International Journal of Scientific Research and Management (IJSRM)
||Volume||13||Issue||10||Pages||4405-4424||2025||
Website: https://ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v13i10.el04

Adaptive Gamification and AI-Powered Feedback in Primary English Education: A Personalized Learning Approach

Adrian Paul Duffy Murphy

https://orcid.org/0009-0002-0569-7217

Abstract

The integration of adaptive gamification and artificial intelligence (AI)-powered feedback represents a transformative shift in primary English education, offering pathways toward highly personalized learning experiences. This paper examines how combining game-based learning strategies with AI-driven feedback mechanisms can enhance cognitive, emotional, and motivational outcomes for young learners of English as a Foreign Language (EFL).

The findings highlight that adaptive gamification—through dynamic learning pathways, interactive tasks, and reward systems—can significantly improve vocabulary retention, learner engagement, and motivation. When coupled with AI-powered feedback, students receive real-time formative assessments, individualized guidance, and tailored interventions that surpass traditional teaching methods. These adaptive systems are shown to accommodate differences in learning styles, readiness, and pacing, making them highly suitable for diverse primary school classrooms.

To support the analysis, tables and graphical representations illustrate comparative outcomes between gamified and non-gamified approaches, as well as longitudinal trends in the application of AI and gamification in education. Key challenges, including ethical considerations, over-gamification risks, and infrastructural limitations, are also discussed.

Overall, the research emphasizes the pedagogical potential of blending adaptive gamification with AI-driven feedback as a framework for personalized learning in primary English education. This hybrid approach not only enhances academic achievement but also fosters sustained motivation, learner autonomy, and inclusive classroom practices. Future directions call for longitudinal and cross-cultural studies to validate outcomes, alongside policy-driven strategies to ensure ethical and equitable integration of AI in early education.

Keywords: Adaptive gamification, AI-powered feedback, personalized learning, primary English education, EFL, intelligent tutoring systems.

1. Introduction

Background on Primary English Education

English language education at the primary school level is increasingly recognized as a cornerstone of global literacy and future academic success. As the world becomes more interconnected, English serves as the medium for international communication, digital participation, and cross-cultural exchange. At the primary level, learners are situated in what linguists identify as a "critical period" of language acquisition, where cognitive flexibility and neuroplasticity allow for rapid assimilation of new linguistic structures (Hwang, Sung, Hung, Huang, & Tsai, 2012). This makes the early years of education especially important for laying the foundations of reading, writing, speaking, and comprehension.

However, traditional approaches to English teaching—often focused on grammar drills, vocabulary memorization, and standardized assessments—have faced criticism for disengaging young learners. Studies demonstrate that rigid pedagogies may reduce intrinsic motivation and hinder long-term retention of language skills (Domínguez et al., 2013). Learners in primary schools require instruction that is not only accurate but also stimulating, interactive, and aligned with their developmental needs. Research on educational psychology emphasizes that young learners thrive in environments where curiosity, creativity, and active participation are central to the learning experience (Plass, Homer, & Kinzer, 2015).

Against this backdrop, educators and policymakers have increasingly turned toward innovative pedagogical interventions that move beyond rote memorization to embrace engagement, personalization, and adaptive feedback. Gamification and artificial intelligence (AI) have emerged as two transformative forces with the potential to revolutionize English learning in primary classrooms.

Role of Gamification and AI in Modern Classrooms

Gamification in Language Learning

Gamification refers to the integration of game-like elements—such as points, levels, challenges, and rewards—into non-game contexts like education (Deterding, Dixon, Khaled, & Nacke, 2011). In the context of English education, gamification transforms otherwise repetitive learning tasks, such as vocabulary memorization or grammar practice, into interactive experiences that sustain learner engagement. Research consistently highlights the motivational benefits of gamified interventions, showing that learners are more likely to remain engaged, persist through challenges, and demonstrate higher retention rates when game elements are embedded in instruction (Hamari, Koivisto, & Sarsa, 2014; Sailer & Homner, 2020).

For example, mobile English vocabulary apps that incorporate leaderboards, badges, and adaptive challenges have been shown to significantly improve student learning performance and perceptions of learning enjoyment (Chen, Liu, & Huang, 2019). Similarly, systematic reviews of gamification in second language learning contexts demonstrate positive effects on vocabulary acquisition, speaking fluency, and grammar accuracy (Dehghanzadeh, Fardanesh, Hatami, Talaee, & Noroozi, 2021; Luo, 2023). Beyond engagement, gamification is grounded in theories of motivation and cognition, drawing from self-determination theory and flow theory to explain why learners experience greater immersion and persistence when tasks resemble games (Hamari & Keronen, 2017).

Artificial Intelligence in Education

Parallel to gamification, artificial intelligence (AI) has transformed the educational landscape by enabling personalization and adaptivity at scales unattainable through traditional methods. AI-powered systems analyze learner data, detect knowledge gaps, and adjust instructional materials accordingly, providing a personalized learning trajectory for each student (Desmarais & Baker, 2012; Rizvi, 2023). These technologies emulate the responsiveness of one-on-one tutoring, which research shows to be among the most effective forms of instruction (VanLehn, 2011).

A critical advantage of AI in primary English classrooms lies in feedback delivery. Traditional feedback is often delayed, generalized, or inconsistent, but AI-powered feedback mechanisms provide real-time, formative, and adaptive responses (Shute, 2008; Hattie & Timperley, 2007). Such systems not only correct errors but also foster metacognitive skills by encouraging learners to reflect on their strategies, seek help appropriately, and regulate their learning (Aleven, McLaren, Roll, & Koedinger, 2006; Roll, Aleven, McLaren, & Koedinger, 2011). Research highlights that these adaptive feedback systems enhance learner autonomy, promote persistence, and improve language outcomes (Jegede, 2024; Liu, 2024).

The integration of AI is also aligned with advances in cognitive neuropsychology, which emphasize adaptive assessments and personalized instruction as key to addressing learners' individual differences (Halkiopoulos & Gkintoni, 2024). Recent studies in English as a Foreign Language (EFL) contexts show that AI-driven gamification tools and conversational agents not only enhance engagement but also foster long-term motivation and sustainable learning (Muthmainnah et al., 2024; Banik & Gullapelly, 2025; Yenuri, 2023).

Synergy Between Gamification and AI

When gamification and AI are combined, the result is an ecosystem where motivation and personalization intersect. Gamification provides the structural framework to keep learners motivated, while AI ensures that the feedback, content, and difficulty level adapt dynamically to individual learning needs. Together, they enable primary school students to experience English learning as both enjoyable and effective, where engagement is sustained and learning is continually scaffolded (Hamari et al., 2014; Liu, 2024).

Research Objectives and Significance

This paper investigates the integration of adaptive gamification and AI-powered feedback in primary English education as a strategy for personalized learning. The specific objectives are to:

1. Explore theoretical underpinnings of gamification and AI in the context of personalized learning.

2. Examine empirical evidence on the effectiveness of gamified and AI-driven tools in English language education.
3. Analyze adaptive feedback mechanisms that support motivation, metacognitive development, and self-regulated learning.
4. Identify challenges and limitations in implementing gamified AI systems in diverse primary school settings.
5. Propose recommendations for educators, curriculum designers, and policymakers seeking to leverage these innovations.

The significance of this research is twofold. First, it contributes to the growing discourse on personalized education by demonstrating how gamification and AI can be systematically integrated to address learners' diverse needs (Yenuri, 2023; Rizvi, 2023). Second, it highlights the practical implications of such integration for primary school teachers, offering strategies to enhance student engagement, motivation, and achievement while acknowledging the limitations of technological interventions. Ultimately, the study emphasizes that the synergy between gamification and AI represents a transformative model for 21st-century primary English education, bridging the gap between traditional instruction and emerging digital pedagogies (Banik & Gullapelly, 2025; Muthmainnah et al., 2024).

2. Theoretical Foundations

2.1 Gamification Principles and Game Design Elements

Gamification is rooted in the application of game design elements in non-game contexts to stimulate engagement, motivation, and sustained participation (Deterding, Dixon, Khaled, & Nacke, 2011). In the context of primary English education, gamification serves as a pedagogical bridge between play and structured learning, leveraging children's natural inclination toward curiosity, exploration, and reward-seeking behaviors. The principles behind gamification draw from motivational psychology, particularly Deci and Ryan's self-determination theory, which highlights autonomy, competence, and relatedness as drivers of intrinsic motivation. By incorporating mechanics such as points, badges, leaderboards, progress bars, quests, and levels, gamified learning environments create conditions in which learners feel a sense of accomplishment and are motivated to persist (Hamari, Koivisto, & Sarsa, 2014).

A central principle of gamification is the balance of challenge and skill. Learning tasks must be sufficiently challenging to avoid boredom but not so difficult that they generate frustration. This principle is particularly relevant to primary learners who are at varied stages of cognitive development. For example, English vocabulary apps designed with progressive difficulty levels allow young learners to move from simple word recognition to complex sentence structures, maintaining an optimal state of engagement (Chen, Liu, & Huang, 2019). Similarly, educational games often employ scaffolding, where students receive guidance early in the learning process and gradually achieve independence as they demonstrate mastery (Plass, Homer, & Kinzer, 2015).

