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Gamifying Education: Trends, Networks, and Insights From 2014–2024

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Abstract

This study provides a comprehensive bibliometric analysis of research on gamification in education from 2014 to 2024, based on 4,784 publications indexed in Scopus. Using VOSviewer and R, the analysis maps global contributions, thematic clusters, and emerging trends. Results indicate a rapid annual growth rate of 23.1% and strong international collaboration, with the United States and Spain leading in productivity and impact, alongside growing contributions from Southeast Asia and Latin America. Keyword co-occurrence reveals eight thematic clusters, with "gamification," "engagement," and "motivation" as core concepts, while emerging topics include AI, adaptive learning, and virtual reality. The findings show a shift from short-term motivational applications toward sustainable, technology-integrated, and learner-centered models. Despite the progress, research gaps remain regarding long-term learning outcomes, cost-effectiveness, and cultural contexts. The study contributes to theory by mapping intellectual structures in gamification research and offers practical implications for policymakers, educators, and EdTech developers seeking to enhance engagement, personalization, and innovation in education.

Keywords:

Gamification, Education, Bibliometric, Engagement, Motivation

Introduction

Over the last four decades, educational technology has grown from a relatively specialized area into a well-recognized subfield of education. In response to increasing global pressure to innovate teaching methods and improve both engagement and learning effectiveness, digital technologies—particularly online learning—have opened new opportunities but also revealed challenges such as reduced learner motivation, higher dropout rates, and limited interaction. Against this backdrop, gamification—the incorporation of game elements into non-game contexts—has been proposed as a promising strategy to enhance participation, motivation, and learning performance (Li et al., 2023). It is essential to differentiate gamification from game-based learning: while gamification refers broadly to the use of game components in real-world situations, game-based learning relies on fully developed games to deliver content and skills (Wijaya et al., 2022). Within education, gamification involves integrating design features such as points, badges, leaderboards, quests, rewards, and instant

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feedback to create a gameful learning environment that stimulates both intrinsic and extrinsic motivation (Li et al., 2024).

A growing body of research has documented notable benefits of gamification. Li et al. (2023), for instance, conducted a meta-analysis of 41 studies with over 5,000 participants and reported a large effect size (Hedges' g ≈ 0.82) favoring gamified approaches over traditional methods, with moderating variables such as learner characteristics, subject area, design, duration, and learning environment shaping outcomes. Similarly, Gini (2025), in an analysis of 9,163 records and over 300,000 documents, found that gamification in education is expanding rapidly in both scale and scope, highlighting its application across primary, higher, and online learning. Likewise, Li et al. (2024) showed that students in gamified settings outperformed their peers in university-level mathematics courses.

Nevertheless, the impact of gamification on learning outcomes remains contested. Prior studies have yielded inconsistent findings: while many reported positive effects, others observed little or no measurable improvement (Bouchrika et al., 2019; Rachels & Rockinson-Szapkiw, 2017). Such discrepancies complicate efforts to draw firm conclusions about its effectiveness.

Moreover, existing research remains fragmented across learner groups (e.g., primary, higher, vocational education), contexts (online, blended, STEM, language learning), and evaluation criteria (motivation, achievement, soft skills). Comprehensive syntheses that systematically map key themes, leading contributors, research gaps, and future opportunities are still lacking (Al-Hafdi & Alhalafawy, 2024).

Although research on gamification in education has expanded rapidly, the existing literature remains fragmented across educational levels, contexts, and outcome measures, often leading to inconsistent and inconclusive findings. In the absence of a systematic bibliometric synthesis, it is difficult to identify dominant research streams, emerging themes, and underexplored gaps, thereby limiting both theoretical consolidation and evidence-based policy formulation. Accordingly, a bibliometric approach is essential to integrate existing knowledge, map the intellectual structure of the field, and guide future research and policy decisions related to gamification in education.

Addressing this gap, the present study offers several novel contributions to the gamification-in-education literature. First, it provides an updated and comprehensive bibliometric overview covering the period 2014–2024, capturing recent technological shifts such as AI-driven personalization and immersive learning environments. Second, by integrating VOSviewer with R-based science mapping techniques, the study not only identifies thematic clusters but also reveals their intellectual linkages and temporal evolution through bibliographic coupling. Third, unlike prior bibliometric reviews, the identified clusters are explicitly interpreted through established educational theories, including Self-Determination Theory, Flow Theory, and Constructivist Learning Theory, thereby strengthening the theoretical grounding and explanatory power of bibliometric findings.

To achieve these objectives, a transparent and replicable bibliometric analysis was conducted using a Scopus-indexed dataset spanning 2014–2024. The study addresses three main research questions: (i) which countries, institutions, authors, journals, and publications have made the most significant contributions to gamification research in education; (ii) which key concepts, themes, and dimensions are attracting scholarly attention and warrant deeper investigation; and (iii) what core research patterns, dominant themes, and emerging trends characterize the field. Overall, this approach provides a holistic view of the development and diffusion of gamification in education across time and space, offering empirically grounded and theoretically informed directions for future research.

Literature Review

The Concept of Gamification

Gamification is often described as distinct from entertainment games and serious games (Bai et al., 2020). Entertainment games are typically developed for leisure purposes (e.g., World of Warcraft), while serious games—also referred to as game-based learning (Boyle et al., 2016) - are designed to cultivate specific skills or deliver academic content (Annetta, 2010). Both types of games usually require substantial financial and technical resources for their development.

Although game elements form the foundation of gamification, there is no universally accepted classification of these elements (Bai et al., 2020). Riar et al. (2022) define gamification as the incorporation of game features into non-game contexts.

Gamification entails applying game elements across a variety of situations (Sanchez et al., 2020). These elements are purposefully designed to achieve certain objectives and are embedded within specific activities or tasks. It involves creating playful and game-like experiences by integrating elements, mechanics, and principles that make games engaging, challenging, enjoyable, and motivating into non-game environments, thereby enhancing user participation, motivation, and overall experience (Seaborn & Fels, 2015).

Gamification in Educational Contexts

Gamification can be implemented across diverse domains and has evolved into an interdisciplinary field of study (Nacke & Deterding, 2017). In recent years, game-based approaches to learning have drawn increasing attention from educators, practitioners, and researchers across different subjects and levels of education (Dahalan et al., 2023; Kaya & Ercag, 2023; Oliveira et al., 2022). Because active learning methodologies lie at the core of gamification, and game design draws upon psychological theories of learning, it has long been anticipated that integrating gamification into educational settings could improve outcomes, participation, and learner experience (Bai et al., 2020; Cechetti et al., 2019).

