84 (8.12)	36.00 (7.45)	18.56 (3.67)
EG	44.21 (7.89)	36.73 (7.56)	17.95 (3.78)

The means for all three variables were quite comparable between the CG and the EG prior to the intervention. The mean for motivation in the CG was 45.84, while the EG had a mean of 44.21. Regarding CL, the CG achieved a score of 36.00, whereas the EG attained a score of 36.73. The CG exhibited a mean retention score of 18.56, whereas the EG had a mean of 17.95. The standard deviations and standard errors reveal similar variability across both groups, indicating baseline equivalence before treatment. The pretest results indicate that there are no initial differences, which supports the validity of the group comparisons and addresses RQ1-3 by establishing a common starting point (Cohen's $d < 0.2$ for all variables).

Table 2.

Pretest Independent Samples t-test for Motivation, CL, and Retention

Variable	t-value	p-value	Cohen's d
Motivation	0.78	.43	0.20
CL	0.36	.71	0.10

Variable	t-value	p-value	Cohen's d
Retention	1.01	.31	0.17

Table 2 presents the results of the independent samples t-test for pretest scores, indicating that there were no statistically significant differences in motivation, CL, or retention between the CG and EG before the intervention took place. The t-value for motivation was 0.78 (p = .43); for CL, it was 0.36 (p = .71); and for retention, it was 1.01 (p = .31). The findings suggest that both groups commenced at a comparable level across all three variables, thereby confirming the initial equivalence of the groups. The minimal effect sizes highlight the equivalence of pretest results, confirming that any differences observed after the intervention can be linked to the AI-gamification treatment instead of initial disparities.

Table 3.

Posttest Group Statistics for Motivation, CL, and Retention

Group	Motivation Mean (SD)	CL Mean (SD)	Retention Mean (SD)
CG	50.38 (9.23)	33.04 (6.89)	21.18 (4.12)
EG	63.46 (8.56)	27.68 (6.78)	26.07 (4.01)

Table 3 presents the posttest group statistics, indicating notable enhancements in the EG across all variables. The EG achieved a higher mean score of 63.46 in motivation compared to the CG, which scored 50.38. The EG exhibited a mean score of 27.68, which is lower than the CG's score of 33.04, suggesting a decrease in mental effort. The EG attained a mean retention score of 26.07, while the CG recorded a mean of 21.18. The observed differences indicate that the AI-driven gamification intervention positively influenced motivation and retention, concurrently decreasing cognitive load in the EG. The observed posttest shifts provide strong evidence for RQ2 and RQ3, demonstrating significant enhancements in motivation and retention, while also addressing RQ1 through reductions in CL. This underscores the intervention's practical significance, with Cohen's d exceeding 0.8 for both motivation and retention.

Table 4.

Posttest Independent Samples t-test for Motivation, CL, and Retention

Variable	t-value	p-value	Cohen's d
Motivation	4.55	.000	1.47
CL	2.74	.007	0.78
Retention	4.53	.000	1.22

Table 4 presents the results of the posttest t-test, indicating statistically significant differences between the EG and CG across all three variables. The results indicated a notable enhancement in motivation within the EG, evidenced by a t-value of 4.55 (p = .000). Concurrently, collaborative learning demonstrated a significant decrease (t = 2.74, p = .007), while retention levels were markedly elevated (t = 4.53, p = .000). The results validate the success of the AI-driven gamification approach in boosting learner motivation and promoting long-term retention, all while decreasing cognitive load. The findings, which exhibit medium to large effect sizes, effectively address RQ1 by demonstrating a reduction in CL through adaptive features, RQ2 through motivational enhancements, and RQ3 through better retention, consistent

with theoretical predictions.

Table 5.

Interviews Themes

Theme	Number of Participants	Description
Increased Motivation	13	Due to badges and progress tracking
Heightened Cognitive Engagement	11	Tasks as mentally stimulating yet enjoyable
Reduced CL	10	Via AI feedback and visual aids
Improved Retention	12	Attributed to interactive repetitions
Autonomy and Self-Pacing	9	Ability to revisit content without pressure
Peer Collaboration	8	Through leaderboards and achievements
Emotional Engagement	10	Increased confidence, less anxiety
Preference for Gamified	12	More engaging than traditional methods

The findings from the interview, illustrated in the table, highlight eight key themes that showcase learners' favorable views on AI-enhanced gamified instruction. A significant number of participants (13 out of 14) indicated a boost in motivation attributed to features such as badges and progress tracking. Additionally, 11 students highlighted an increase in cognitive engagement, characterizing the tasks as both mentally stimulating and enjoyable. Ten learners observed that immediate AI feedback and visual tools contributed to a decrease in their cognitive load by alleviating confusion and enhancing comprehension. Enhanced long-term retention was emphasized by 12 students who credited their recall of vocabulary and grammar to consistent engagement through interactive game levels and simulations.

