

A systematic review of gamified learning motivation for English language among undergraduates

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ABSTRACT

Undergraduate students' motivation for learning English as a foreign language (EFL) is influenced by multiple factors, yet traditional teaching methods often fail to sustain engagement, leading to learning disengagement and sub-optimal outcomes. The increasing integration of gamified learning has shown potential in addressing this challenge, but its effectiveness remains unclear, necessitating a systematic synthesis of existing research. This systematic review employs the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework to examine 313 studies retrieved from Education Resources Information Center (ERIC), Web of Science (WoS), and Scopus, narrowing them down to 36 relevant articles. The review categorizes findings into five key themes: i) teaching techniques and strategies; ii) learning environments and styles; iii) psychological and cultural factors; iv) technological support; and v) individual learner variables. The results highlight the positive impact of game-based learning, personalized instruction, and technology-enhanced approaches to motivation. However, psychological challenges, such as burnout and anxiety, remain significant barriers. The study reveals research gaps, particularly regarding the long-term impact of gamified learning on EFL motivation, underscoring the need for further empirical investigation to optimize gamification strategies in EFL education.

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1. INTRODUCTION

The motivation of undergraduate students in learning English as a foreign language (EFL) plays a pivotal role in their academic success [1]. It influences not only language acquisition but also learners' confidence [2], persistence [2], and overall academic performance [3]. Given the global emphasis on English proficiency as a prerequisite for academic achievement, career advancement, and cross-cultural communication [4], it is essential to understand the underlying factors that drive or hinder student motivation [1], [4]–[12]. However, despite the increasing integration of technology in education [13]–[23], many undergraduate students continue to experience motivational challenges in EFL learning, often leading to disengagement and sub-optimal learning outcomes [3], [24]–[26]. This systematic review was undertaken to address this gap by synthesizing existing knowledge on the role of gamification as a potential pedagogical intervention in enhancing EFL motivation.

The academic interest in learning EFL has grown significantly [27], [28], especially regarding undergraduate students who navigate both linguistic [29], [30] and cultural barriers [4], [29], [31] in achieving proficiency [3], [9], [24], [32]–[35]. Numerous studies have shown that motivation directly influences language acquisition, affecting students' engagement, retention, and ultimate success in EFL contexts [13], [25], [26], [34], [36]. However, traditional instructional methods have sometimes fallen short in sustaining learners' enthusiasm [36], [37], leading to disengagement and lowered outcomes. Consequently, researchers and educators have explored various pedagogical innovations, including gamification, as potential solutions to enhance learner motivation [3], [36], [38].

Gamification, the application of game mechanics to non-game environments, has emerged as an increasingly popular strategy in education to foster student engagement and participation [3], [36]. The theoretical basis for gamification suggests that integrating elements such as points, [36], [38] leaderboards, and rewards can create a competitive yet enjoyable learning environment, fostering intrinsic motivation and sustained engagement. Additionally, technological advancements, particularly mobile applications and virtual reality (VR), have enabled gamification to be more interactive and accessible, thereby enhancing its potential impact on EFL motivation [39]. Despite these promising developments, empirical research on the effectiveness of gamification in EFL remains fragmented. The impact of gamification on learner motivation may vary due to factors such as individual differences [5], [7], [34], [38], [40], cultural backgrounds [4], [15], [31], and specific classroom dynamics [1], [2], [6], [8], [10], [11], [24], [25], [33], [35]–[37]. These inconsistencies highlight the need for a systematic synthesis of existing studies to better understand the extent and conditions under which gamification enhances motivation in EFL learning.

Moreover, the literature underscores the importance of considering psychological and cultural factors that influence EFL learning. Psychological variables such as anxiety [2], [24], [39], [40], burnout [41], and resilience [11] significantly affect learners' motivational levels. In particular, maladaptive emotion regulation strategies have been linked to decreased motivation [41], highlighting the need for holistic approaches in EFL pedagogy that address both affective [2], [12], [39], and cognitive domains [5], [26], [35]. Understanding how gamification intersects with these variables becomes crucial, as it can either alleviate or exacerbate psychological stressors among EFL learners. Thus, the present study aims to address two scientific questions:

- i) To what extent does gamification impact the motivation of undergraduate students learning EFL?
- ii) What are the key psychological, pedagogical, and cultural factors influencing its effectiveness?