By its very nature, gamification can make learning experiences more interactive and engaging, while simultaneously boosting students' interest in subjects, participation, self-efficacy, persistence, focus, and motivation, ultimately supporting better academic performance (Bouchrika et al., 2019; Kim et al., 2017; Yildirim, 2017). Motivational elements embedded in gamification can foster desirable student behaviors and enhance psychological states (Hanus & Fox, 2015). However, some studies have reported opposite effects, where gamification discouraged learners or even hindered academic performance (Hanus & Fox, 2015; Kwon & Özpolat, 2020). The emotional and social dimensions of gamified learning are also noteworthy. Kuo and Chuang (2015), for example, emphasized the importance of collaborative gamified activities in strengthening peer interaction, thereby fostering more meaningful social relationships among students. Similarly, Zainuddin et al. (2017) highlighted how escalating challenges in gamified environments reinforce learners' confidence by cultivating a sense of accomplishment. According to Lampropoulos et al. (2024), learning environments that integrate virtual reality and game-based elements allow students to experience contexts, scenarios, and conditions both individually and collaboratively, engaging in educational activities that would otherwise be impossible. Nevertheless, as Ryan and Deci (2000) cautioned, an overreliance on extrinsic motivators may undermine intrinsic motivation, particularly when gamified applications are misaligned with clear pedagogical objectives. To overcome these challenges, stronger collaboration among educators, policymakers, and developers is necessary to design gamification solutions that are both pedagogically sound and holistically effective.

Theoretical Foundations Commonly Used to Explain the Effects of Gamification

These theoretical perspectives provide an important lens for interpreting bibliometric clusters. For instance, themes related to engagement, motivation, and autonomy can be understood through Self-Determination Theory, which emphasizes intrinsic motivation and psychological needs. Clusters focusing on challenge, immersion, and enjoyment align closely with Flow Theory, highlighting optimal learning experiences. Meanwhile, themes such as active learning, collaboration, and problem-solving resonate with Constructivist Learning Theory, which views knowledge as actively constructed through meaningful interaction. This theoretical integration enhances the interpretive depth of the bibliometric results.

Self-Determination Theory

Self-Determination Theory (SDT) is considered one of the most influential frameworks in contemporary behavioral science and is widely recognized as one of the most comprehensive and practical motivation theories in the social sciences (Proulx et al., 2016). SDT has played a crucial role in the study and application of gamification, particularly in explaining psychological and motivational processes in gaming contexts (Ryan et al., 2006). Hsia et al. (2024) describe SDT as a psychological theory that explores human motivation and behavior through the lens of psychological needs. According to SDT, three basic psychological needs must be satisfied for individuals to thrive and achieve success: autonomy, competence, and relatedness. When individuals operate within rigid structures, intrinsic motivation may be undermined due to limited autonomy (Ryan & Deci, 2000). Conversely, environments that provide choice and opportunities for self-direction can enhance intrinsic motivation by reinforcing a sense of autonomy, thereby fostering continuous personal growth (Ryan & Deci, 2020).

Empirical studies have shown that when gamification elements meet learners' basic psychological needs, improvements are observed in motor skills, learning behaviors, and classroom engagement (Fernandez-Rio et al., 2020; Quintas et al., 2020). Gao (2024) emphasizes that SDT is particularly suited to examining when and how gamification is effective, as it reveals the underlying psychological and motivational mechanisms. Within SDT, competence refers to the sense of effectiveness and mastery when individuals face challenges that align with their current abilities, enabling them to maintain and enhance their skills (Deci & Ryan, 2000). Moreover, SDT distinguishes between different forms of motivational regulation along a continuum from controlled to autonomous: external and introjected regulation are more controlling, whereas identified, integrated, and intrinsic regulation are more autonomous, contributing to stronger engagement and optimal learning outcomes (Manganelli et al., 2019; Niemiec & Ryan, 2009).

Through gamification elements, students' psychological needs—autonomy, competence, and relatedness—can be effectively addressed, supporting them in achieving their learning goals (Grabner-Hagen & Kingsley, 2023). This application of SDT has been endorsed by several scholars as a theoretical lens to explain the positive impacts of gamified learning environments in education (Dehghanzadeh et al., 2024).

Flow Theory

One of the most frequently cited theoretical foundations in gamification research is Flow Theory, also known as the theory of optimal experience (Guo et al., 2016). Flow represents an optimal state of intrinsic motivation in which learners perceive challenges as well matched to their skills and capabilities. According to Wong and Csikszentmihalyi (1991), learning experiences can be classified into three main channels: the boredom channel, the frustration (or overload) channel, and the flow channel. When challenges are too low compared to a learner's abilities, boredom quickly emerges, leading to disengagement. Conversely, when tasks are excessively difficult, learners may experience frustration and ultimately withdraw. Flow occurs only when task difficulty is properly aligned with learners' skill development, enabling them to sustain engagement and maximize intrinsic motivation (Sharek & Wiebe, 2011).In educational contexts, gamification has been identified as an effective mechanism for fostering flow states. Game elements such as clear goals, immediate feedback, progressive challenges, and a sense of control help create the conditions necessary for flow (Hamari & Koivisto, 2014; Högberg et al., 2019). These factors play a critical role in maintaining motivation and engagement, which in turn are closely tied to learning outcomes (Oliveira et al., 2019).

For example, Wan et al. (2021) developed a flow-based model to examine the antecedents of flow in game-based learning environments. Their findings showed that learners highly valued conditions supporting flow—particularly concentration and challenge. The model concluded that when courses were designed with clear objectives and high levels of autonomy, learners tended to report stronger motivation and improved academic performance. Similarly, Kaya and Ercag (2023) conducted an experimental study with 60 university students, incorporating challenge-based gamification into a course. The results indicated significant improvements in both learning outcomes and learner motivation. Although the increase in flow experiences among gamified groups did not reach statistical significance, the findings still suggested that gamification strategies centered on challenge and competition can support conditions for flow by enhancing perceived competence and enjoyment. While several studies have confirmed the positive influence of gamification on flow in learning contexts (Hamari et al., 2016; Xi & Hamari, 2019), there remains a shortage of research investigating how individual differences—such as learning styles, technological proficiency, or initial motivation levels—moderate this relationship. Addressing this gap offers promising opportunities for future research to explore how gamification can be more effectively designed to personalize learning, optimize flow states, and improve educational outcomes.

Constructivist Learning Theory

One of the key pioneers of constructivist learning theory was Lev Vygotsky, a Russian psychologist and educator who emphasized the inherently social nature of learning (Tilak & Glassman, 2022). He argued that children's cognitive and linguistic development does not occur in isolation from their social environment (Rochat, 2023; Tilak & Glassman, 2022). More than half a century ago, Vygotsky highlighted the importance of social interaction in shaping the child's mind. Vygotsky's ideas gained increasing attention in the late 20th century. He maintained that every individual develops within a social context, and that intellectual processes—such as meaning-making, memory, reasoning, and perception—evolve from interpersonal interactions before being internalized. From this perspective, all higher-order cognitive functions originate in social interactions situated within specific cultural contexts. Cognition, therefore, can be seen as the internalization of social exchanges. This socio-cultural theory underscores the need for a social foundation to better understand educational processes (Alkhudiry, 2022).

In this sense, constructivist learning refers to the process by which learners generate knowledge and ideas through personal exploration, experience, and reflection. As Wibowo et al. (2024) argue, constructivism emphasizes the search for knowledge and ideas rather than focusing solely on the "correct" answers. Learning is viewed as an active process in which students build their own understanding. Knowledge cannot simply be transmitted; instead, it must be co-constructed through the dynamic interaction between teachers and learners (Moşteanu, 2021). Within this framework, gamification functions as a pedagogical tool that helps put constructivist principles into practice. Game elements such as challenges, instant feedback, rewards, and task progression encourage learners to engage actively rather than passively absorb information (Grover & Pea, 2013). By experimenting, tackling appropriately designed challenges, collaborating with peers, and adjusting strategies in response to feedback, learners construct knowledge through experience.