Moreover, learners appreciated the independence and flexibility provided by the platform, with 9 noting the opportunity to review challenging material at their own pace without feeling rushed. Collaboration among peers and a sense of competition served as significant motivators for eight students, particularly through the use of leaderboards and collective accomplishments. Emotional engagement surfaced as a significant theme, as 10 students reported increased confidence and reduced anxiety throughout their learning experience. Finally, 12 participants indicated a clear preference for gamified learning compared to traditional methods, perceiving it as more engaging, contemporary, and enjoyable. The collective findings highlight the motivational, cognitive, and emotional advantages of incorporating AI-driven gamification into language learning settings. These themes directly respond to RQ4 by uncovering perceptions of increased autonomy and engagement, triangulating quantitative findings and indicating the role of gamification in meeting SDT needs.

The reduced cognitive load of the EG can be understood through CLT, as the adaptive scaffolding provided by AI minimized extraneous load, thereby allocating more resources for germane processing (Sweller, 1988). This is consistent with the findings of Huber et al. (2023), who observed comparable load reductions in gamified tasks; however, our study demonstrates

more pronounced effects in EFL attributed to personalized language support. This study aimed to explore the impact of gamification combined with AI on the motivation, collaborative learning, and long-term retention of English language learners within a virtual learning context. The results demonstrated that students who engaged in gamified instruction enhanced by AI achieved significantly higher performance across all three assessed dimensions. Specifically, the EG demonstrated heightened motivation following the intervention, decreased cognitive load, and enhanced retention rates when compared to the CG. The findings were further corroborated by qualitative data, as learners expressed heightened enjoyment and motivation due to gamification elements like badges, points, and progress tracking. Additionally, their understanding was enhanced by adaptive AI feedback and the flexibility offered by self-paced learning. Moreover, the capacity to evaluate assignments without negative feedback, along with the incorporation of social elements like leaderboards, fostered heightened emotional engagement, boosted self-assurance, and enhanced peer collaboration.

The results of this study align with the current body of literature regarding the incorporation of gamification and AI in educational settings. For example, Dahri et al. (2025) demonstrated that AI gamification notably improved student learning and engagement by providing enhanced interactivity and feedback mechanisms, thereby reinforcing the notion that technology-enhanced scaffolding facilitates substantial learning advancements. Similarly, Jiang et al. (2025) demonstrated that AI-gamified scaffolding improved the learning experience by aligning game mechanisms with educational goals, consistent with previous research that indicates increased motivation and decreased cognitive load. Furthermore, Xu et al. (2024) illustrated that an AI chatbot utilized in a virtual gaming environment markedly improved higher-order cognitive abilities and educational outcomes, especially through the provision of real-time feedback and adaptive interaction, essential components that are also incorporated in the gamified learning framework of the current study.

Huang et al. (2023) provide evidence that the adaptive AI function plays a crucial role in sustaining learner motivation and interest. They established that AI-driven personalized recommendations in inverted classrooms contributed to improved learning outcomes and engagement. From the perspective of emotional and behavioral involvement, the results align with the work of Yuan and Liu (2025), who emphasized the motivational and emotional benefits of AI tools in EFL contexts. Similarly, Jafarian and Kramer (2025) emphasized the motivational power of AI-enhanced audio learning, particularly regarding its impact on improving reading engagement and academic performance, aligning with the findings of the current study on vocabulary retention through gamification repetition. Moreover, as validated by Ratinho and Martins (2023), the impact of gamified learning strategies on enhancing motivation across different educational levels supports the notion that, when applied thoughtfully, gamification serves as a powerful pedagogical instrument in both secondary and post-secondary educational settings. Nonetheless, divergent results have surfaced concerning the efficacy of gamification within educational settings. Almeida et al. (2023) and Koivisto and Hamari (2019) pointed out cases where gamification failed to enhance students' performance. Zainuddin et al. (2020) also noted possible adverse impacts on motivation and engagement.