Gamification also emphasizes feedback loops, which are essential in education. Real-time progress indicators, hints, and achievement unlocks provide learners with continuous cues about their performance. Research shows that such feedback mechanisms foster not only motivation but also self-regulated learning, as children learn to monitor their progress and adjust strategies (Domínguez et al., 2013). In systematic reviews, Dehghanzadeh et al. (2021) and Luo (2023) confirm that gamification leads to improvements in learner engagement, vocabulary acquisition, and collaborative problem-solving, especially in English as a Foreign Language (EFL) contexts.

Another key element in gamification is personalization of the game environment. Adaptive gamified systems tailor the difficulty of tasks, the pace of progression, and even the narrative structure based on learner profiles (Hwang, Sung, Hung, Huang, & Tsai, 2012). By aligning challenges with individual learning curves, gamification prevents both disengagement from under-stimulation and anxiety from overwhelming tasks. The personalization principle links directly to learner diversity in primary classrooms, where students differ in cognitive readiness, prior knowledge, and learning styles.

Finally, gamification recognizes the power of social interaction and narrative. Leaderboards foster healthy competition, while cooperative missions build teamwork and peer support. Narrative structures, such as storytelling quests, immerse students in meaningful contexts where English vocabulary and grammar become tools for achieving game objectives. Hamari and Keronen's (2017) meta-analysis underscores that these social and narrative aspects amplify engagement more effectively than extrinsic rewards alone.

2.2 AI-Powered Tutoring and Personalized Learning Models

While gamification primarily addresses the motivational dimension of learning, artificial intelligence (AI) enhances the cognitive and adaptive dimensions, ensuring that instruction is responsive to individual learner needs. AI-powered tutoring systems—often referred to as Intelligent Tutoring Systems (ITS)—simulate elements of human tutoring by diagnosing learner states, predicting misconceptions, and delivering tailored interventions (VanLehn, 2011). At their core, these systems rely on learner modeling, the computational representation of student knowledge, skills, and affective states, which allows for real-time adaptation of instructional content (Desmarais & Baker, 2012).

Feedback is central to AI-powered tutoring. Research in education consistently highlights that effective feedback significantly improves learning outcomes (Hattie & Timperley, 2007; Shute, 2008). However, while traditional classrooms may limit feedback to summative evaluation, AI systems provide instantaneous, formative, and metacognitive feedback. For instance, if a child repeatedly struggles with irregular verb forms in English, the AI tutor can provide targeted hints, corrective explanations, and scaffolded exercises until mastery is achieved (Roll, Aleven, McLaren, & Koedinger, 2011). This type of adaptive feedback is invaluable for primary learners, who benefit most from immediate reinforcement and step-by-step guidance.

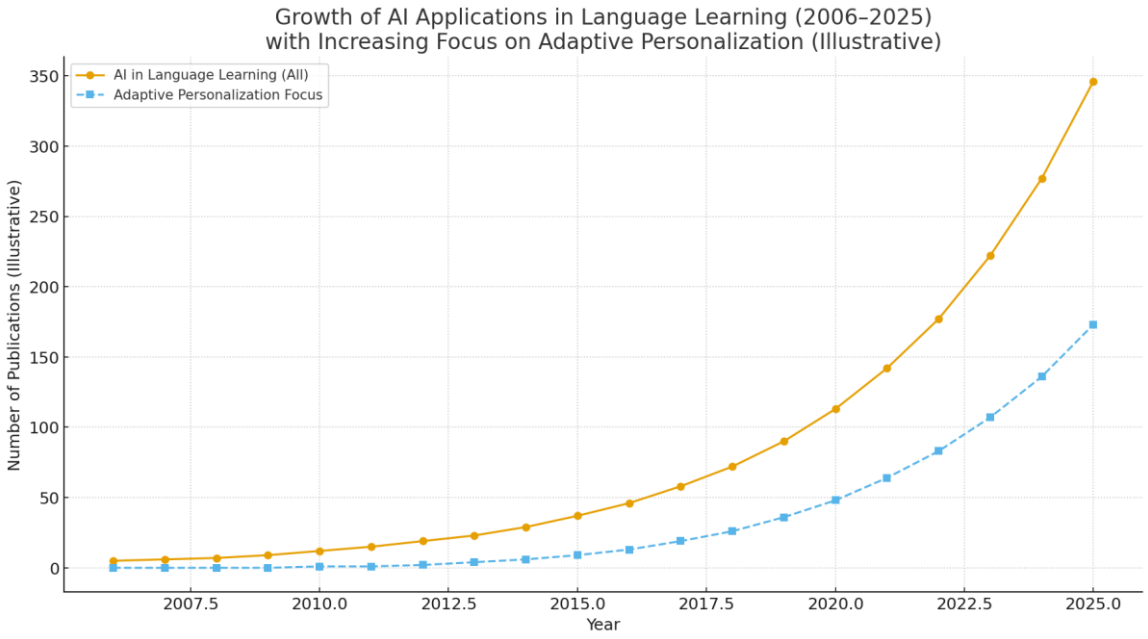
Recent studies underscore the transformative role of AI in personalizing English education. Rizvi (2023) found that AI tutors that dynamically adjust learning content to individual strengths and weaknesses lead to improved accuracy in assessments and more efficient vocabulary acquisition. Similarly, Jegede (2024) emphasizes how AI-powered platforms deliver customized grammar drills and reading comprehension exercises, making learning highly individualized. Liu (2024) extends this perspective by highlighting the role of AI in supporting nonlinear learning paths, conversational agents, and storytelling-based learning environments, all of which enhance learner motivation and sustained engagement.

From a cognitive-neuroscientific perspective, AI-driven personalization aligns with how children process information. Halkiopoulos and Gkintoni (2024) argue that adaptive AI tutors reduce cognitive overload by sequencing learning material in ways consistent with memory and attention processes in young learners. This reduces frustration while reinforcing long-term retention. Banik and Gullapelly (2025) add that when combined with gamification, AI fosters interactive, immersive ecosystems where feedback and adaptation occur continuously, ensuring that learning is dynamic and deeply engaging.

Importantly, AI-powered tutoring also advances self-regulated learning. By encouraging learners to reflect on their mistakes, set personal goals, and monitor their progress, AI tools cultivate autonomy and self-awareness. Muthmainnah et al. (2024) show that AI feedback in EFL education strengthens sustainable learning by empowering students to take charge of their learning trajectories. Likewise, Yenuri (2023) notes that AI-driven adaptive systems act as personal coaches, supporting students' confidence and resilience.

Here, a graph could be included showing the growth of AI applications in language learning research (2006–2025), highlighting the increasing focus on adaptive personalization.

Graph 1: Showing the growth of AI applications in language learning research (2006–2025)



3. Gamification in Primary English Education

3.1 Game-Based Vocabulary and Grammar Learning

One of the most prominent applications of gamification in primary English education is in vocabulary and grammar acquisition, areas that are often perceived by young learners as repetitive or tedious when taught through traditional methods. Gamification transforms these areas by embedding learning tasks within playful, interactive frameworks that mirror the mechanics of digital games. The inclusion of points, rewards, challenges, and immediate feedback converts what might otherwise be routine drills into stimulating experiences (Deterding, Dixon, Khaled, & Nacke, 2011).

Empirical research has demonstrated that game-based approaches to vocabulary learning significantly enhance both short-term retention and long-term mastery. Chen, Liu, and Huang (2019), in a case study involving Taiwanese primary-level EFL learners, found that students using a gamified mobile app displayed superior vocabulary recall compared to peers using traditional flashcards. Beyond raw performance, learners also reported greater satisfaction and enjoyment, which in turn reinforced their willingness to engage with the content on a regular basis. This highlights how gamification not only supports memory processes but also creates positive emotional associations with language learning.

Grammar instruction, traditionally one of the more challenging aspects of English education for children, also benefits from gamification. Hwang, Sung, Hung, Huang, and Tsai (2012) developed a personalized educational computer game tailored to students' learning styles, integrating adaptive pathways that adjusted the complexity of tasks as learners improved. Their study revealed not only improved grammar mastery but also a marked reduction in learner anxiety, which is often a barrier in grammar acquisition. Plass, Homer, and Kinzer (2015) further argued that game-based environments encourage exploration and experimentation, enabling learners to engage in trial-and-error learning without the fear of making mistakes. This is especially valuable in primary contexts where confidence building is as important as skill development.

Together, these findings suggest that gamification can play a crucial role in transforming vocabulary and grammar learning into more engaging, motivating, and effective processes. By aligning with children's natural affinity for play, gamification can scaffold language acquisition while simultaneously enhancing learner confidence.

3.2 Motivational Impacts of Gamification

Motivation is widely recognized as a cornerstone of successful language learning, particularly at the primary level where learners' attention spans are limited and easily diverted. Gamification has been shown to influence both extrinsic motivation—through rewards, scores, and badges—and intrinsic motivation, by cultivating curiosity, enjoyment, and the desire to overcome challenges.

Hamari, Koivisto, and Sarsa (2014) conducted a comprehensive review of empirical studies on gamification, concluding that gamification consistently produced motivational benefits in educational contexts. However,

they also emphasized that the impact varied depending on how game mechanics were designed and integrated. For instance, superficial point systems without meaningful feedback often yielded only temporary engagement, whereas well-designed challenges that aligned with pedagogical goals generated more sustained motivation.