Constructivist learning theory also stresses the importance of social interaction and collaboration. Gamification mechanisms such as leaderboards, group systems, or team-based missions create opportunities for students to communicate, share, and solve problems together. This not only strengthens their understanding of content but also enhances critical thinking, creativity, and problem-solving skills in educational settings (Liu et al., 2021). Furthermore, constructivism highlights the necessity of contextualizing learning within real-world situations and practical applications. Gamification supports this by simulating authentic scenarios and designing tasks that mirror real-life or professional contexts, enabling learners to see the relevance and applicability of their knowledge (Kale et al., 2018).

These theoretical perspectives provide an important lens for interpreting bibliometric clusters. For instance, themes related to engagement, motivation, and autonomy can be understood through Self-Determination Theory, which emphasizes intrinsic motivation and psychological needs. Clusters focusing on challenge, immersion, and enjoyment align closely with Flow Theory, highlighting optimal learning experiences. Meanwhile, themes such as active learning, collaboration, and problem-solving resonate with Constructivist Learning Theory, which views knowledge as actively constructed through meaningful interaction. This theoretical integration enhances the interpretive depth of the bibliometric results.

Research Methodology

Scopus and Web of Science (WoS) are widely recognized as two of the most reputable academic databases globally, and numerous comparative studies have been conducted to highlight their respective strengths and limitations (Mongeon & Paul-Hus, 2016). Although both systems have certain constraints, Pranckute (2021) notes that Scopus demonstrates several advantages over WoS: (i) broader content coverage; (ii) provision of author and institutional profiles along with publication abstracts, facilitating easier access and exploration; (iii) more comprehensive and less manipulable impact metrics that are applicable across disciplines and publication types; and (iv) a unified database structure, in contrast to WoS, which is divided into multiple collections (e.g., SCIE, SSCI, ESCI), often causing confusion for new users. In this study, the authors combined quantitative bibliometric analysis with a comprehensive literature review, focusing on works published in journals indexed by Scopus. This database is considered reputable, particularly for its capacity to assess research impact, measure influence, and reflect the quality of published studies (Baas et al., 2020). The search strategy was developed based on the keywords "gamification" and "education", carefully selected to ensure both relevance and coverage. The specific query used was: TITLE-ABS-KEY(("gamification") AND ("education")). The search was limited to the period 2014–2024, yielding a total of 4,784 scientific publications, which served as the primary dataset for subsequent analyses.

Bibliometric Analysis

Bibliometric analysis is widely regarded as a rigorous and systematic quantitative method for examining large volumes of scientific data (Aria & Cuccurullo, 2017). This approach enables researchers to trace the development of a field, identify emerging research themes, and uncover potential knowledge gaps. In this study, bibliometric techniques are applied to investigate the prevailing topics and directions within the domains of educational gamification research.

At its core, bibliometric analysis quantitatively examines scholarly outputs such as books, journals, and other academic publications. By employing indicators such as citation counts, co-authorship networks, and keyword co-occurrence, the method helps evaluate both the impact and relevance of scientific contributions within a particular domain (Donthu et al., 2021).

The importance of bibliometric analysis lies in several aspects: (i) it offers a systematic and objective framework to assess the current state of research, pinpoint knowledge gaps, and track trends over time; (ii) it facilitates mapping of collaboration networks among scholars and institutions; and (iii) it guides researchers toward emerging research areas and potential partnerships (Kumar et al., 2021).

To maximize its strengths, this study integrates bibliometric analysis with a comprehensive literature review. A key technique employed is co-occurrence analysis, which identifies when two or more terms appear together in the same context, thereby revealing thematic or semantic relationships. This helps illustrate the intellectual structure of the field and highlight its core topics (Allahbakhshian Farsani et al., 2024; Zhou et al., 2022). Moreover, citation frequency continues to serve as an essential indicator, reflecting both the visibility and the scholarly contribution of individual works in advancing the field (Allahbakhshian Farsani et al., 2024; Donthu et al., 2021).

Data Characteristics

The dataset employed in this study covers publications from 2014 to 2024, comprising a total of 4,784 articles. These works were authored by 13,511 researchers, with only 415 being single-authored papers, while the vast majority involved multiple contributors. This highlights the high level of international collaboration in the field and suggests that the research provides

a global perspective on strategies for enhancing user engagement in digital environments.

Data Processing

Two specialized bibliometric tools were used for data analysis: VOSviewer and R (Moral-Muñoz et al., 2020; Aria & Cuccurullo, 2017). Both were selected for their ability to visualize and map scientific networks and trends over time. VOSviewer was applied to construct co-occurrence networks, intellectual structures, and developmental trajectories within the field (Moral-Muñoz et al., 2020). Meanwhile, R was used to perform statistical analysis and generate visualizations that illustrate research trends, interrelationships, and contributions at the author, journal, and country levels. This dual approach enabled a comprehensive and dynamic assessment of the field's evolution and emerging directions (Moral-Muñoz et al., 2020).

Data Extraction

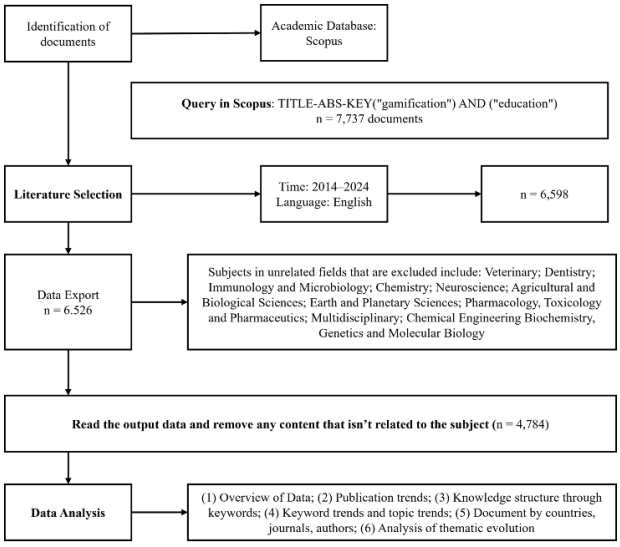
The Scopus database was selected for data retrieval on the topic of education and gamification, as it is widely used in the social sciences for large-scale bibliometric and systematic reviews (Naeem et al., 2022; Rabbani et al., 2022). The search process followed the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), as illustrated in Figure 1. The PRISMA process consists of four main stages. In the identification stage, records were retrieved from the Scopus database using predefined keywords. During screening, duplicate and irrelevant records were removed based on titles and abstracts. The eligibility stage involved full-text assessment to ensure alignment with the study's scope. Finally, the included stage resulted in the final dataset used for bibliometric analysis.

Using Boolean combinations of the keywords "gamification" AND "education", the search initially yielded 7,737 documents, which were exported in .CSV format for further screening.

The extracted records were carefully examined to ensure relevance to the study's scope. Several inclusion and exclusion criteria were applied. Publications outside the 2014–2024 period, non-English documents, and non-academic items such as books, short notes, and editorials were excluded, removing 1,139 records. The inclusion criteria were limited to journal articles, book reviews, book chapters, and conference papers. Importantly, only studies with a clear focus on gamification in education were retained. Titles and abstracts were manually screened, leading to the exclusion of an additional 1,814 records.