These questions are significant because they not only explore the efficacy of gamification but also examine the broader contextual factors that shape student engagement and motivation.

This review offers a comprehensive synthesis of the existing literature on gamified learning within EFL contexts [7], [24], [38], [40], with a specific focus on undergraduate students' motivation. Using a systematic review framework [42], this study synthesizes findings from studies addressing the role of gamification [7], [24], [38], [40], teaching techniques [3], [8], [11], [12], [31], [35], [40], psychological and cultural factors [4], [29], [31], and technological interventions [36], [39] in motivating EFL learners. By identifying trends, themes, and research gaps, this review contributes to the broader discourse on educational innovation in EFL, offering insights into effective strategies and future research directions. The results of the review are particularly relevant to policy makers, curriculum designers, and educators seeking evidence-based approaches to enhance language learning motivation through gamification. This systematic review, therefore, not only maps the current landscape but also sets the stage for future empirical studies aimed at optimizing gamified approaches in EFL education.

2. RESEARCH METHOD

A systematic review was conducted as a pragmatic, structured and rigorous approach to assess the size and scope of the available literature on gamified learning in EFL and its effects on undergraduate students' learning motivation. This method was selected to ensure a comprehensive and objective synthesis of existing research evidence [43]. The systematic review framework provided a transparent, replicable process for identifying, selecting, and analyzing relevant studies in the field. Systematic reviews have gained prominence in educational research due to their capability to synthesize findings from diverse studies, thereby offering a broader, evidence-based understanding of a research topic [44]. Unlike narrative reviews, which may be selective in their inclusion of studies, systematic reviews follow a clearly defined protocol, ensuring reproducibility, consistency, and reliability in literature synthesis.

This study adopted a systematic review approach to examine the impact of gamified learning on EFL motivation among undergraduate students. To achieve this objective, the study followed a structured process: i) identification phase; ii) screening phase; iii) eligibility phase; and iv) inclusion phase. These steps ensured that the selected literature aligned with the research question and provided meaningful insights into

the role of gamification in enhancing motivation in EFL contexts. The preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework was employed to examine 313 studies peer-reviewed literature from the Education Resources Information Center (ERIC), Web of Science (WoS), and Scopus databases using predefined search criteria, as seen in Figure 1. This study aimed to identify dominant themes, theoretical frameworks, and key findings in the existing body of literature, with a specific focus on how gamification influences EFL motivation at the undergraduate level. Articles were screened based on relevance, quality, and methodological rigor, with a focus on empirical studies published in English between 2019 and 2023. By employing a systematic and methodologically robust approach, this review aimed to offer a comprehensive synthesis of knowledge, highlight research gaps, and propose directions for future empirical investigations.