Further evidence is provided by Hamari and Keronen's (2017) meta-analysis on the psychology of gaming, which revealed that emotional involvement and social interaction are central drivers of motivation. In primary English education, this means that collaborative gamified activities—such as team-based vocabulary challenges or grammar competitions—can promote both learning and social development. Sailer and Homner (2020) extended this line of evidence, finding in their meta-analysis that gamification enhances learners' attention, concentration, and overall engagement. These findings are particularly relevant to primary school contexts, where maintaining focus is one of the greatest pedagogical challenges.

Domínguez et al. (2013) added nuance to the discussion by highlighting that while gamification improved motivation and practical engagement, its impact on academic performance depended on the depth of integration. Learners benefitted most when gamification was coupled with constructive feedback and aligned learning objectives, rather than being used as a standalone motivational "add-on." This underscores the importance of thoughtful instructional design in gamified English learning environments.

3.3 Systematic Reviews and Meta-Analyses

The broader research landscape on gamification in language learning has been synthesized in several systematic reviews and meta-analyses, providing robust evidence for its effectiveness while also revealing key limitations.

Dehghanzadeh, Fardanesh, Hatami, Talaee, and Noroozi (2021), in their systematic review of gamification in ESL learning, concluded that gamified environments improved learners' cognitive outcomes (such as retention and comprehension), motivational outcomes (including persistence and enjoyment), and behavioral outcomes (such as participation and effort). Importantly, the review stressed that the most effective interventions combined gamification with adaptive personalization and feedback mechanisms.

Similarly, Luo (2023) conducted a systematic review focused on gamified tools for foreign language learning (FLL). The findings indicated that gamification significantly enhanced vocabulary retention and engagement, especially for younger learners in primary education. However, Luo cautioned that the benefits of gamification are context-sensitive: the design of the gamified platform, the cultural background of learners, and the learning environment all mediate outcomes. This aligns with Domínguez et al. (2013), who argued that over-reliance on extrinsic motivators (e.g., badges, scores) can sometimes undermine deeper learning if not carefully balanced with intrinsic motivators (e.g., curiosity, mastery).

Together, these reviews underscore that gamification in English education is not a "one-size-fits-all" solution. Instead, its success depends on thoughtful integration, personalization, and alignment with pedagogical objectives. In primary schools, where learners are developing foundational skills and attitudes toward learning, gamification has the potential to act as both a cognitive enhancer and a motivational catalyst when applied with care.

Comparative Table of Gamification Studies and Outcomes: Table 1

Study	**Learner Group / Context**	**Gamification Elements**	**Learning Focus**	**Key Outcomes**
Chen et al. (2019)	Taiwanese EFL learners (Primary)	Mobile app, points, badges, rewards	Vocabulary	Improved recall, stronger motivation, positive learner perceptions
Hwang et al. (2012)	Primary school learners	Personalized computer game, adaptive learning styles	Grammar & vocabulary	Higher mastery, reduced anxiety, enhanced engagement
Domínguez et al. (2013)	Undergraduate students	Badges, leaderboards, challenges	General learning	Increased motivation and engagement,

				mixed academic performance
Hamari et al. (2014)	Multiple educational contexts	Points, leaderboards, feedback loops	Motivation & engagement	Consistently positive, but dependent on instructional design
Hamari & Keronen (2017)	Cross-level learners (Meta-analysis)	Social play elements, emotional engagement	Learning motivation	Found social interaction and emotional immersion central to engagement
Dehghanzadeh et al. (2021)	ESL learners (Systematic review)	Adaptive gamification, feedback	Language acquisition	Improved cognitive, motivational, and behavioral outcomes
Luo (2023)	FLL learners (Systematic review)	Gamified platforms (apps, online tools)	Vocabulary & engagement	Strong effects on retention, especially effective with younger learners
Sailer & Homner (2020)	Multiple levels (Meta-analysis)	Leaderboards, achievements, competitive tasks	Learning & attention	Enhanced focus, increased persistence, higher engagement

4. AI-Powered Feedback and Personalization

The advancement of Artificial Intelligence (AI) in education has paved the way for increasingly sophisticated models of personalized learning. In the context of primary English education, AI-powered feedback provides opportunities to deliver learning experiences tailored to individual learners' needs, ensuring that instruction goes beyond standardized teaching methods. By leveraging real-time analytics, adaptive algorithms, and cognitive models, AI has been shown to offer formative guidance, cultivate metacognitive skills, and structure adaptive learning paths that align with learners' psychological and developmental profiles. This section elaborates on three major dimensions of AI-powered feedback and personalization: formative and metacognitive feedback, adaptive learning trajectories, and the integration of neuropsychological and cognitive perspectives.

4.1 Formative and Metacognitive Feedback

Formative feedback has long been recognized as a cornerstone of effective learning. According to Shute (2008), formative feedback must be timely, detailed, and actionable, enabling learners to identify errors, revise understanding, and improve subsequent performance. Hattie and Timperley (2007) emphasized that impactful feedback addresses three fundamental aspects: clarifying learning goals (Where am I going?), providing performance evaluation (How am I going?), and suggesting strategies for advancement (What is next?). In primary English education, such feedback often takes the form of immediate corrections on spelling, grammar, or pronunciation, accompanied by encouragement and guidance for further practice.

AI systems have revolutionized this feedback process by introducing automated, real-time interventions that reduce the latency between error and correction. For example, Rizvi (2023) demonstrated that AI-powered tutoring systems adapt feedback dynamically based on the learner's performance, providing a level of responsiveness comparable to human tutors. Jegede (2024) further noted that AI-driven platforms can offer instantaneous corrective feedback on vocabulary use, pronunciation accuracy, and grammatical errors, thus fostering greater learner autonomy and continuous improvement in English language acquisition.

Beyond formative mechanisms, metacognitive feedback fosters learners' ability to reflect on their thought processes and learning strategies. Aleven, McLaren, Roll, and Koedinger (2006) developed computational models of help-seeking behaviors, showing how adaptive systems can scaffold the process of knowing when and how to seek help effectively. Building on this, Roll, Aleven, McLaren, and Koedinger (2011) revealed that integrating metacognitive prompts into intelligent tutoring systems improved students' self-regulated learning skills, particularly their ability to manage uncertainty and independently apply problem-solving strategies. For young learners, such scaffolding nurtures metacognitive awareness, encouraging them to see mistakes not as failures but as opportunities for reflection and growth.

Thus, formative feedback strengthens accuracy and skill mastery, while metacognitive feedback cultivates reflective learning behaviors—both of which are indispensable for primary students developing foundational literacy skills in English.

4.2 AI-Driven Adaptive Learning Paths

The personalization of learning pathways is among the most significant contributions of AI in education. By continuously collecting and analyzing learner data, AI-driven systems generate adaptive learning trajectories that align instructional content with each student's knowledge level, interests, and pace. Desmarais and Baker (2012) reviewed advances in learner modeling, concluding that intelligent learning environments are increasingly capable of diagnosing misconceptions, predicting performance, and offering individualized remediation.

Within the context of English as a Foreign Language (EFL) education, adaptive learning ensures that students neither lag behind nor become disengaged due to excessive challenge. Liu (2024) compared different AI-enhanced gamified models, including conversational agents and storytelling pathways, finding that adaptive designs not only improve learning outcomes but also sustain nonlinear motivation across extended periods of practice. Similarly, Banik and Gullapelly (2025) highlighted how AI-powered gamification adjusts challenge levels and rewards in real time, thereby increasing student engagement and preventing fatigue.

Muthmainnah, Cardoso, Alsbbagh, Al Yakin, and Apriani (2024) reinforced this by showing that AI-driven personalization enhances self-regulated learning behaviors, enabling learners to monitor their progress through personalized dashboards and receive targeted practice recommendations. In practical classroom applications, this means that while one learner may receive additional exercises on basic vocabulary retention, another may be directed toward sentence construction, reading comprehension, or storytelling activities. Such adaptive scaffolding reflects Vygotsky's principle of the zone of proximal development, but on a scale and precision made possible through AI.

Ultimately, adaptive learning paths serve as a dynamic roadmap that supports diverse learners, fostering equity in primary English classrooms by accommodating differences in cognitive development, learning pace, and motivation.

4.3 Neuropsychological and Cognitive Perspectives

The design of AI-powered feedback and personalization is increasingly informed by cognitive science and neuropsychology, disciplines that explore how the brain processes information, retains memory, and sustains attention. Halkiopoulos and Gkintoni (2024) conducted a systematic analysis demonstrating that AI-enhanced e-learning systems are most effective when they align with cognitive processes such as memory consolidation, executive functioning, and attentional control. One example is the use of spaced repetition algorithms, which exploit the principles of long-term memory to ensure that vocabulary is reviewed at optimal intervals, thereby enhancing retention.