As a result, a final dataset of 4,784 documents was compiled for synthesis and bibliometric analysis. This dataset was used to explore both past and emerging research trends in gamification and education. Bibliometric analysis served as a systematic technique to examine publication patterns, citation impact, leading authors and journals, co-authorship networks, and keyword co-occurrence (Hassan et al., 2023; Wasiq et al., 2023). The analysis was conducted using the Biblioshiny interface in R, which supports the processing of large bibliographic datasets and provides advanced visualization tools tailored for bibliometric research (Hassan et al., 2023).

Figure 1.
The actual process of conducting bibliographic analysis



Several limitations should be acknowledged. First, the analysis is limited to English-language publications indexed in the Scopus database, which may exclude relevant studies published in other languages or databases. Second, regional research output may be unevenly represented. These limitations should be considered when interpreting the findings.

Results

This chapter presents a comprehensive bibliometric analysis of research on gamification in education published between 2014 and 2024, structured explicitly around three core research objectives. First, the chapter aims to identify the countries, institutions, authors, journals, and publications that have made the most significant scholarly contributions to the field, based on analyses of research output and citation impact. Second, through keyword co-occurrence analysis and thematic trend examination, the chapter elucidates the key concepts, research themes, and analytical dimensions that are currently attracting scholarly attention and warrant further investigation. Third, the chapter seeks to uncover the dominant research patterns, core thematic structures, and emerging trends that characterize the evolution

and intellectual positioning of gamification research in education over time. Accordingly, the chapter is organized into six interrelated sections: (i) an overview of the dataset, (ii) publication and citation trends, (iii) scholarly contributions by countries, institutions, authors, and publication sources, (iv) the knowledge structure based on keyword analysis, (v) keyword and thematic trends, and (vi) the evolution and thematic positioning of research topics.

Overview of the dataset

Table 1 illustrates that between 2014 and 2024, the field produced 4,784 publications from 1,856 sources, with an annual growth rate of 23.1%, reflecting its rapid and dynamic expansion. On average, the publications are 4.37 years old and have received 15.63 citations per paper, indicating both currency and a relatively strong academic impact. In terms of content, the field demonstrates substantial diversity, with more than 11,000 Keywords Plus and 8,400 author keywords, highlighting the breadth of research coverage. The author community consists of 13,511 researchers, with most works being collaborative in nature—averaging 3.52 co-authors per paper and showing 16.22% international collaboration. Regarding document types, journal articles (2,135) and conference papers (2,318) dominate the dataset, while reviews (213) and other categories represent only a minor share. Overall, the data suggest that this is a young and rapidly expanding field, characterized by strong international collaboration and a predominant focus on articles and conference proceedings. To assess the development and thematic diversification of the gamification research field, we examined the ratio between the number of keywords and the number of documents, a descriptive measure commonly used in bibliometric and co-word analyses (Callon et al., 1983; Cobo et al., 2011). This ratio, hereafter denoted as K, was calculated as:

$$K = \frac{Number\ of\ keywords}{Number\ of\ documents} = \frac{8429}{4784} = 1.76$$

A value of K = 1.76 indicates a high level of thematic diversity, suggesting that gamification research in education has evolved into a conceptually rich, interdisciplinary, and multi-dimensional research field rather than remaining focused on a narrow set of topics. To provide a clearer overview, this chapter is organized into four sections: (i) publication trends, (ii) keyword and content analysis, (iii) authors, countries, and journals, and (iv) thematic evolution of the research field.

Table 1.

Descriptive Statistics of the Dataset (2014–2024)

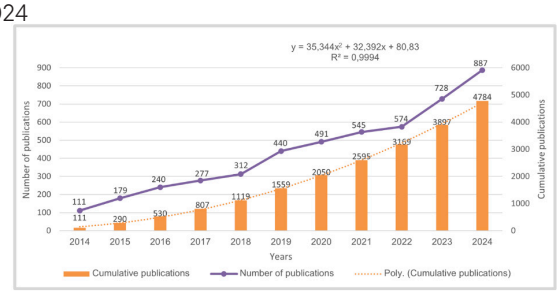
Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2014:2024
Sources (Journals, Books, etc)	1856
Documents	4784
Annual Growth Rate %	23,1
Document Average Age	4,37
Average citations per doc	15,63
References	146499
DOCUMENT CONTENTS	
Keywords Plus (ID)	11114
Author's Keywords (DE)	8429
AUTHORS	
Authors	13511
Authors of single-authored docs	415
AUTHORS COLLABORATION	
Single-authored docs	459
Co-Authors per Doc	3,52
International co-authorships %	16,22
DOCUMENT TYPES	
article	2135
book chapter	2
conference paper	2318
conference review	116
review	213

Publication Trends

As the figure 2, the results indicate a pronounced and sustained growth in scholarly publications on gamification in education over the period 2014–2024. In the early stage of the field, only 111 documents were published in 2014. However, this number increased steadily over the following decade, reaching 887 publications in 2024 and resulting in a cumulative total of 4,784 documents. A clear turning point emerged in 2018, when annual publications exceeded 300 for the first time, marking the transition from an emerging to a rapidly expanding research domain. From 2019 onward, the growth trajectory accelerated considerably, reflecting the escalating academic recognition of gamification as a pivotal pedagogical approach and a mainstream topic within educational research.

Figure 2.

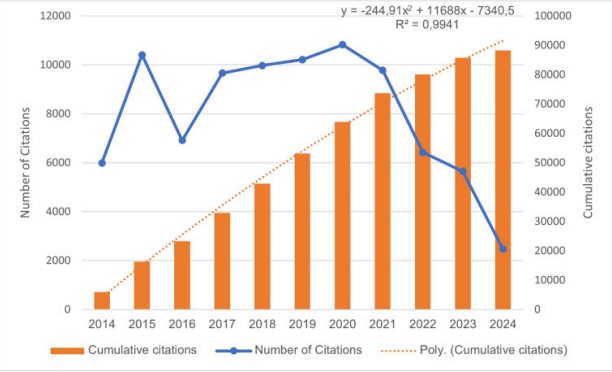
Annual number of scientific publications on the topic of gamification in education during the period 2014–2024



Further insights into the scholarly impact of this field in figure 3 are provided by the analysis of annual and cumulative citations. Overall, cumulative citations exhibit a strong and uninterrupted upward trend throughout the decade, increasing from fewer than 10,000 citations in 2014 to more than 90,000 citations by 2024. The polynomial trend line fitted to cumulative citations shows an excellent goodness of fit ($R^2 = 0.9941$), underscoring the robustness and consistency of long-term scholarly attention to gamification in education.

In contrast, annual citation counts display a more fluctuating pattern. Following a sharp increase from approximately 6,000 citations in 2014 to over 10,000 citations in 2015, a temporary decline occurred in 2016. This was followed by a renewed and steady rise, culminating in a peak around 2020. However, from 2021 onward, annual citations show a gradual decline, despite the continued accumulation of total citations. This divergence suggests that the field may have entered a phase of relative maturity, characterized by a well-established and highly cited knowledge base, while the marginal growth in new citation activity has begun to stabilize. Taken together, these publication and citation trends highlight both the historical consolidation of the field and the evolving dynamics of its scholarly influence.