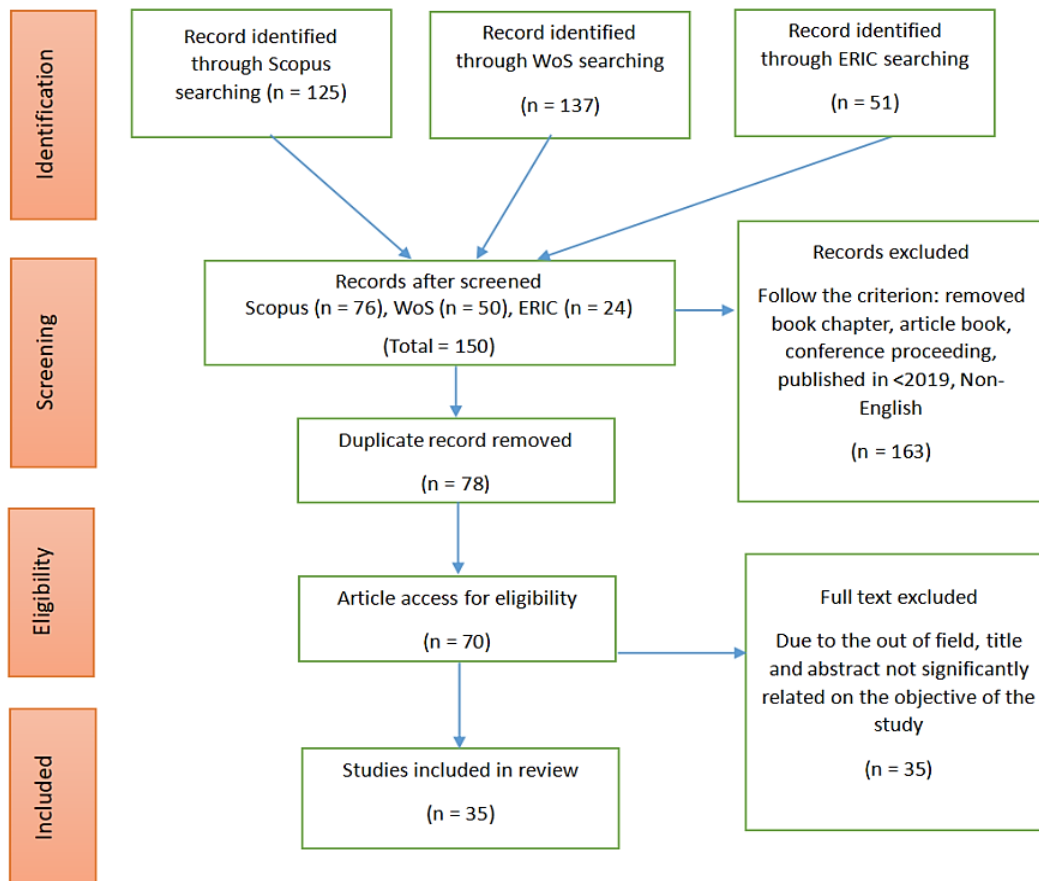


Figure 1. PRISMA framework employed in this review [35]

2.1. Identification

The identification phase involved a systematic extensive literature search in three major academic databases: ERIC, WoS, and Scopus, in order to cover high-impact, peer-reviewed journal articles comprehensively in the field of education and linguistics. To ensure thorough literature retrieval, the search strategy incorporated the primary keywords of “EFL”, “motivation”, and “undergraduate” with the AND Boolean operator, i.e., EFL AND motivation AND undergraduate. The query strings used in ERIC, WoS, and Scopus were shown in Table 1. The search initially retrieved 313 journal articles that met the broad search criteria. The study followed a five-stage process, as recommended by Teng *et al.* [9]: i) defining the research question (as stated in introduction); ii) identifying the total number of potentially relevant studies across selected databases; iii) applying predefined selection criteria to refine the pool of articles; iv) charting the data for collation, summary, and synthesis; and v) analyzing and reporting findings to determine trends, theoretical underpinnings, and research gaps. The final selection process yielded 36 relevant studies for systematic review. This method provided a rigorous, transparent, and replicable approach to map the field of interest and to identify gaps in research related to gamified learning in EFL motivation.

2.2. Screening

The screening was carried out to streamline the collected dataset and to ensure methodological rigor by applying clear inclusion and exclusion criteria. To maintain relevance and credibility, this study focused on empirical research articles that provided primary, peer-reviewed data upon the relevance between gamified learning and EFL motivation in undergraduates contexts, as shown in Table 2. This study excluded all book chapters, commentaries, conference proceedings, meta-syntheses, meta-analyses, opinion pieces, and review articles. In addition, only articles published in English between 2019 and 2023 were considered to ensure timeliness and contemporary relevance. Also, 72 duplicated articles were removed. After applying these criteria, 70 out of the initial 313 articles complied with the criteria for further review and analysis. The selected studies provided the most reliable and relevant empirical insights for addressing the research questions.