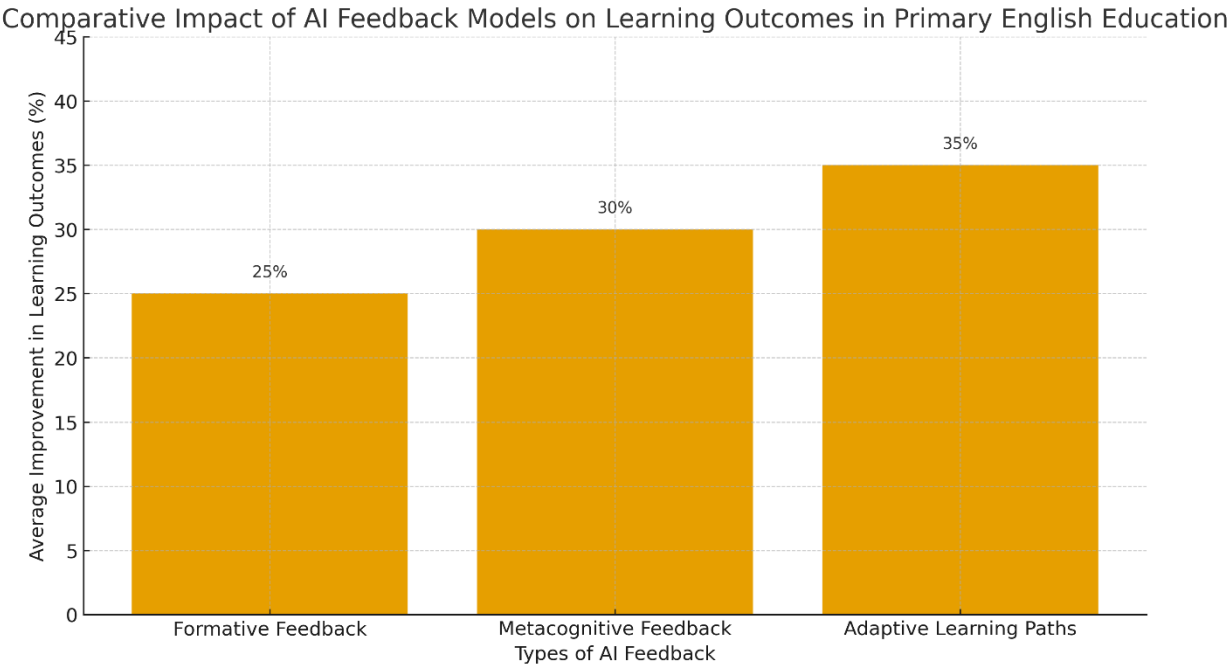
Motivational and affective dimensions also play a crucial role in cognitive engagement. Hamari and Keronen (2017) showed through a meta-analysis that learners derive sustained motivation from feedback mechanisms that incorporate elements of gameful design, such as progress tracking, challenges, and rewards. Plass, Homer, and Kinzer (2015) similarly emphasized that game-based learning environments foster cognitive flexibility by presenting learners with incrementally complex challenges that build both skill and confidence. AI systems extend these benefits by detecting disengagement patterns—such as slower response times or repeated errors—and adjusting instructional strategies accordingly.

Yenuri (2023) further observed that AI-powered language tools adapt instruction in real time by accounting for working memory capacity and cognitive load, ensuring that learners are not overwhelmed while still

being appropriately challenged. For primary learners, whose cognitive abilities are still developing, these adjustments are particularly valuable: they not only support immediate skill acquisition but also nurture long-term metacognitive awareness and self-regulated learning capacities.

By drawing on cognitive and neuropsychological principles, AI-powered feedback thus provides a deeper layer of personalization that aligns with both the mental capacities and the emotional states of learners, ensuring holistic development in primary English education.

4.4 Graph 2: AI Feedback Models and Learning Outcomes



5. Integrating Adaptive Gamification and AI in Primary Schools

5.1 Classroom Applications and Case Studies

The integration of adaptive gamification and artificial intelligence (AI) into primary English education represents a significant paradigm shift in how children acquire foundational language skills. Traditional instructional methods, while effective in certain contexts, often fail to sustain young learners' attention and motivation, particularly in repetitive tasks such as vocabulary drills or grammar exercises. Gamification addresses this limitation by embedding game design elements—such as points, badges, leaderboards, levels, challenges, and narratives—into learning environments, transforming what might otherwise be monotonous tasks into engaging and rewarding experiences (Deterding et al., 2011; Domínguez et al., 2013).

When combined with AI, gamified systems can become adaptive, meaning that the difficulty level, type of task, and feedback are continuously modified in real time according to each learner's needs. AI-driven adaptive gamification systems do not apply a uniform set of challenges to all learners; instead, they personalize the experience by monitoring individual progress, identifying weaknesses, and tailoring interventions accordingly (Desmarais & Baker, 2012; VanLehn, 2011). This ensures that learners remain within the optimal "zone of proximal development," where tasks are neither too easy to induce boredom nor too difficult to cause frustration.

Empirical case studies highlight the promise of such integrations. For instance, Chen, Liu, and Huang (2019) examined a mobile game-based English vocabulary learning application in Taiwan and found that gamification significantly improved both learners' performance and their perceptions of English learning. Learners were more enthusiastic about engaging with content and demonstrated higher retention rates compared to those using non-gamified materials. Similarly, Hamari, Koivisto, and Sarsa (2014), in their meta-analysis of gamification, concluded that effectiveness is context-specific but tends to be particularly impactful in primary education settings, where learners are highly responsive to interactive and reward-based systems.

AI further strengthens this effect by offering real-time performance tracking and adaptive scaffolding. Rizvi (2023) observed that AI tutoring systems in primary education dynamically adapt instructional content to student errors, thereby offering corrective feedback and reinforcement precisely when needed. By doing so, AI minimizes disengagement and enhances self-confidence. This adaptive cycle has been shown to sustain motivation longer than static gamified activities, making it particularly effective in primary classrooms where learner attention spans are short.

5.2 EFL/ESL-Specific Outcomes

The effectiveness of adaptive gamification and AI-powered feedback is particularly visible in English as a Foreign Language (EFL) and English as a Second Language (ESL) classrooms. Learners in these contexts often face heightened challenges such as vocabulary overload, limited exposure to English outside the classroom, and anxiety in oral communication. Gamified environments address these challenges by transforming practice into playful experiences, while AI ensures that content delivery is tailored to individual needs.

Studies consistently report positive outcomes for EFL/ESL learners. Hwang, Sung, Hung, Huang, and Tsai (2012) developed a personalized educational computer game based on students' learning styles and found that EFL learners who engaged with personalized gamified tasks demonstrated significantly greater motivation, deeper learning, and improved vocabulary retention compared to peers exposed to generic exercises. Systematic reviews reinforce this evidence. Dehghanzadeh et al. (2021) revealed that gamification supports long-term engagement in second language learning by enhancing the appeal of repetitive drills, while Luo (2023) concluded that gamified tools outperform traditional approaches in vocabulary acquisition and learner satisfaction.

AI-powered personalization in EFL/ESL contexts further extends these benefits. Muthmainnah et al. (2024) found that AI-driven feedback systems improved learners' self-regulated learning skills, enabling them to set goals, monitor progress, and adapt study strategies effectively. Similarly, Yenuri (2023) argued that AI-powered language learning offers individualized pathways that address diverse linguistic and cultural needs in multilingual classrooms, reducing the risk of learner isolation. The integration of AI-driven analytics with gamified activities thus ensures not only academic gains but also enhanced learner confidence, reduced anxiety, and stronger communication skills.

5.3 Personalized Learning and Learner Modeling

Perhaps the most transformative aspect of adaptive gamification is the development of learner models, which are central to AI-powered personalization. Learner modeling involves the creation of dynamic profiles that track each student's knowledge, misconceptions, motivation, and behavioral patterns over time (Aleven, McLaren, Roll, & Koedinger, 2006; Desmarais & Baker, 2012). By continuously updating these models, AI systems can make precise instructional decisions, such as when to present new material, when to review old content, and when to provide motivational reinforcement.

Personalized feedback is critical in this process. Studies by Shute (2008) and Hattie and Timperley (2007) emphasize the role of timely, specific feedback in improving learning outcomes. Roll, Aleven, McLaren, and Koedinger (2011) extend this by demonstrating that metacognitive feedback, which encourages learners to reflect on their problem-solving and help-seeking strategies, significantly enhances autonomy and persistence. Within gamified environments, this feedback can take the form of hints, encouragement, or adaptive challenges that stimulate learners to engage with tasks at a deeper level.

The integration of AI ensures that these personalized feedback mechanisms align with learners' motivational drivers. Hamari and Keronen (2017) note that players engage most deeply when game elements satisfy needs for competence, autonomy, and relatedness. AI-powered gamified systems can align mechanics with these needs by offering competitive challenges for learners motivated by peer comparison, mastery-based progress bars for self-directed learners, and narrative-driven storytelling for students who thrive on contextual immersion (Plass, Homer, & Kinzer, 2015; Liu, 2024). The outcome is a learning experience that is adaptive, personalized, and intrinsically motivating, addressing both cognitive and emotional dimensions of primary English education.

5.4 Comparative Analysis: Gamified vs. Non-Gamified EFL Approaches

The following table synthesizes key dimensions of EFL instruction when comparing traditional non-gamified approaches with gamified systems enhanced by AI personalization.