Figure 3.
Annual number of scientific citations on the topic of gamification in education during the period 2014–2024

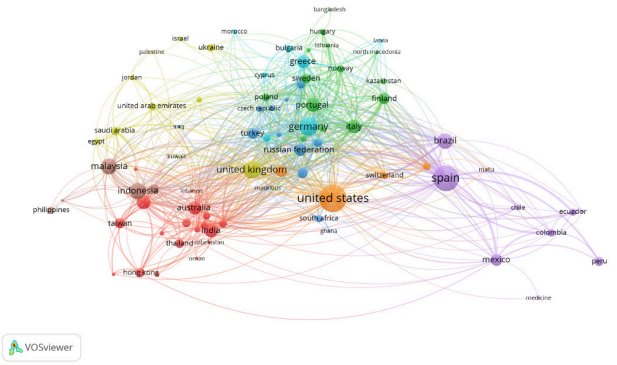


Academic Contributions by Countries, Journals, and Authors

Countries

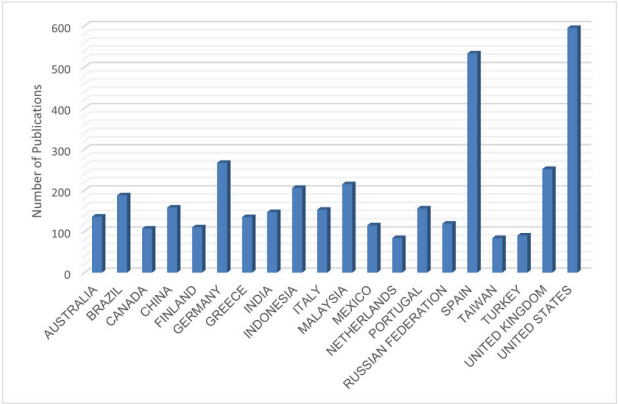
The data analysis presented in Figure 4 reveals that 168 countries and territories have contributed publications related to gamification in education during the period 2014–2024. While the topic demonstrates a global scope, its distribution remains uneven. The top 20 most productive countries are listed in Figure 5, with the United States leading decisively with 595 publications, highlighting its pioneering role in the field of education and research. Spain follows closely with 533 publications, underscoring Europe's strong engagement, further supported by significant contributions from Germany (267), the United Kingdom (252), Italy (153), Portugal (156), Greece (135), Finland (110), and the Netherlands (84). This confirms Europe as a major research hub for gamification. In Asia, notable contributions come from Malaysia (215), Indonesia (206), China (158), India (147), Turkey (90), and Taiwan (84), with Malaysia and Indonesia standing out for their relatively high publication output, reflecting the dynamism of Southeast Asia in adopting and advancing gamification. In Latin America, Brazil (188) and Mexico (115) reinforce the global expansion of this research field, while Canada (107) and Australia (136) highlight the involvement of North America and Oceania. Russia (119), although moderate in output, affirms Eastern Europe's presence in the broader research landscape. Overall, as illustrated in Figure 5, the United States and Spain dominate the field, yet the growing contributions from Asian and Latin American countries demonstrate that gamification research has expanded beyond developed nations, evolving into a global trend closely tied to educational innovation.

Figure 4.
Country Collaboration Network



Source: Visual map extracted from VOSviewer

Figure 5.
Leading countries in publications on gamification in education (2014–2024).

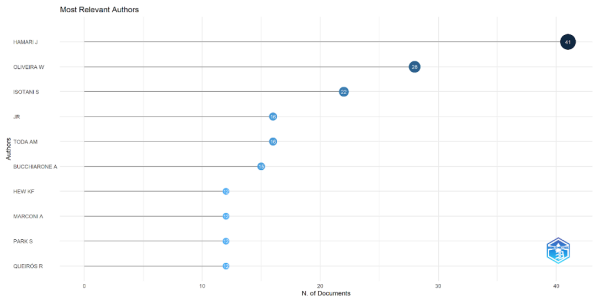


Source: Visual map extracted from Rstudio

Authors

The analysis in Figure 6 indicates that among 13,989 authors, there exists a notable disparity between publication volume and scholarly impact. Within this landscape, the top 10 most productive authors can be identified. Hamari J. leads with 41 publications, highlighting his prominent role and substantial academic contributions to the field. He is followed by Oliveira W. (28) and Isotani S. (22), both of whom demonstrate sustained and active engagement in gamification research.Subsequently, JR and Toda A.M. each contributed 16 papers, while Bucchiarone A. authored 15 publications, underscoring their significance within the scholarly community. Additionally, authors such as Hew K.F., Marconi A., Park S., and Queirós R., each with 12 publications, further illustrate the diversity of research contributions. This distribution reflects a broad and collaborative academic community rather than dominance by a single individual or a small group of scholars.

Figure 6.
Most Relevant Authors.

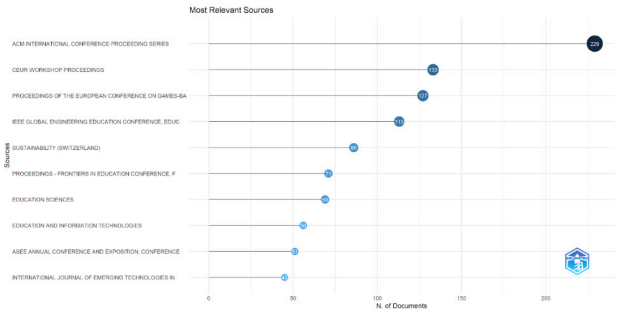


Source: Visual map extracted from Rstudio

Journals and Conferences

In terms of publication sources, the most prominent outlets are concentrated in international conference proceedings. As shown in Figure 7, the ACM International Conference Proceeding Series leads with 229 publications, underscoring ACM's role as a major forum for research at the intersection of technology and education. This is followed by CEUR Workshop Proceedings (133) and the Proceedings of the European Conference on Games-Based Learning (127), reflecting the strong academic interest in gamification and game-based learning within educational contexts. In addition, conferences under the IEEE network such as IEEE EDUCON (113) and the Frontiers in Education Conference (71) play a vital role in disseminating research. On the journal side, scholarly outlets including Sustainability (Switzerland) (86), Education Sciences (69), and Education and Information Technologies (56) provide significant contributions to the academic foundation of the field. Notably, the International Journal of Emerging Technologies in Learning (45) highlights the growing attention toward innovative technologies in education.

Figure 7.
Most Relevant Sources.



Source: Visual map extracted from Rstudio

Knowledge Structure through Keywords

Keyword co-occurrence analysis was conducted to examine the intellectual structure of research on gamification in education and to identify dominant thematic patterns within the field. Based on 4,784 Scopus-indexed documents, a total of 8,444 unique keywords were extracted, among which 106 met the minimum occurrence threshold of 20. The resulting keyword network in figure 8 reflects both the frequency of key concepts and the strength of their conceptual relationships, thereby revealing the knowledge structure of the domain.