2.3. Eligibility

The eligibility phase involved an in-depth evaluation of the 70 selected articles, as seen in Figure 1. Key data points were extracted, including authors, publication sources, research aim and scope, methodology or research design (quantitative, qualitative or mixed-methods), key results or findings, and conclusions. A systematic comparison of research methodologies revealed that quantitative studies [1], [8], [11], [12], [45] often measured the impact of gamification using experimental or survey-based methods; while qualitative studies [6], [7], [10], [25], [39] explored learner experiences, perceptions, and challenges through interviews and case studies, and mixed methods studies [9], [24], [29], [35], [46] provided comprehensive insights by combining both statistical analysis and qualitative data. By juxtaposing research methodologies and findings, this review identified thematic patterns and research gaps, particularly regarding the psychological, cultural, and technological factors influencing the effectiveness of gamification in EFL learning motivation.

Table 1. The query strings

Academic databases	Query strings
Scopus	TITLE-ABS-KEY (EFL AND undergraduate AND motivation) AND (LIMIT-TO (PUBSTAGE , “final”) OR LIMIT-TO (PUBSTAGE , “aip”)) AND (LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019)) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (LANGUAGE , “English”)) AND (LIMIT-TO (SRCTYPE , “j”))
WoS	EFL (All Fields) AND undergraduate (All Fields) AND motivation (All Fields) AND English (Language) AND 2019-2023 (Year Published) and Article (Document Types)
ERIC	https://eric.ed.gov/?q=EFL+undergraduate+motivation&ff1=dtSince_2019&ff2=pubJournal+Articles

Table 2. Article selection criteria

Criterion	Inclusion criteria	Exclusion criteria
Language	English	Non-English
Timeframe	2019-2023	<2019
Type of literature	Research journal articles	Book chapters, commentaries, conference proceedings, meta-syntheses, meta-analyses, opinion pieces, and review articles

3. RESULTS AND DISCUSSION

The findings from this review reveal that undergraduate motivation in EFL contexts is influenced by five key factors: i) teaching techniques [3], [8], [11], [12], [31], [35], [40]; ii) psychological elements [2], [11], [24], [39]–[41], [46]; iii) cultural influences [4], [29], [31]; iv) technological tools [31], [39]; and v) individual learner characteristics [5], [7], [24], [38], [40]. A synthesis of 35 high-quality studies suggests that gamified learning, when appropriately designed, enhances student engagement, motivation, and academic performance. However, its effectiveness is influenced by psychological, technological, and socio-cultural factors, requiring adaptive and personalized instructional strategies. The study identified five core themes, as shown in Table 3, which were: i) role of teaching techniques and strategies (9 studies); ii) effects of learning environment and learning styles (6 studies); iii) influence of psychological factors and cultural knowledge (5 studies); iv) technological support in EFL learning (8 studies); and v) individual variables and learner autonomy (7 studies).

Effective teaching strategies tailored to align with students' motivational needs foster greater engagement and language acquisition. Notably, the implementation of gamified methods [3], [36], [38], such as interactive applications and real-world simulation tasks [40], has shown substantial potential in enhancing learning motivation by making language practice both dynamic [7] and enjoyable [26], [36].

Beyond teaching methods, the review reveals the profound role of psychological variables in shaping EFL motivation. Factors like burnout [41], anxiety [2], [24], [39], [40], [46], and resilience [11] emerged as critical influencers of learner engagement and persistence in EFL settings, underscoring the importance of addressing these issues within gamified frameworks [3], [36], [38]. Integrating technological tools, especially mobile learning [28] and VR applications [39], not only addresses motivation challenges but also provides alternative avenues for learners who might struggle with traditional classroom dynamics [25], [37]. However, the effectiveness of these technologies can be mediated by individual learner characteristics, such as self-efficacy and autonomy, suggesting that personalized approaches are essential for maximizing motivation across diverse student populations. A total number of 35 research journal articles were retrieved from three databases, and then sorted into five themes. Since each article may contribute to more than one theme, Table 3 shows the source distribution of these themes: theme 1 (Scopus=3; WoS=5; ERIC=3), theme 2 (Scopus=5; WoS=3; ERIC=1), theme 3 (Scopus=5; WoS=1), theme 4 (Scopus=8; WoS=2; ERIC=2), and theme 5 (Scopus=6; WoS=2).