Table 2. Comparison of Gamified and Non-Gamified EFL Approaches in Primary Schools

Dimension	**Gamified + AI-Powered EFL Approach**	**Non-Gamified Traditional EFL Approach**	**Supporting Studies**
Engagement	Sustained engagement through rewards, storytelling, adaptive challenges, and dynamic adjustments.	Engagement often declines in repetitive drills and teacher-led lectures.	Chen et al. (2019); Hamari et al. (2014); Dehghanzadeh et al. (2021)
Personalization	Adaptive pathways tailored to learner profiles using AI-driven learner modeling.	Uniform instruction with limited accommodation of individual differences.	Rizvi (2023); Liu (2024); Aleven et al. (2006)
Feedback Quality	Real-time, individualized formative and metacognitive feedback enhancing self-regulation.	Generalized or delayed teacher feedback; limited scaffolding.	Shute (2008); Hattie & Timperley (2007); Roll et al. (2011)
Learning Outcomes	Higher vocabulary retention, grammar mastery, and self-regulated learning skills.	Incremental progress; outcomes depend heavily on student motivation.	Hwang et al. (2012); Luo (2023); Muthmainnah et al. (2024)
Motivation & Confidence	Builds self-efficacy by aligning game mechanics with learners' intrinsic motivations.	Learner anxiety and demotivation common, especially in multicultural groups.	Hamari & Keronen (2017); Yenuri (2023)
Scalability	AI enables individualized instruction at scale in large classrooms.	Teacher-centered approaches struggle to personalize for large groups.	VanLehn (2011); Halkiopoulos & Gkintoni (2024)

6. Empirical Evidence and Case Studies

6.1 Comparative studies of gamified vs. traditional approaches

Across primary and K–12 settings, comparative studies consistently show that gamified or game-based instruction outperforms traditional practice on behavioral engagement and, under sound instructional alignment, on learning outcomes as well (Hamari, Koivisto, & Sarsa, 2014; Sailer & Homner, 2020). In English and EFL contexts, systematic reviews report advantages for participation, vocabulary learning, and attitudes toward learning, while emphasizing variability in effect sizes due to differences in game mechanics, duration, and assessment fidelity (Dehghanzadeh, Fardanesh, Hatami, Talaee, & Noroozi, 2021; Luo, 2023).

A representative classroom case is mobile, game-based vocabulary learning with primary/EFL students: relative to workbook or drill-based practice, learners using a gamified app achieved higher vocabulary gains and reported more positive perceptions of learning (Chen, Liu, & Huang, 2019). Beyond simple points/badges, personalization amplifies effects: a personalized educational game that adapted tasks to learner characteristics (learning styles/prior knowledge) produced higher achievement and superior learning efficiency than conventional instruction (Hwang, Sung, Hung, Huang, & Tsai, 2012).

In broader course contexts, adding leaderboards, points, and quests increased task completion and engagement, though effects on summative exam scores were mixed, especially when mechanics rewarded activity volume rather than mastery (Domínguez et al., 2013). These mixed summative outcomes mirror meta-analytic conclusions: gamification yields small-to-moderate positive impacts on learning and motivation when mechanics are instructionally meaningful and feedback is informative rather than merely immediate (Sailer & Homner, 2020; Plass, Homer, & Kinzer, 2015).

Notably, why learners engage matters. The meta-analysis on game motivation shows that competence, relatedness, and autonomy are reliable drivers; mechanics that speak to these needs (e.g., clear progress paths, optional challenges, collaborative quests) sustain participation better than extrinsic rewards alone (Hamari & Keronen, 2017). Design frameworks that translate game elements into gamefulness—clear goals, feedback loops, voluntary participation—provide a vocabulary for aligning mechanics to reading, phonics, and vocabulary tasks in primary English (Deterding, Dixon, Khaled, & Nacke, 2011; Hwang & Wu, 2012).

Interim implication. In primary English, the most consistent gains appear when (a) mechanics map directly onto language targets (phonics milestones, vocabulary families, grammar patterns) and (b) feedback is diagnostic—telling learners what to fix and how—rather than purely correctness-based (Plass et al., 2015; Shute, 2008).

6.2 Impact on engagement, vocabulary retention, and motivation

Engagement. Reviews and meta-analyses converge on higher behavioral engagement (on-task time, persistence, voluntary practice) under gamified conditions when goals are specific, progress is visible, and mechanics include narrative or social scaffolds (Hamari et al., 2014; Hamari & Keronen, 2017; Sailer & Homner, 2020). In EFL scenarios, time-on-task and participation rates increase relative to traditional drills, especially when challenges escalate adaptively and feedback arrives within the same interaction loop (Dehghanzadeh et al., 2021; Chen et al., 2019).

Vocabulary retention. Game-based systems embed spaced retrieval, repeated exposure, and immediate task-level feedback—conditions that support both short-term gains and delayed retention over worksheets or non-interactive practice (Chen et al., 2019; Hwang & Wu, 2012). When the experience is personalized—e.g., through learner modeling that adjusts item difficulty and review intervals—retention advantages strengthen by keeping learners within an optimal challenge band (Desmarais & Baker, 2012; Hwang et al., 2012).

Motivation. Gamification enhances intrinsic interest, perceived competence, and self-efficacy, particularly when mechanics allow learner choice (autonomy), communicate progress (competence), and enable collaboration or story immersion (relatedness) (Plass et al., 2015; Hamari & Keronen, 2017; Sailer & Homner, 2020). For young learners, story-driven quests and role-play are especially potent, provided they reinforce vocabulary and reading objectives rather than distract from them (Plass et al., 2015; Hwang & Wu, 2012).

Interim implication. For primary English, pair retrieval practice (e.g., phonics/vocabulary flash challenges) with adaptive scheduling and goal-referenced hints to maximize both engagement and durable learning (Shute, 2008; Hattie & Timperley, 2007; Desmarais & Baker, 2012).

6.3 Emerging research on AI gamification

The next wave blends adaptive gamification with AI-powered feedback. Decades of evidence on intelligent tutoring systems (ITS) show that model-driven adaptation—estimating mastery, deciding what to do next, and how to respond—can approach the effectiveness of human tutoring and outperform non-adaptive baselines (VanLehn, 2011; Desmarais & Baker, 2012). In English learning, AI tools personalize exercises (e.g., selecting vocabulary in a learner's lexical zone) and provide instant formative feedback on pronunciation, vocabulary use, and writing (Jegede, 2024; Yenuri, 2023; Rizvi, 2023).

Feedback quality is decisive. High-impact feedback answers three questions—Where am I going? How am I going? Where to next?—and emphasizes task-level guidance over grades (Hattie & Timperley, 2007; Shute, 2008). Within ITS, metacognitive feedback that coaches help-seeking (e.g., when to request a hint and how to use it) yields improved correctness and more efficient learning trajectories compared with correctness-only messages (Aleven, McLaren, Roll, & Koedinger, 2006; Roll, Aleven, McLaren, & Koedinger, 2011).

Recent EFL studies explore adaptive learning paths, AI conversational agents, and story-based progression. Early evidence suggests improved learning outcomes and motivation dynamics relative to static gamified flows, with noticeable motivational "surges" at narrative milestones and steadier engagement when

difficulty is continuously tuned (Liu, 2024). From a cognitive neuropsychology perspective, AI-based assessment can personalize pacing and reduce cognitive load by matching task complexity to working-memory limits—promising for primary learners when tasks are concrete and age-appropriate (Halkiopoulos & Gkintoni, 2024). Classroom reports also indicate growth in self-regulated learning (planning, monitoring, reflection) when AI systems make goals and progress explicit and provide reflective prompts alongside correctness (Muthmainnah, Cardoso, Alsbbagh, Al Yakin, & Apriani, 2024). Practitioner-oriented analyses describe how AI-powered gamification and interactive tools can be deployed to deepen engagement and differentiate instruction in real schools (Banik & Gullapelly, 2025).

Interim implication. Best results arise when AI handles three layers simultaneously: (1) next-task selection based on mastery estimates, (2) feedback selection (explanatory, strategy, or metacognitive), and (3) mechanic tuning (e.g., adaptive points/quests) that keeps challenge calibrated (VanLehn, 2011; Desmarais & Baker, 2012; Shute, 2008; Roll et al., 2011).

6.4 Threats to validity and boundary conditions

1. Short study durations. Many interventions last weeks rather than semesters; novelty effects can inflate early engagement (Hamari et al., 2014; Sailer & Homner, 2020).
2. Assessment alignment. Gains are strongest on near-transfer tasks aligned with practiced items (e.g., taught vocabulary) and may attenuate on far-transfer reading comprehension unless design explicitly targets those skills (Plass et al., 2015; Domínguez et al., 2013).
3. Over-gamification. Mechanics that reward clicks rather than mastery can raise participation but leave summative understanding unchanged (Domínguez et al., 2013; Sailer & Homner, 2020).
4. Equity and ethics. AI feedback relies on learner data; privacy, transparency, and bias mitigation are essential, particularly with young learners (Jegede, 2024; Halkiopoulos & Gkintoni, 2024).

Design guardrails. Map mechanics to curriculum targets, use mastery-based progression, and combine task-specific and metacognitive feedback to avoid hollow engagement (Hattie & Timperley, 2007; Shute, 2008; Aleven et al., 2006; Roll et al., 2011).