The analysis identifies eight interrelated thematic clusters: education, e-learning, gamification, higher education, engagement, game-based learning, active learning, and educational technology. Together, these themes form a coherent structure in which education represents the foundational context, supported by technological enablers such as e-learning and educational technology, while gamification occupies a central integrative role connecting pedagogical approaches, learning environments, and educational outcomes.

The education theme serves as a core foundation, closely linked with gamification, e-learning, STEM education, online learning, and serious games. It acts as a conceptual bridge between technology-oriented topics (e.g., artificial intelligence, augmented reality, and blockchain) and pedagogical concerns such as motivation, flipped classrooms, and higher education.

Closely associated with this foundation, e-learning emerges as a key technological driver, reflecting strong scholarly interest in digital and distance learning environments. Research in this theme emphasizes the integration of gamification with emerging technologies such as MOOCs, adaptive learning systems, artificial intelligence, and digital badges.

At the center of the knowledge structure lies gamification, which exhibits strong connections with education, e-learning, engagement, motivation, serious games, and game-based learning. This central

positioning underscores its role as the primary research focus that integrates pedagogical innovation with technological advancement.

The higher education theme reflects a strong concentration of gamification research within university settings, particularly in relation to motivation, academic performance, flipped classrooms, and professional training, including medical education. Existing studies report positive effects on engagement and learning outcomes.

Engagement appears as a key outcome-oriented theme, strongly associated with gamification, motivation, educational technology, and game elements. Most studies conceptualize engagement as an immediate or short-term effect of gamified learning environments, with limited attention given to sustained engagement or its influence beyond the classroom.

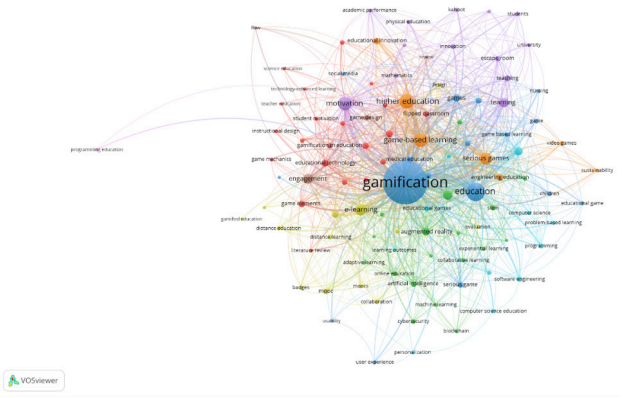
In parallel, game-based learning constitutes a closely related yet distinct research stream, emphasizing the design and implementation of educational games to achieve specific learning objectives. It is frequently linked to assessment, simulation, and specialized training contexts.

The active learning theme highlights the integration of gamification with student-centered pedagogies such as problem-based learning, collaborative learning, and experiential learning. Although widely applied in engineering and STEM education, its adoption in the social sciences, humanities, and vocational education remains limited.

Finally, educational technology functions as an enabling framework that supports the implementation of gamification through instructional design, mobile learning, and social media integration. While prior studies emphasize its role in enhancing learning experiences, challenges related to large-scale adoption, cost-effectiveness, and educational quality have not been systematically addressed.

Overall, the keyword-based knowledge structure reveals a mature yet evolving research domain, characterized by strong conceptual integration around gamification but limited attention to long-term effectiveness and sustainability. These gaps highlight important directions for future research and provide a foundation for advancing theory and practice in gamified education.

Figure 8.
Cluster network illustrating the relationship between Gamification and other keywords

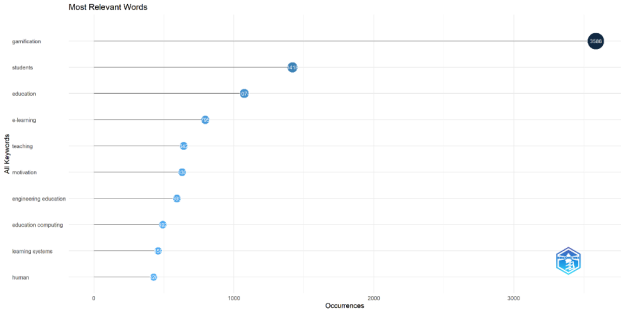


Keyword and Thematic Trends

Most Frequently Used Keywords

Based on the analysis of the most frequently occurring keywords shown in Figure 9, gamification emerges as the central term with 3,586 occurrences, underscoring its dominant role in this research domain. Closely related keywords such as students (1,418), education (1,074), e-learning (795), and teaching (642) highlight that gamification is primarily applied within educational contexts, focusing on learners and online learning environments. Additionally, the presence of terms like motivation (630) and engineering education (593) emphasizes gamification's contribution to enhancing learning motivation and its growing adoption in technical training. Keywords such as education computing (492), learning systems (459), and human (426) further indicate the field's expansion toward educational technologies, learning infrastructures, and human-centered aspects. Overall, these findings reaffirm that gamification stands as a prominent research trend, closely associated with improving learning quality and enriching educational experiences in modern contexts.

Figure 9.
Most Relevant Keywords

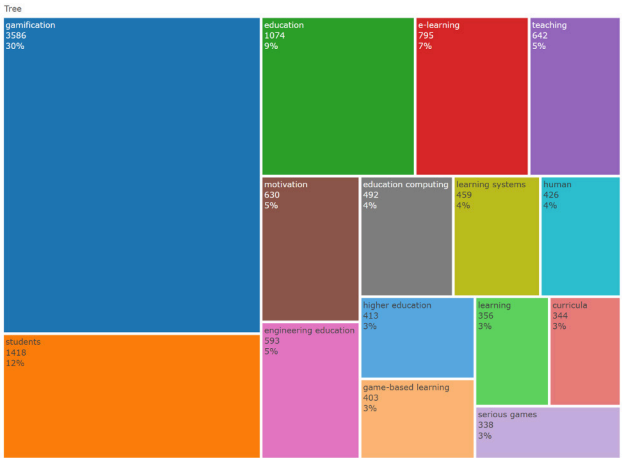


Source: Visual map extracted from Rstudio

In addition, the treemap in Figure 10 illustrates that gamification accounts for the largest proportion (30%), reaffirming its position as the core axis of this research field. The keyword students (12%) highlights learners as the primary focus of most studies, while education (9%), e-learning (7%), and teaching (5%) reflect the educational settings and pedagogical environments where gamification is most frequently applied. Keywords with medium frequencies, such as motivation, engineering education, education computing, and learning systems (4–5%), indicate that gamification research extends beyond general theoretical discussions to more specialized applications and supporting learning technologies. The presence of the keyword human further demonstrates an emphasis on individual factors and learner experiences. Moreover, smaller clusters of keywords—including higher education, game-based learning, curricula, and serious games (around 3%)—showcase the diversification of the field, with trends pointing toward applications in higher education, game-based pedagogies, and integration into formal curricula. Overall, the treemap portrays a multidimensional landscape in which gamification remains the central hub, closely interlinked with pedagogical, technological, and learner-centered perspectives.

Figure 10.