Our research revealed more pronounced positive effects compared to Almeida et al. (2023), likely because the personalization offered by AI helps to alleviate the novelty wear-off in the

Saudi context. The findings align with the principles of SDT (Deci & Ryan, 1985), suggesting that intrinsic motivation is enhanced when individuals feel a sense of autonomy, competence, and relatedness. In this study, participants were granted the freedom to manage their own performance and complete tasks (autonomy), received ongoing tailored feedback from AI (competence), and took part in both collaborative and competitive activities (relatedness). Consequently, the gamified AI system effectively fulfilled all three psychological needs, resulting in enhanced motivation and engagement.

The CLT (Sweller, 1988), provides a comprehensive explanation of the reduced mental effort observed in the EG. AI-driven scaffolding and adaptive support systems probably reduced unnecessary cognitive load by providing immediate explanations, feedback, and reminders (Lee & Wu, 2025). This, consequently, allowed learners to allocate greater cognitive resources to relevant processing, thereby improving their comprehension and retention. Moreover, the Cognitive Theory of Multimedia Learning (Mayer, 2009) highlights the effectiveness of multimodal stimuli that integrate auditory, visual, and interactive components, which played a crucial role in the AI-gamified platform. This theory posits that the most effective learning takes place when learners actively engage with both verbal and visual information.

The incorporation of gamified features such as progress dashboards, animated rewards, and AI-generated audio-visual feedback likely facilitated this dual-channel processing, thereby enhancing engagement and memory (Vidanaralage et al., 2022). While the encouraging nature of these findings is worth acknowledging, it is essential to recognize the considerable limitations that accompany them. The initial motivational impact linked to the novelty of AI-gamification highlights the need for longitudinal studies to evaluate its long-term effects. The observed gains might be attributed to the novelty effect instead of intrinsic pedagogical value, indicating that future research should incorporate washout periods or novelty controls. Secondly, reduced digital literacy levels might not have yielded the same extent of advantages from the intervention, raising issues related to accessibility and the need for training. Third, varying cultural perspectives on competition and gamification could influence results in different contexts, highlighting the necessity for careful consideration regarding generalizability. These limitations highlight the importance of placing AI-gamified teaching within broader educational frameworks and considering student diversity. The significant enhancement in motivation, retention, and CL reduction in the EG can be linked to the benefits of AI-driven gamification, which merges elements of AI with game-based learning to stimulate motivation.

Algorithms powered by AI provided instant feedback on learners' performance and dynamically adjusted the difficulty, speed, and type of content (Kabudi et al., 2021). The tailored feedback and adaptive assistance fostered a feeling of competence, as learners were provided with support specifically crafted to align with their current level of expertise. As noted by Deci and Ryan (1985) in their SDT, experiences of competence have a notably positive impact on intrinsic motivation. Moreover, the implementation of gamified dashboards offered learners visual support through progress bars, levels, and achievement indicators, enabling them to effectively track their advancement. The incorporation of these features established clear objectives and provided immediate feedback, thereby enhancing learner motivation and promoting long-term retention via regular self-assessment and self-reflection (Capatina et al.,

2024). The implementation of reward systems, including badges, leaderboards, and virtual rewards, facilitated the establishment of a rewarding environment that engaged learners' intrinsic motivation mechanisms (Xiao & Hew, 2024). The incorporation of peer comparison and collaborative play elements enhanced the dimension of relatedness, a fundamental component of SDT, which offered learners a sense of social connection and emotional support. One of the key factors contributing to the reduced cognitive load was the immediate support provided by the AI system through hints, reminders, and instructional prompts. These aids contributed to a reduction in extraneous cognitive load (Sweller, 1988), allowing cognitive effort to be focused on meaningful learning activities rather than on procedural or technical navigation. Furthermore, the multimodal presentation of content, which includes visuals, narration, animation, and interactivity, is consistent with the principles outlined in the Cognitive Theory of Multimedia Learning (Mayer, 2009). The theory highlights the importance of dual-channel processing, wherein learners integrate visual and auditory inputs to enhance memory retention and promote deeper cognitive engagement.

The gamified AI-learning environment provided learners with enhanced autonomy, enabling them to manage the pacing, sequence, and review of information according to their preferences. This enhanced independence fostered a deeper emotional commitment to the learning experience and extended durations of involvement. The AI-supported platform, unlike conventional teaching methods, provided instant and tailored feedback, enabling learners to swiftly identify and rectify mistakes (Katona & Katonane Gyonyoru, 2025). This ongoing feedback mechanism enhanced learning cycles and fostered the development of confidence and competence. The incorporation of gamification through AI-driven features such as personalization, real-time data analysis, motivational strategies, multimodal resources, and autonomy has created an environment that significantly enhances motivation, supports knowledge retention, and alleviates cognitive overload (Song et al., 2025).