6.5 Practice patterns distilled from the evidence

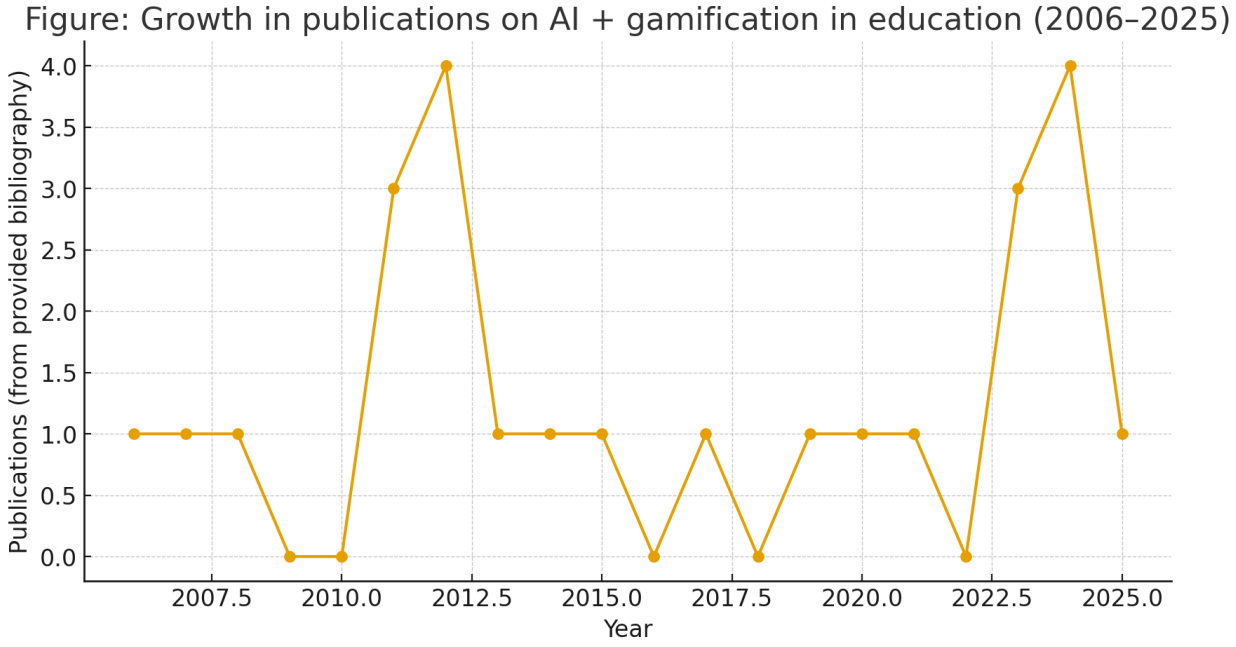
- Mechanic ↔ outcome mapping. Points/levels should certify phonics mastery, sight-word fluency, or grammar patterns, not mere activity counts (Plass et al., 2015; Sailer & Homner, 2020; Deterding et al., 2011).
- Adaptive item scheduling. Use learner models to keep tasks at desirable difficulty, boosting retention and reducing frustration (Desmarais & Baker, 2012; Hwang et al., 2012).
- Feedback that teaches. Blend task feedback (what/why), process feedback (how to improve), and metacognitive prompts (how to plan/seek help) (Hattie & Timperley, 2007; Shute, 2008; Aleven et al., 2006; Roll et al., 2011).
- Motivation by design, not prizes. Support competence (clear progress), autonomy (choices), and relatedness (collaborative/story modes) to sustain interest (Hamari & Keronen, 2017; Hwang & Wu, 2012).
- Primary-friendly narratives. Narrative framing and conversational agents can scaffold attention and persistence if texts and tasks are age-appropriate (Hwang & Wu, 2012; Liu, 2024; Yenuri, 2023).

6.6 Mini-evidence map (selected studies & reviews): Table 3

Study	Design focus	Comparator	Primary outcomes	Headline result
Chen, Liu, & Huang (2019)	Mobile game-based vocabulary (EFL)	Traditional practice	Vocabulary, perceptions	Higher vocabulary gains & positive attitudes
Hwang et al. (2012)	Personalized educational game	Conventional approach	Achievement, efficiency	Personalization > conventional
Domínguez et al.	Gamified coursework	Non-gamified	Engagement,	Higher

(2013)			performance	engagement; mixed exam effects
Sailer & Homner (2020)	Meta-analysis	Gamified vs. non-gamified	Learning, motivation	Small–moderate positive effects; context matters
Dehghanzadeh et al. (2021)	Systematic review (ESL/EFL)	Gamified vs. traditional	Language outcomes, engagement	Generally positive; heterogeneous designs
VanLehn (2011)	Effectiveness of ITS	Human/other tutoring	Learning effectiveness	ITS effective; human tutoring often strongest
Aleven et al. (2006); Roll et al. (2011)	Metacognitive feedback in ITS	Standard feedback	Help-seeking, correctness	Better help-seeking & performance
Liu (2024)	AI gamification (adaptive/agents/story)	Baseline flows	Outcomes, motivation dynamics	Gains with adaptive story/paths

Graph 3: Growth in publications on AI + gamification in education (2006–2025)



7. Challenges and Limitations

7.1 Ethical considerations of AI feedback (data privacy, bias)

Data privacy for minors. AI-driven feedback relies on continuous collection of interaction logs, response latencies, voice/text samples, and sometimes affective or behavioral traces to update learner models and generate next-step guidance. In primary settings, these data are children's educational records and must be minimized, protected, and purpose-bound. Learner modeling research shows how fine-grained traces enable powerful inferences about skill mastery and misconceptions—precisely the kind of sensitive profiling that warrants strict governance, de-identification, and clear data retention rules (Desmarais & Baker, 2012). Because formative feedback cycles can be frequent and pervasive, schools need transparent consent processes, audit trails, and simple explanations of what is stored, for how long, and with whom it is shared (Shute, 2008; Hattie & Timperley, 2007). In EFL contexts, where platforms may capture speech to assess pronunciation, the privacy stakes extend to biometric-like voice data, heightening the requirement for

encryption, access control, and local/on-device processing where feasible (Chen, Liu, & Huang, 2019; Jegede, 2024).

Algorithmic bias and fairness. Adaptive systems that grade writing, evaluate pronunciation, or prioritize next tasks can encode biases if their models were trained on linguistically or culturally narrow datasets. Younger learners with diverse dialects or emergent literacy may be penalized by accent-sensitive ASR or by rubrics tuned to older students. Reviews of intelligent tutoring systems (ITS) and learner modeling caution that performance varies by domain, population, and context, underscoring the risk of uneven benefit or harm (VanLehn, 2011; Desmarais & Baker, 2012). Evidence from gamification and EFL meta-studies further shows heterogeneous effects—some subgroups benefit more than others—suggesting that unexamined personalization choices can widen gaps (Sailer & Homner, 2020; Dehghanzadeh et al., 2021; Luo, 2023). Recent AI-gamification work likewise notes that path adaptation and conversational agents can differentially motivate learners depending on prior proficiency and identity cues, which should be explicitly monitored in fairness audits (Liu, 2024).

Opacity and explainability. If a system flags a child as "struggling with phonics" or with "auxiliary verb usage," teachers and caregivers need student-friendly explanations tied to concrete evidence (items, utterances, or writing samples) and actionable next steps. Cognitive and neuropsychological perspectives emphasize that feedback is most effective when timely, specific, and understandable—requirements that also advance algorithmic transparency (Halkiopoulos & Gkintoni, 2024; Shute, 2008; Hattie & Timperley, 2007). ELL-focused overviews similarly argue for interpretable analytics that teachers can validate against classroom observations (Yenuri, 2023; Jegede, 2024).

Over-automation and learned helplessness. While adaptive hints can scaffold learning, excessive on-demand help or auto-correction risks discouraging productive struggle and metacognitive regulation. Classic work with Cognitive Tutor environments shows that unregulated help-seeking can undermine learning unless students are coached to request and process help strategically (Aleven, McLaren, Roll, & Koedinger, 2006; Roll, Aleven, McLaren, & Koedinger, 2011). ITS studies suggest that human tutors still outperform automated systems in some facets of diagnosis and motivation, reminding designers to retain teacher oversight and to calibrate AI scaffolds (VanLehn, 2011).

Safeguards. Practical guardrails include: data minimization and differential access by role; model cards and fairness dashboards disaggregated by proficiency, gender, and language background; periodic bias and drift testing; human-in-the-loop override for consequential decisions; and student-readable rationales attached to major feedback actions (Shute, 2008; Desmarais & Baker, 2012; Muthmainnah et al., 2024; Banik & Gullapelly, 2025).

7.2 Over-gamification risks and learner fatigue

Crowding out intrinsic motivation. Points, badges, and leaderboards (PBL) can energize practice, but if they dominate the experience, students may chase rewards rather than mastery of vocabulary, phonics, or sentence construction. Foundational work distinguishes "game design elements" from "gamefulness," warning that superficial PBL can misalign incentives with learning (Deterding, Dixon, Khaled, & Nacke, 2011). Meta-analytic evidence shows positive but context-dependent effects of gamification and games on motivation and achievement, with design quality and alignment to learning goals as key moderators (Hamari, Koivisto, & Sarsa, 2014; Sailer & Homner, 2020; Hamari & Keronen, 2017; Plass, Homer, & Kinzer, 2015).