Treemap of the Top 15 Most Frequently Occurring Keywords



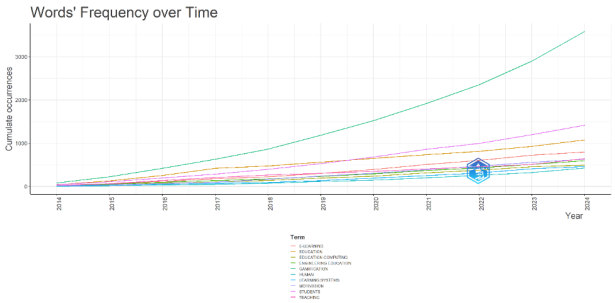
Source: Visual map extracted from Rstudio

Keyword Frequency Over Time

As shown in Figure 11, the temporal analysis of keyword frequency indicates that gamification has experienced exceptional growth, particularly after 2018, reaching more than 3,000 cumulative occurrences by 2024. This trend confirms its role as the central theme of the field. The keywords students and education also display steady growth, reflecting that both the educational context and the learner remain at the core of gamification research. In addition, e-learning, teaching, and motivation maintain consistent upward trends, underscoring the role of gamification in supporting online learning, enhancing teaching practices, and fostering learner motivation. Meanwhile, topics such as education computing, learning systems, and engineering education have developed more gradually yet steadily, highlighting the complementary role of technology and specialized training applications. Overall, the longitudinal analysis demonstrates that gamification has become a sustainable research trend in modern education.

Figure 11.

Words'Frequency over Time.



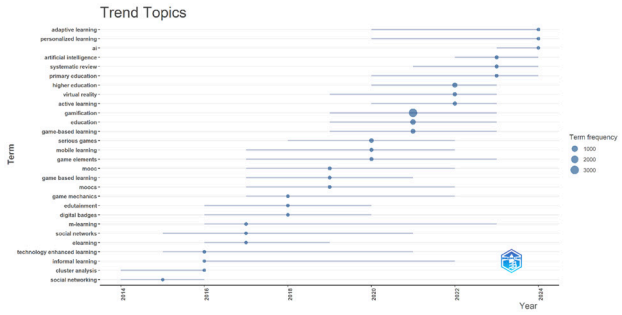
Source: Visual map extracted from Rstudio

Trend Topics

As illustrated in Figure 12, the trend analysis indicates that "gamification" and "education" have consistently maintained their central positions throughout 2014–2024, underscoring their foundational role in the field. Topics such as "game-based learning," "MOOCs," and "mobile learning" experienced significant growth between 2016 and 2020 but gradually declined in prominence in subsequent years. Conversely, emerging keywords including "AI," "personalized learning," "adaptive learning," and "virtual reality" have gained momentum since 2020, highlighting a shift toward the integration of advanced technologies. Overall, these thematic trends reflect the evolution of the field—from the early application of traditional gamification approaches to the adoption of intelligent technologies and personalized learning within modern education.

Figure 12.

Trend Topics



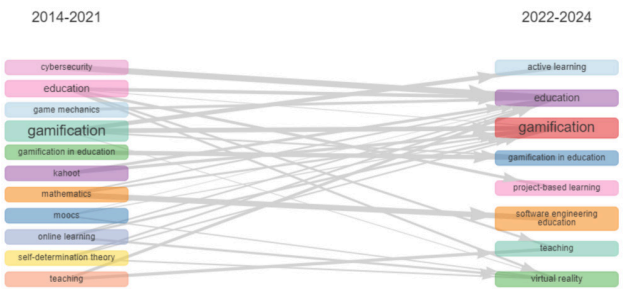
Source: Visual map extracted from Rstudio

Analysis of thematic evolution

As shown in figure 13 depicts the longitudinal evolution of research themes in gamification in education from 2014 to 2024, revealing a clear shift from conceptual foundations toward more applied and technology-driven pedagogical approaches. In the early phase (2014–2021), research was primarily anchored in core theoretical and methodological themes, including gamification, education, game mechanics, online learning, MOOCs, self-determination theory, and platform-based tools such as Kahoot. These themes played a foundational role in establishing the conceptual legitimacy of gamification and in exploring how game elements could be systematically integrated into digital learning environments.

In contrast, the more recent period (2022–2024) is characterized by the emergence and consolidation of application-oriented themes such as active learning, project-based learning, software engineering education, and virtual reality. This transition signals a growing emphasis on experiential, learner-centered pedagogies supported by advanced technologies. Rather than focusing solely on motivational mechanisms or isolated digital tools, recent studies increasingly investigate how gamification can be embedded within broader instructional designs and immersive learning environments. Notably, gamification and education persist as stable and central themes across both periods, indicating their enduring relevance. Meanwhile, earlier topics such as MOOCs, online learning, and Kahoot appear to have been progressively integrated into more complex pedagogical and technological frameworks. Overall, the thematic evolution reflects a natural maturation of the field—from establishing theoretical and technological foundations to advancing innovative, experience-driven educational practices aimed at enhancing learning effectiveness and engagement.

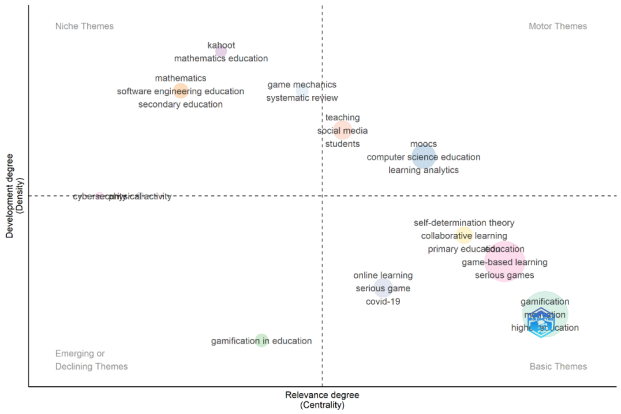
Figure 13.
Thematic Evolution.



Source: Visual map extracted from Rstudio

As shown in figure 14 illustrates the thematic structure of gamification in education research based on centrality and density, revealing a differentiated yet coherent knowledge landscape. In the Motor Themes quadrant, topics such as MOOCs, learning analytics, computer science education, game mechanics, and systematic review exhibit both high relevance and strong internal development, indicating that they actively drive the field. Their prominence reflects a shift toward data-driven, large-scale digital learning environments and methodological consolidation in gamification research. The Basic Themes quadrant contains gamification, education, higher education, game-based learning, serious games, and self-determination theory. These themes are highly central but less dense, suggesting that they form the conceptual backbone of the field while still offering room for further theoretical refinement and empirical expansion. In contrast, the Niche Themes quadrant—comprising Kahoot, mathematics education, software engineering education, and secondary education—represents well-developed but context-specific applications that remain weakly connected to the broader research structure. Finally, the Emerging or Declining Themes quadrant includes gamification in education and cyber–physical activity, indicating themes that are either in an early stage of development or gradually losing prominence. Overall, the map confirms that while foundational gamification concepts remain central, the field is increasingly shaped by technologically advanced and analytically oriented research directions.

Figure 14.
Thematic Map illustrating the position of research themes in the field of gamification in education based on centrality and density.



Source: Visual map extracted from Rstudio

Discussion

This study provides a comprehensive bibliometric overview of gamification research in education during the period 2014–2024, revealing a rapidly expanding and increasingly diversified research field. The findings indicate a sustained annual growth rate of 23.1%, strong international collaboration, and a clear thematic evolution from foundational motivational applications toward technology-integrated and learner-centered pedagogical models. These results suggest that gamification has progressed beyond a short-term

engagement strategy and is now positioned as a core component of the digital education ecosystem.