The interconnected mechanisms elucidate the enhanced performance of the EG and showcase the potential for transformative gaming-enabled AI-augmented learning within contemporary EFL classrooms. While the positive implications of the findings are encouraging, it is essential for future research to investigate the long-term impacts of these interventions and to explore possible disparities in access to AI resources. Furthermore, it is essential for educators and instructional designers to exercise caution regarding excessive dependence on gamification, ensuring that it serves to support rather than detract from learning objectives. Nonetheless, the results indicate that thoughtfully implemented AI-driven gamification can enhance not only cognitive benefits but also emotional and motivational engagement, paving the way for a novel approach to adaptive, learner-centered teaching methods. This study expands on CLT by illustrating the role of AI in managing extraneous load through personalization in EFL learning (Sweller, 1988), and it further develops SDT by demonstrating that gamified autonomy boosts motivation in collectivist cultures (Deci & Ryan, 2013).

Conclusion

The use of AI in gamified EFL learning processes greatly boosts learners' motivation, aids in long-term retention, and improves their emotional experience, all while decreasing cognitive load. The combination of adaptive AI and game-like elements, including points, badges, levels,

and interactive challenges, creates a vibrant and motivating learning atmosphere that maintains students' interest and encourages active participation (Choustoulakis et al., 2024). These characteristics not only foster both intrinsic and extrinsic motivation but also empower learners to cultivate increased self-confidence, autonomy, and enjoyment in their language learning journey. Through the reduction of unnecessary cognitive load via tailored scaffolding, prompt feedback, and visual aids, AI-driven platforms assist learners in effectively managing challenging language material (Du & Daniel, 2024). This cognitive stimulation fosters a deeper understanding and promotes the transfer of learning to long-term memory, thereby improving the long-term retention of vocabulary and grammar. The core concern of the affective advantages of gamified teaching lies in fostering positive affective states in students, such as increased confidence, reduced anxiety, and a sense of accomplishment. The significance of these emotional states is especially pronounced in EFL contexts, where anxiety and disengagement among learners often serve as common obstacles to advancement. In summary, these findings suggest that gamified teaching powered by AI offers a pedagogically sound, technologically advanced, and student-centered alternative to traditional digital methods. It offers a more tailored, engaging, and emotionally supportive learning atmosphere, making it particularly effective for instructing vocabulary and grammar in secondary-level EFL settings and beyond. The findings indicate considerable promise for improving EFL outcomes in Saudi settings, serving as a proof-of-concept.

The results of this study hold significant relevance for EFL educators and students, along with educational policymakers and curriculum developers, concerning the incorporation of AI-driven gamification in language teaching. For educators, AI-gamified platforms present a chance to create more effective, personalized, and learner-focused lessons. For instance, EFL teachers might implement badge systems to acknowledge grammar accuracy, thereby fulfilling the competence requirement outlined in SDT. The responsive characteristics of AI technology facilitate differentiated instruction by automatically modifying the difficulty level, pace, and type of learning materials to align with individual learner needs and performance metrics (Bhutoria, 2022). This approach to personalization proves especially advantageous in mixed-ability classrooms, where conventional “one-size-fits-all” teaching frequently results in certain learners feeling disengaged or insufficiently challenged. Through customized assistance, AI-driven gamification promotes fairer learning results and allows educators to concentrate on guiding rather than simply presenting material.

Furthermore, the research emphasizes that gamified teaching methods can notably decrease learners' cognitive load. Tools that provide embedded scaffolding, including immediate feedback, real-time hints, and visual dashboards, help to clarify intricate grammatical and lexical structures. This support enables learners to engage with new content without experiencing cognitive overload. This has clear implications for instructional design: educators can utilize these tools to develop progressive learning sequences in which concepts are introduced incrementally, thereby improving understanding and promoting long-term retention. The motivational aspects found in gamified platforms, including achievement badges, leaderboards, and point systems, can be purposefully utilized by educators to promote ongoing engagement. Instead of employing these features merely as incentives, educators can connect them with mastery-oriented objectives to foster intrinsic motivation, prompting students to

appreciate growth and skillfulness rather than rivalry.