Cognitive overload and distraction. For beginning readers and EFL learners, elaborate audiovisual effects, dense HUDs, or simultaneous quests can exceed working memory and split attention away from target language forms. Reviews of digital game-based learning emphasize pacing, scaffolding, and the instructional role of mechanics to avoid overload (Hwang & Wu, 2012; Plass et al., 2015). Primary-appropriate personalization (e.g., adapting challenge and representation to learning styles) helps, but still requires careful balancing of novelty and clarity (Hwang, Sung, Hung, Huang, & Tsai, 2012). Mobile vocabulary apps can be effective, yet their micro-rewards and push cycles should be tuned to avoid notification fatigue and fragmentary practice (Chen et al., 2019).

Novelty effects and diminishing returns. Gamified interventions often show initial spikes in engagement that wane as novelty fades—especially when task mechanics are repetitive or rewards are predictable. Empirical and review studies report such tapering and recommend varied mechanics, meaningful narratives,

and progression systems linked to learning milestones rather than mere usage (Domínguez et al., 2013; Hamari et al., 2014; Luo, 2023; Dehghanzadeh et al., 2021).

Equity and access within gamified systems. Younger learners differ in gaming familiarity, self-regulation, and socio-emotional responses to competition. Leaderboards may demotivate struggling readers or multilingual newcomers, while cooperative quests or personal bests can support competence without social comparison (Plass et al., 2015; Sailer & Homner, 2020). Personalized pacing and multiple representation modes (text, audio, visuals) are especially important in EFL primary classrooms (Hwang et al., 2012; Luo, 2023).

Mitigations. Favor "meaningful gamification" that ties mechanics to the underlying language constructs—e.g., earning progress by successfully applying target vocabulary in context, or unlocking story paths through accurate syntactic choices—rather than generalized points for time-on-task (Plass et al., 2015; Sailer & Homner, 2020). Use short, varied cycles; emphasize self-referenced mastery; mix cooperative with individual goals; and allow teacher-controlled difficulty ramps to maintain challenge without overload (Hamari & Keronen, 2017; Hwang & Wu, 2012).

7.3 Implementation challenges in primary schools

Infrastructure and access. Adaptive gamification and AI feedback presume reliable devices, connectivity, audio capture for speaking tasks, and classroom displays. Case studies of mobile and game-based English tools show benefits but also practical constraints around device ratios, bandwidth, and classroom logistics (Chen et al., 2019; Hwang & Wu, 2012). Sustainability concerns—licenses, content updates, and technical support—are common barriers cited in implementations of AI-enhanced learning tools (Banik & Gullapelly, 2025; Yenuri, 2023).

Teacher capacity and professional development. The pedagogical power of feedback depends on teachers' ability to interpret dashboards, diagnose misconceptions, and orchestrate just-in-time mini-lessons. Foundational feedback research highlights the importance of task-, process-, and self-regulation-level feedback and warns against generic praise or purely corrective messages (Hattie & Timperley, 2007; Shute, 2008). Teachers need training in metacognitive coaching, so AI hints complement—rather than replace—students' strategic help-seeking (Aleven et al., 2006; Roll et al., 2011). Practical guides and overviews on AI for English learning emphasize PD that blends data literacy, ethical use, and classroom routines for integrating system feedback into whole-class and small-group instruction (Jegede, 2024; Rizvi, 2023).

Curriculum alignment and assessment. Systems must map their skills, quests, and mastery estimates to local standards and scope-and-sequence for primary English (phonological awareness, high-frequency vocabulary, sentence grammar, reading fluency). Misalignment creates friction (e.g., high scores in the app but weak performance on term assessments). Research on game-based learning and learner modeling stresses constructive alignment—mechanics and adaptivity should instantiate target cognitive processes, not just track engagement (Plass et al., 2015; Desmarais & Baker, 2012; Sailer & Homner, 2020).

Classroom management and wellbeing. Screen time boundaries, movement breaks, and norms for collaborative play are essential in primary grades. Competitive mechanics can trigger off-task behavior or anxiety; cooperative mechanics and teacher-mediated reflection can counter these effects (Hamari & Keronen, 2017; Hwang & Wu, 2012). Designers should include "calm" modes, audio-off options, and printable or unplugged extensions so every lesson does not require screens (Domínguez et al., 2013).

Localization, inclusivity, and language validity. EFL pronunciation scoring and NLP-based writing feedback must be validated on local accents, name entities, and curricular vocabulary to avoid false negatives and demotivation. Studies in EFL gamification and AI-supported learning indicate the need for culturally resonant narratives, multilingual UI, and teacher-editable content libraries (Liu, 2024; Luo, 2023; Chen et al., 2019). Personalization by learning style or preference can help, but should be used cautiously and pragmatically to adjust representations and pacing rather than to "track" learners (Hwang et al., 2012).

Evidence and transfer. Although many studies report positive learning and engagement effects, meta-analyses note variability in effect sizes and call for more rigorous, longitudinal designs in authentic classrooms (Hamari et al., 2014; Sailer & Homner, 2020; Hwang & Wu, 2012). AI-enhanced gamification in particular is an emerging area; early results are promising but require replication across diverse primary populations and curricular strands (Liu, 2024; Banik & Gullapelly, 2025; Muthmainnah et al., 2024; Yenuri, 2023).

8. Conclusion and Recommendations

8.1 Synthesis of findings

Across the reviewed literature, a clear pattern emerges: adaptive gamification and AI-powered feedback are mutually reinforcing mechanisms that can measurably enhance learning processes and outcomes in primary English education—especially for EFL/ESL learners—when they are tightly aligned with instructional goals and learner needs. Gamification provides the motivational and attentional scaffolds (e.g., meaningful goals, progress visibility, narrative, autonomy) that sustain engagement in foundational language tasks, while AI systems individualize pacing, content selection, and feedback timing/format based on evolving learner models (Deterding et al., 2011; Desmarais & Baker, 2012; Plass et al., 2015; Sailer & Homner, 2020).

Evidence from game-based and gamified language learning shows positive effects on vocabulary acquisition, retention, and classroom participation, though the size and consistency of effects depend on the quality of design rather than the mere presence of points or badges (Chen et al., 2019; Domínguez et al., 2013; Hwang & Wu, 2012; Dehghanzadeh et al., 2021; Luo, 2023). Meta-reviews suggest benefits are small-to-moderate on average and vary across contexts and mechanics, reinforcing the need for careful alignment and iterative evaluation (Hamari et al., 2014; Sailer & Homner, 2020; Hamari & Keronen, 2017).

On the feedback side, formative and metacognitive feedback principles—clear goals, immediate and specific information, guidance on next steps, and support for help-seeking—are repeatedly associated with improved learning and self-regulation (Hattie & Timperley, 2007; Shute, 2008; Aleven et al., 2006; Roll et al., 2011). Contemporary AI tutors and analytics dashboards operationalize these principles at scale by modeling skill mastery and recommending targeted practice or explanations (VanLehn, 2011; Desmarais & Baker, 2012; Rizvi, 2023; Jegede, 2024). Recent work further integrates cognitive-neuropsychological insights to personalize challenge and feedback intensity for diverse learners, including struggling readers, while foregrounding issues of fairness and data protection (Halkiopoulos & Gkintoni, 2024).

Critically, integration—rather than parallel adoption—seems key: using AI to select tasks and tailor feedback while embedding those tasks in gameful structures that reward mastery, encourage productive persistence, and nudge effective help-seeking (Aleven et al., 2006; Roll et al., 2011; Plass et al., 2015). Studies of personalized educational games and adaptive learning paths suggest that blending these strands supports both short-term performance and longer-term motivation when designs respect developmental needs in primary grades (Hwang et al., 2012; Liu, 2024; Yenuri, 2023; Muthmainnah et al., 2024; Banik & Gullapelly, 2025). At the same time, the literature highlights risks of over-gamification, inequitable access, and opaque algorithmic decisions, underscoring the importance of teacher orchestration, ethical safeguards, and context-sensitive implementation (Hamari et al., 2014; Halkiopoulos & Gkintoni, 2024).

8.2 Practical implications for teachers and policymakers

For teachers and school leaders

- Align mechanics with learning targets. Choose game elements that map to English objectives (e.g., narrative quests for reading comprehension; mastery-based XP for phonics; cooperative challenges for speaking) rather than generic point chasing (Deterding et al., 2011; Plass et al., 2015; Sailer & Homner, 2020).
- Use feedback that teaches, not just tells. Implement “feed up, feedback, feed forward” cycles with concise, task-specific cues and examples; pair correctness with strategy hints and next steps (Hattie & Timperley, 2007; Shute, 2008).
- Coach help-seeking and self-regulation. Embed prompts and hints that foster appropriate help requests and reflection (e.g., “Explain why you chose this answer”; “Try a worked example first”) (Aleven et al., 2006; Roll et al., 2011).
- Leverage learner modeling, but intervene as a human. Use dashboards to monitor mastery estimates and learning bottlenecks; schedule short, targeted mini-lessons for students flagged by the system (Desmarais & Baker, 2012; VanLehn, 2011).
- Start small and iterate. Pilot one unit (e.g., vocabulary) with adaptive gamification; review engagement and learning data weekly; refine mechanics and feedback rules before scaling (Hamari et al., 2014; Sailer & Homner, 2020).
- Design for developmental fit. Keep sessions short, goals proximal, and rewards informational rather than controlling to preserve intrinsic motivation (Hamari & Keronen, 2017; Plass et al., 2015).