From a theoretical perspective, the dominance of keywords such as motivation, engagement, and learning can be effectively interpreted through Self-Determination Theory (SDT). SDT posits that learning environments fostering autonomy, competence, and relatedness are more likely to support intrinsic motivation and sustained engagement (Ryan & Deci, 2020). The bibliometric evidence shows that gamification research consistently emphasizes motivational constructs, aligning with prior meta-analyses demonstrating that gamified learning environments significantly enhance students' motivation and engagement (Li et al., 2023; Li et al., 2024). This confirms SDT as a dominant explanatory framework underpinning the effectiveness of gamification in education. However, the persistence of motivation as a core theme over a decade also suggests that research has largely focused on short-term psychological outcomes, while the sustainability of motivation remains insufficiently explored.

In addition, the emergence of themes related to challenge, immersion, virtual reality, and adaptive learning reflects the growing relevance of Flow Theory in contemporary gamification research. Flow Theory emphasizes the importance of balancing challenge and skill to create optimal learning experiences characterized by deep concentration and enjoyment (Wong & Csikszentmihalyi, 1991). The increasing integration of immersive technologies such as VR and AI-driven adaptive systems indicates a shift toward designing gamified environments that can dynamically adjust task difficulty and feedback, thereby facilitating flow states. This trend extends earlier empirical findings that gamification can enhance engagement and learning when flow conditions are met (Hamari et al., 2016; Oliveira et al., 2019), and suggests a maturation of the field toward more sophisticated, experience-driven learning designs.

Furthermore, the growing prominence of themes such as active learning, project-based learning, and collaborative learning resonates strongly with Constructivist Learning Theory. Constructivism views learning as an active process in which learners construct knowledge through experience, reflection, and social interaction (Sanchez et al., 2019). The bibliometric clusters indicate that gamification is increasingly embedded within constructivist pedagogical approaches, particularly in STEM, engineering, and professional education. This finding is consistent with prior studies showing that gamified learning environments can support problem-solving, collaboration, and higher-order thinking skills when aligned with constructivist principles (Grover & Pea, 2013; Kale et al., 2018). Importantly, this shift reflects a transition from reward-based gamification toward experience-based and competence-oriented learning designs.

Beyond theoretical integration, the results also highlight several critical research gaps. First, despite the rapid growth of publications, there remains a lack of longitudinal studies examining the long-term effects of gamification on learning outcomes and skill development. Second, relatively little attention has been paid to the cost-effectiveness and scalability of gamified educational solutions, particularly in resource-constrained contexts. Third, although the geographical distribution of research is becoming more global, socio-cultural influences on gamification design and effectiveness remain underexplored. These gaps suggest that while the field has achieved conceptual maturity, further empirical consolidation is required to inform sustainable educational practice and policy.

Overall, the discussion reveals that gamification research in education is theoretically grounded, technologically evolving, and pedagogically diversifying. By integrating SDT, Flow Theory, and Constructivist Learning Theory, this study demonstrates that gamification functions not merely as a motivational tool but as a comprehensive educational strategy that bridges psychology, technology, and pedagogy in the digital era.

Conclusion

This bibliometric study analyzed 4,784 publications on gamification in education from 2014 to 2024. The findings confirm that gamification has evolved into a global research frontier, characterized by rapid growth, strong international collaboration, and increasing sophistication in research themes. As a central node in the knowledge network, gamification now intersects with multiple fields of education and technology, highlighting its dual role as both a driver of innovation and a foundation of modern pedagogy. Bibliometric evidence also indicates that gamification research is increasingly connected with AI, e-learning, personalized learning, immersive learning, and educational management, while issues related to transferability, long-term impact, and cost-effectiveness remain underexplored. This trend reflects a shift from short-term motivational studies toward the pursuit of more sustainable and interdisciplinary educational models.

Theoretical Contributions

Theoretically, this study enriches the academic body of knowledge on education and digital technology by providing the first comprehensive quantitative analysis focusing on gamification in education. The

results demonstrate that gamification has become a central theme, bridging domains such as e-learning, game-based learning, learner motivation, and digital skill development.

The study also identifies six core thematic clusters, reflecting the diversity of gamification applications: (i) gamification and e-learning; (ii) learner motivation and engagement; (iii) game-based learning and STEM; (iv) gamification in professional training (e.g., healthcare, engineering); (v) applications of emerging technologies (AI, VR/AR, blockchain); (vi) impact assessment and sustainable development in education.

Keyword analysis shows that gamification, engagement, motivation, and game-based learning remain foundational, while new topics such as adaptive learning, personalized education, virtual reality, and AI indicate a strong integration of gamification with Industry 4.0 in education.

Furthermore, the results contribute to behavioral and psychological theory by revealing a research gap: while short-term motivation has been extensively studied, sustainability of motivation and its effects on critical thinking, collaboration, and creativity remain underexplored. This study helps highlight that gap, paving the way for future research integrating gamification with experiential learning theories and 21st-century skill development.

Practical Implications

The findings of this study provide concrete implications for educators, policymakers, EdTech developers and learners.

For educators, the prominence of themes related to engagement, motivation, and active learning suggests that gamification should be embedded systematically into curriculum design rather than applied as an isolated instructional add-on. For example, learning objectives can be aligned with progressive game mechanics such as levels, challenges, and feedback loops to support mastery learning, while collaborative game elements (e.g., team-based missions or quests) can be used to foster peer interaction and problem-solving skills.

For policymakers, the growing integration of gamification with digital platforms, AI, and immersive technologies highlights the need for supportive policy frameworks that promote pedagogically grounded innovation. This includes investing in teacher training on gamified instructional design, developing quality standards for gamified learning tools, and incorporating gamification into national digital education strategies to reduce learner disengagement and online dropout rates.

For EdTech developers, the emergence of adaptive learning, AI, and personalized education as key research trends indicates strong opportunities to design intelligent gamified systems that adjust content difficulty, feedback, and learning pathways based on learner behavior and performance. Such systems can support scalable and data-informed curriculum development while ensuring that game elements remain aligned with educational objectives rather than purely entertainment-oriented features.

For learners: Gamification can foster enthusiasm, build intrinsic motivation, and enhance soft skills through mechanisms of feedback, rewards, and healthy competition.

Limitations and Future Research

This study has several limitations. First, the dataset was collected from Scopus, which may not fully capture all publications on gamification, particularly non-English sources or "grey literature" (e.g., project reports, policy documents). Second, the study focuses on bibliometric analysis and therefore does not assess the content or quality of individual works. Third, the timeframe was limited to 2024, potentially omitting emerging trends beyond this point.

Future research should address these limitations by combining bibliometric analysis with systematic reviews or meta-analyses to assess research quality and effect sizes. More importantly, future studies should adopt longitudinal research designs to examine the long-term impacts of gamification on learning outcomes and skill development. Expanding research into diverse cultural and educational contexts would also enhance the generalizability of findings. Finally, greater attention should be paid to cost-effectiveness and AI-driven personalization in gamified learning systems to support sustainable and equitable implementation at scale.

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