Another implication relates to evaluation methods. Platforms powered by AI offer immediate data analytics that allow educators to pinpoint learning gaps right away and implement focused interventions, shifting from conventional summative assessments to a model that prioritizes ongoing formative assessment. This approach, grounded in data, provides educators with practical insights into students' strengths and weaknesses, facilitating evidence-based decision-making in lesson planning and remediation. To fully harness these advantages, it is essential for educators to engage in professional development focused on AI integration, gamification techniques, and digital teaching methods. It is essential for academic institutions and education ministries to allocate resources towards organized training programs and workshops, enabling educators to cultivate the requisite technological and pedagogical skills. This training will also tackle any potential resistance or anxiety that educators might experience when it comes to embracing new technologies. From the perspective of learners, gamification driven by AI provides tailored, self-directed learning experiences that resonate with the ideals of independence and continuous education. Students have the opportunity to review challenging content, obtain prompt and personalized feedback, and advance at their own pace—elements that not only improve academic success but also cultivate confidence, resilience, and self-regulation abilities. The results indicate that learners showed increased motivation, emotional involvement, and lower anxiety levels, suggesting that gamified settings can foster psychologically safe environments for language experimentation and risk-taking, which are essential elements of successful language learning. Ultimately, the incorporation of AI-gamified learning provides students with essential 21st-century skills, such as digital literacy, critical thinking, and collaborative problem-solving, which are applicable not only in language learning but also in wider academic and professional settings. The implications highlight the potential of AI-driven gamification, serving not just as a pedagogical innovation but also as a transformative element in equipping learners for the challenges of a technology-driven environment.

In terms of learning outcomes, gamified instruction led to improved long-term retention of vocabulary and grammar, attributed to the repeated exposure provided by game-based activities and simulations in authentic contexts. Students reported lower levels of anxiety and heightened confidence, indicating that gamified platforms create psychologically safe spaces for language practice. Students also appreciated social features such as leaderboards and group activities, as they provided opportunities for healthy competition and peer-to-peer interaction, thereby fostering social learning and communication skills. Finally, by utilizing AI-driven gamified tools, learners develop essential 21st-century competencies such as digital literacy, self-regulation, and critical thinking. These skills extend well beyond the realm of language acquisition and are greatly valued in both academic and professional settings.

While the results of this study seem promising, it is crucial to identify certain limitations to appropriately contextualize the findings and guide future research endeavors. A significant limitation pertains to the restricted and geographically specific sample of 85 ninth-grade Saudi EFL learners drawn from a single region in Saudi Arabia, utilizing convenience sampling methods. The small sample size and specific geographical focus limit the applicability of the findings to wider populations and varied educational contexts. To address this issue effectively,

subsequent studies ought to include larger and more demographically representative samples of participants, encompassing a variety of cultural, linguistic, and educational backgrounds. Increasing the sample size would enhance external validity and enable more significant comparisons among various learner populations. Another limitation is the short duration of the intervention, which spanned merely six weeks. Although this was adequate for assessing immediate improvements in motivation and language skills, it might be too limited in duration to evaluate the lasting impact of AI-driven gamification on learning retention or persistence. Consequently, it is advisable for future research to adopt longitudinal designs that extend across several academic terms or school years. Employing these designs would facilitate the evaluation of the enduring stability of learning outcomes and monitor the changes in learner motivation throughout time. Particular recommendations involve conducting cross-cultural comparisons (for instance, between Saudi and East Asian EFL learners) or investigating varying impacts based on proficiency levels or gender. Third, the research failed to consider the digital literacies of the learners prior to the intervention. Given that the participants' familiarity with digital tools was neither established nor controlled, variations in individuals' technological skills may have influenced their capacity to equally benefit from the AI-based platform.

To address this issue, subsequent research should either assess digital literacy as a moderating factor or implement training sessions for participants to establish a baseline level of exposure to the technology. Implementing these measures would contribute to minimizing variability and establishing a more equitable environment. Ultimately, the thematic analysis was largely descriptive and centered mainly on favorable learner experiences. This limitation emerged due to the exclusive inclusion of positively framed questions in the interview protocol, resulting in participants predominantly offering favorable feedback concerning AI-powered gamified learning. Consequently, negative or contradictory experiences were not documented, and given that the participants are no longer accessible, it was not feasible to gather further data retrospectively. The findings underscore significant motivational, cognitive, and emotional advantages; however, they might not completely capture the diversity of learner experiences. Future research ought to include a greater number of open-ended and neutrally framed questions to encompass both positive and negative viewpoints, thereby offering a more comprehensive understanding of the intervention's effects. To tackle this bias, upcoming protocols might incorporate prompts such as 'What aspects of the platform did you find unappealing?'

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Biodata

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