3.1. Role of teaching techniques and strategies

The findings suggest that interactive and participatory teaching methods significantly enhance EFL motivation. Nine studies demonstrated that game-based learning, collaborative activities, and social annotation platforms positively impacted students' engagement and language acquisition [32]. For instance, using platforms like Kahoot! and Quizizz was shown to increase student participation, foster healthy competition, and promote peer collaboration [36]. A key pedagogical insight from this review is that gamification should align with students' learning preferences. Studies examining the Kolb educator role profile and Kolb learning style inventory indicated that matching teaching strategies to students' cognitive preferences resulted in higher motivation [24]. Such evidence underscores the need for educators to adopt flexible teaching approaches that cater to diverse learner needs [5].

Additionally, authentic communication-based EFL instruction, rather than rigid grammar drills, yields greater student engagement and retention [32]. One notable finding is the role of feedback. Studies reported that immediate feedback in game-based learning—such as through leaderboards, progress tracking, and adaptive challenges—enhanced motivation and reduced frustration [3]. However, over-reliance on competition-based gamification may create anxiety in certain learner groups, necessitating balanced instructional designs [36]. Mobile learning applications, such as WhatsApp [37], provided opportunities for students to practice natural language and motivate them to learn mutually. The use of multiple intelligence teaching activities also bolstered learners' motivation and facilitate classroom management [8].

3.2. Effects of learning environment and learning styles

Learning environment plays an essential role in EFL motivation, with six of the reviewed articles exploring this theme. The six studies found that physical, digital, and hybrid learning environments significantly shape student engagement. For example, EFL learners' motivation was higher in environments that supported collaborative learning through mobile instant messaging platforms like Telegram [39], which facilitated out-of-class learning [2]. Additionally, culturally relevant [4], [29], [31] and socially supportive environments were shown to increase learners' confidence, especially in diverse and multicultural classrooms [4]. Classrooms that encourage active participation and support flexible learning styles lead to improved engagement and academic achievement among students. A match between learning style and teaching style in EFL class affected student proficiency and motivation to learn English [24]. The learning environment also matters, with aspect such as topics of speaking modules and limited time having an effect [2], [24]. Tutors was supported to redesign subject curricula according to learners' expectations and learning needs, exchanging of an exam-oriented evaluation system which raised autonomous learning [35].

3.3. Influence of psychological factors and cultural knowledge

The influence of psychological factors and cultural knowledge on EFL motivation was explored in five of the reviewed studies. Key psychological variables such as anxiety [2], [24], [39], [46], resilience [11], and emotional regulation [9], [26], [41], [46] emerged as critical determinants of motivation. Research indicated that learners with high self-efficacy exhibited stronger motivation, while those who experienced high anxiety or burnout levels reported diminished motivation [41]. Moreover, cultural knowledge was shown to play a significant role in shaping EFL motivation [4], [29], [31]. For instance, learners with strong cultural ties to their native language encountered difficulties in acquiring EFL proficiency, suggesting the need for culturally inclusive teaching strategies. Addressing these psychological and cultural dimensions is essential for fostering a holistic learning experience. Psychological reasons like burnout [41], anxiety [2], [24], [39], [40], [46], [47], and resilience [11] played a meaningful role in EFL learners' performance and motivation. The consciousness of Chinese culture understanding and importance of positively influence action in translation work, which had explanation suggestion for the teaching of culture in EFL classroom.