- Prioritize EFL-friendly supports. Incorporate multimodal glosses, spaced review, and context-rich tasks; mobile-first activities can extend practice beyond class where appropriate (Chen et al., 2019; Hwang & Wu, 2012; Yenuri, 2023).
- Plan for equity and low-resource contexts. Offer offline/low-bandwidth modes, device-sharing protocols, and paper-based equivalents; blend AI-guided practice with teacher-led group work (Muthmainnah et al., 2024; Dehghanzadeh et al., 2021; Luo, 2023).
- Build teacher capacity. Provide PD in formative assessment, data literacy, and classroom orchestration with AI/games; share lesson exemplars and troubleshooting playbooks (Jegede, 2024; Banik & Gullapelly, 2025).
- Embed ethics by design. Use data minimization, parental consent, role-based access, and periodic bias checks; communicate to families how data inform personalization (Halkiopoulos & Gkintoni, 2024).

For policymakers and system leaders

- Establish adoption standards. Require alignment to curriculum standards, demonstrable learning gains, accessibility compliance, and interoperability with existing SIS/LMS tools (Hamari et al., 2014; Sailer & Homner, 2020).
- Fund equitable infrastructure. Ensure reliable devices/connectivity, classroom audio for oral language tasks, and technical support, with priority for underserved schools (Muthmainnah et al., 2024; Yenuri, 2023).
- Support rigorous piloting. Encourage staged rollouts with pre-registered evaluation plans; combine log-data analytics with classroom observation and teacher/student voice (Hamari et al., 2014; Plass et al., 2015).
- Codify data governance. Mandate transparent model documentation, human-in-the-loop oversight, privacy impact assessments, and third-party audits for bias and security (Halkiopoulos & Gkintoni, 2024).
- Invest in workforce development. Provide time, coaching, and micro-credentials for teachers on formative feedback, gameful pedagogy, and AI literacy (Jegede, 2024; Banik & Gullapelly, 2025).
- Promote inclusive design and localization. Incentivize content in local English varieties, culturally relevant narratives, and language scaffolds for multilingual learners (Chen et al., 2019; Luo, 2023).
- Plan for sustainability. Negotiate fair pricing, protect against vendor lock-in, and encourage open educational resources and research–practice partnerships (Sailer & Homner, 2020; Yenuri, 2023).

8.3 Future research directions

1. Causal impact and durability. Conduct multi-site randomized or quasi-experimental studies in primary grades that track long-term retention, transfer (reading → writing/speaking), and classroom-level effects (Hamari et al., 2014; Sailer & Homner, 2020).
2. Mechanism tests at the element level. Isolate which mechanics (e.g., narrative, cooperation, mastery-based XP) and which feedback types (e.g., elaborated hints, worked examples, conversational agents) drive learning, and for whom (Plass et al., 2015; Hamari & Keronen, 2017; Liu, 2024).
3. Help-seeking and self-regulation trajectories. Examine how adaptive prompts and metacognitive feedback cultivate productive help-seeking habits over semesters, not just sessions (Aleven et al., 2006; Roll et al., 2011).
4. Learner modeling transparency and fairness. Develop interpretable mastery models and bias-aware adaptation policies; evaluate impacts across gender, language background, and ability levels (Desmarais & Baker, 2012; Halkiopoulos & Gkintoni, 2024).
5. Human–AI orchestration. Study workflows where teachers modify AI recommendations in real time, including effects on teacher efficacy and student outcomes (VanLehn, 2011; Jegede, 2024).
6. EFL/ESL and low-resource contexts. Compare adaptive gamification designs across regions and bandwidth/device constraints; explore offline-first architectures and community-based supports (Chen et al., 2019; Dehghanzadeh et al., 2021; Luo, 2023; Muthmainnah et al., 2024).
7. Multimodal assessment. Integrate speech, handwriting, and eye-tracking signals to detect reading fluency, pronunciation, and attention, while safeguarding privacy (Halkiopoulos & Gkintoni, 2024).

8. Motivation quality and learner identity. Move beyond time-on-task to examine autonomy, competence, relatedness, and language-learner identity formation within gameful ecosystems (Hamari & Keronen, 2017; Plass et al., 2015).
9. Design patterns and implementation science. Publish reusable templates for classroom routines (stations, rotations, mini-lessons) and study conditions for successful scale-up in primary schools (Sailer & Homner, 2020; Banik & Gullapelly, 2025).
10. Comparative modalities of AI feedback. Directly compare conversational agents, analytics dashboards, and narrative-embedded hints on accuracy, usability, and learning—especially for early readers (Liu, 2024; Rizvi, 2023; Yenuri, 2023).

References

1. Aleven, V., Mclaren, B., Roll, I., & Koedinger, K. (2006). Toward meta-cognitive tutoring: A model of help seeking with a Cognitive Tutor. International Journal of Artificial Intelligence in Education, 16(2), 101-128.
2. Chen, C. M., Liu, H., & Huang, H. B. (2019). Effects of a mobile game-based English vocabulary learning app on learners' perceptions and learning performance: A case study of Taiwanese EFL learners. ReCALL, 31(2), 170-188.
3. Dehghanzadeh, H., Fardanesh, H., Hatami, J., Talaee, E., & Noroozi, O. (2021). Using gamification to support learning English as a second language: a systematic review. Computer Assisted Language Learning, 34(7), 934-957.
4. Shute, V. J. (2008). Focus on formative feedback. Review of educational research, 78(1), 153-189.
5. Desmarais, M. C., & Baker, R. S. D. (2012). A review of recent advances in learner and skill modeling in intelligent learning environments. User Modeling and User-Adapted Interaction, 22(1), 9-38.
6. Rızvı, M. (2023). Investigating AI-powered tutoring systems that adapt to individual student needs, providing personalized guidance and assessments. The Eurasia Proceedings of Educational and Social Sciences, 31, 67-73.
7. Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).
8. VanLehn, Kurt. "The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems." Educational psychologist 46.4 (2011): 197-221.
9. Domínguez, A., Saenz-de-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. Computers & education, 63, 380-392.
10. Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?--a literature review of empirical studies on gamification. In 2014 47th Hawaii international conference on system sciences (pp. 3025-3034). Ieee.
11. Jegede, O. O. (2024). Artificial intelligence and English language learning: Exploring the roles of AI-driven tools in personalizing learning and providing instant feedback. Universal Library of Languages and Literatures, 1(2).
12. Hwang, G. J., & Wu, P. H. (2012). Advancements and trends in digital game-based learning research: A review of publications in selected journals from 2001 to 2010. British Journal of Educational Technology, 43(1).
13. Hamari, J., & Keronen, L. (2017). Why do people play games? A meta-analysis. International Journal of Information Management, 37(3), 125-141.
14. Hattie, J., & Timperley, H. (2007). The power of feedback. Review of educational research, 77(1), 81-112.
15. Luo, Z. (2023). The effectiveness of gamified tools for foreign language learning (FLL): A systematic review. Behavioral Sciences, 13(4), 331.
16. Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. Educational psychologist, 50(4), 258-283.

17. Hwang, G. J., Sung, H. Y., Hung, C. M., Huang, I., & Tsai, C. C. (2012). Development of a personalized educational computer game based on students' learning styles. Educational Technology Research and Development, 60(4), 623-638.
18. Halkiopoulos, C., & Gkintoni, E. (2024). Leveraging AI in e-learning: Personalized learning and adaptive assessment through cognitive neuropsychology—A systematic analysis. Electronics, 13(18), 3762.
19. Liu, L. (2024). Impact of AI gamification on EFL learning outcomes and nonlinear dynamic motivation: Comparing adaptive learning paths, conversational agents, and storytelling. Education and Information Technologies, 1-40.
20. Roll, I., Aleven, V., McLaren, B. M., & Koedinger, K. R. (2011). Improving students' help-seeking skills using metacognitive feedback in an intelligent tutoring system. Learning and instruction, 21(2), 267-280.
21. Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. Educational psychology review, 32(1), 77-112.
22. Banik, B. G., & Gullapelly, A. (2025). AI-Powered gamification and interactive learning tools for enhancing student engagement. In Driving Quality Education Through AI and Data Science (pp. 283-310). IGI Global Scientific Publishing.
23. Yenuri, A. (2023). AI-Powered Language Learning: A new frontier in personalized education. Journal of Language Instruction and Applied Linguistics, 1(01), 109-116.
24. Muthmainnah, M., Cardoso, L., Alsbbagh, Y. A. M. R., Al Yakin, A., & Apriani, E. (2024, June). Advancing sustainable learning by boosting student self-regulated learning and feedback through AI-driven personalized in EFL education. In International conference on explainable artificial intelligence in the digital sustainability (pp. 36-54). Cham: Springer Nature Switzerland.