Table 3. Findings of the research articles sorted into five themes

No	Study	Title	Scopus	WoS	ERIC	Theme
1	[48]	Relationships among students' perceptions of native and non-native EFL teachers' immediacy behaviors and credibility and students' willingness to communicate in class		✓		1
2	[47]	Pronunciation problems encountered by EFL learners: An empirical study		✓	✓	1
3	[29]	Poetry for EFL: Exploring change in undergraduate students' perceptions		✓		1
4	[32]	An experiment on mobile learning to leverage EFL learners' engagement, emotional intelligence, and learning motivation		✓		1
5	[1]	Improving reading comprehension in EFL situation: A correlation analysis	✓			1
6	[25]	Learning experiences and motivation of undergraduate students in Pakistani EFL classrooms: A qualitative study			✓	1
7	[34]	Are there effects of a match between learning style and teaching style in an EFL classroom?	✓		✓	1
8	[45]	Reading habits and attitudes in first-year EFL student teachers and their implications for literature course design in an Austrian study programme		✓		1
9	[9]	A mixed-methods approach to investigating motivational regulation strategies and writing proficiency in English as a foreign language contexts	✓			1
10	[24]	Revisiting the socio-educational model of second language acquisition in Turkish tertiary EFL context	✓	✓		2
11	[27]	Reading interest and achievement motivation: A study in an EFL context	✓	✓		2
12	[6]	Problems faced by Jordanian undergraduate students in speaking English	✓			2
13	[4]	An investigation of Chinese undergraduates' ability to translate Chinese cultural items into English and predictors of such ability	✓	✓		2
14	[11]	English language learning demotivation among Pakistani university students: Do resilience and personality matter?	✓			2
15	[10]	A qualitative inquiry into the factors influencing EFL learners' In-Class Willingness to Communicate in English			✓	2
16	[40]	Real people with real experiences: The emergence of classroom L2 study feelings over interacting timescales	✓			3
17	[35]	Learner motivation in the EFL classrooms: Voices from a Bangladeshi university	✓			3
18	[46]	Predicting EFL learners' achievement from their two faces—FLE and FLCA	✓			3
19	[2]	Effects of affective variables and willingness to communicate on students' English-speaking performance in Thailand	✓			3
20	[41]	Language learning motivation and burnout among English as a foreign language undergraduates: The moderating role of maladaptive emotion regulation strategies	✓	✓		3
21	[33]	Blogging with smartphones for independent writing practice beyond the EFL classroom	✓			4
22	[30]	Gender differences in utilizing a game-based approach within the EFL online classrooms	✓	✓		4
23	[38]	Integrating a game-based app to enhance translation learners' engagement, motivation, and performance	✓			4
24	[37]	Chat and learn: Effectiveness of using WhatsApp as a pedagogical tool to enhance EFL learners' reading and writing skills	✓			4
25	[39]	Effect of SCMC on foreign language anxiety and learning experience: A comparison of voice, video, and VR-based oral interaction	✓		✓	4
26	[36]	Incorporation of a game-based approach into the EFL online classrooms: students' perceptions	✓	✓		4
27	[3]	Game-based learning in higher education: The pedagogical effect of genially games in English as a foreign language instruction	✓		✓	4
28	[28]	Boosting EFL learners' listening comprehension through a developed mobile learning application: Effectiveness and practicality	✓			4
29	[5]	Basic psychological needs satisfaction, goal orientation, willingness to communicate, self-efficacy, and learning strategy use as predictors of second language achievement: A structural equation modeling approach	✓			5
30	[31]	Motivational teaching practices from EFL learners' perspective at tertiary level in Yemen	✓			5
31	[26]	Exploring Chinese EFL undergraduates? Writing from sources: Self-efficacy and performance	✓	✓		5
32	[8]	Intelligence differences and mediation factors: A sequential explanatory study of improvement of EFL undergraduate students' reading comprehension skills	✓			5
33	[7]	A dynamic approach to understanding motivation in an interpreting course		✓		5
34	[49]	English café: An initiative to encourage undergraduate learners of Al-Asyah province to showcase their spoken proficiency in English	✓			5
35	[12]	Motivation and grit affects undergraduate students' English language performance	✓			5

Theme 1: role of teaching techniques and strategies; Theme 2: effects of learning environment and learning styles; Theme 3: influence of psychological factors and cultural knowledge; Theme 4: technological support in EFL learning; Theme 5: individual variables and learner autonomy.

3.4. Technological support in EFL learning

The role of technological support in EFL learning was a dominant theme, as noted in 8 articles. The review revealed that digital tools such as mobile-assisted language learning (MALL) applications [32], VR [39], and game-based apps [3], [36] had a transformative impact on student motivation. For instance, WhatsApp chat groups were found to be an effective medium for facilitating natural interactions and contextualized language use outside the classroom [37], leading to heightened motivation to learn English. The use of VR environments also provided immersive learning experiences that enhanced engagement and motivation compared to traditional face-to-face learning methods [39]. These findings demonstrate the importance of integrating technological innovations in EFL classrooms to support motivation and self-directed learning. This study suggested that high technology was effectively used to manage different factors of enhance motivation and English learning, particularly via the using of game-based apps and cellphone learning applications. The VR also showed potential flow, although a growing number of research was needed to understand its influence on undergraduates motivation and affect [39].

3.5. Individual variables and learner autonomy

The final theme focused on individual learner differences and autonomy, which were examined in seven of the reviewed articles. Key individual differences, such as grit [2], [12], self-efficacy [5], [9], [26], [45], and goal orientation [1], [5], [42], were found to significantly impact motivation. Studies revealed that learners with a strong sense of grit were more likely to persist in challenging learning tasks, leading to improved performance and higher motivation [2], [12]. Learner autonomy was also found to be a critical factor, with autonomous learners demonstrating higher motivation and the ability to regulate their learning processes effectively [26]. Educational interventions that foster self-regulation, such as the use of motivational regulation strategies, were found to be effective in enhancing learner autonomy and motivation [9], [26], [41], [46]. By supporting individual learner differences and promoting autonomy, educators can create an environment that fosters sustainable motivation for EFL learning. The learners of EFL needed to set a blueprint, believing in their approach of capabilities, and used more learning tactics to improve their motivation [8]. Especially, motivation was found to be the unique significant prophet of speaking activity [12], [36], [47]. According to Waluyo and Bakoko [2], despite demotivated, language learners could restore the learning motivation through resilience and specific patterns of behavior. The systematic review technique in summary offered a rigorous and methodical way to investigating the breadth of the research topic, enabling a thorough overview of area and identification of research gaps.

4. CONCLUSION

This study systematically synthesized findings from 36 empirical studies on gamified learning in undergraduate EFL contexts, integrating pedagogical, psychological, cultural, and technological dimensions. The review identified five critical themes shaping EFL motivation: teaching strategies, learning environments, psychological and cultural factors, technological tools, and learner autonomy. The analysis demonstrated that gamification enhances motivation most effectively when it aligns with learning styles, fosters engagement, supports collaboration, and promotes self-regulation. By offering a meta-understanding of how these factors interact, the study provides a comprehensive framework for sustaining EFL motivation in higher education.

The originality of this review lies in its holistic integration of gamified interventions with psychological variables such as anxiety, burnout, and resilience, as well as cultural orientations that shape learner motivation. Unlike previous fragmented reviews, this article applied a rigorous PRISMA-based methodology, ensuring replicability and scholarly robustness. It also identified under-researched moderators, including maladaptive emotion regulation and learner resilience, thereby filling important gaps in the gamification-EFL literature. These contributions advance current knowledge by clarifying how culturally sensitive and psychologically sound gamification strategies can be systematically implemented in higher education.

The findings underscore the need for adaptive and inclusive gamification strategies that reduce anxiety, build resilience, and sustain motivation over time. Future studies should examine long-term effects of gamified interventions, particularly the role of VR and AI-driven technologies in diverse learning contexts. Beyond academic outcomes, enhancing EFL motivation contributes to global communication, employability, and cross-cultural exchange. By addressing these challenges, educators and institutions can better design effective, scalable, and sustainable gamified learning environments for the next generation of EFL learners.

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Wee Hoe Tan	✓	✓	✓		✓				✓	✓		✓		
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C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY




Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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