

GAMIFICATION IN EDUCATION: MAPPING GLOBAL RESEARCH TRENDS, INTELLECTUAL STRUCTURES, AND EMERGING TOPICS THROUGH BIBLIOMETRIC ANALYSIS

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ABSTRACT

Gamification has emerged as an increasingly influential approach in educational research, particularly alongside the rapid development of digital learning technologies and learner-centered pedagogies. This study aims to map the global development of gamification in education research by identifying publication patterns, thematic structures, research hotspots, and emerging topics. A bibliometric analysis was conducted using Scopus data covering the period from 2012 to 2026. The initial search identified 444 documents, which were distributed across diverse subject areas, particularly Computer Science (262 documents), Social Sciences (238), Engineering (120), and Mathematics (55). The dataset also demonstrates broad international participation, with Spain, the United States, Malaysia, Brazil, and India representing the most productive countries. Bibliometric visualization was performed using VOSviewer to examine keyword co-occurrence, research clusters, and the temporal development of research themes. The results indicate that gamification, gamification in education, education, e-learning, learning systems, teaching, and educational technology constitute the core research themes. The thematic structure further reveals strong connections between gamification and active learning, game design, student experiences, motivation, adaptive learning, artificial intelligence, mobile learning, human-computer interaction, and personalized learning. The overlay analysis

suggests a shift from foundational research on game elements and learning environments toward emerging technological applications, including artificial intelligence, adaptive learning, augmented reality, digital tools, and personalized learning. These findings demonstrate that gamification research is becoming increasingly interdisciplinary and technology-oriented. Future research should strengthen empirical and longitudinal investigations and explore the integration of gamification with AI, learning analytics, immersive technologies, and personalized learning to support more effective, engaging, and sustainable educational experiences.

Keywords: *gamification, gamification in education, game-based learning, bibliometric analysis, VOSviewer*

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I. INTRODUCTION

The rapid development of educational technology has encouraged educators and researchers to seek innovative approaches that can enhance students' motivation, engagement, and learning experiences. One approach that has gained considerable attention is gamification, which refers to the use of game-design elements and gameful experiences in non-game contexts, including educational environments (Deterding et al., 2011; Dichev & Dicheva, 2017). In education, gamification may involve the integration of points, badges, leaderboards, challenges, rewards, levels, feedback, and competition into learning activities. Rather than converting learning into a conventional game, gamification seeks to utilize selected game mechanisms to encourage participation and create more engaging learning experiences. The growing scholarly interest in this approach reflects broader efforts to develop learner-centered and technology-enhanced educational environments (Dichev & Dicheva, 2017; Zainuddin et al., 2020).

The potential of gamification is particularly associated with its capacity to influence student motivation, engagement, and learning outcomes. Gamified environments can provide learners with immediate feedback, clear goals, opportunities for recognition, and structured challenges, which may encourage active participation in learning activities. A meta-analysis conducted by Bai et al. (2020) involving 30 independent interventions and 3,202 participants found a significant medium positive effect of gamification on student learning performance (Hedges' $g = 0.504$). The study also identified enthusiasm, feedback, recognition, and goal setting as important reasons why learners respond positively to gamified learning. However, the authors also reported potential negative experiences, including anxiety and jealousy, demonstrating that the effects of gamification are not universally positive.

Subsequent evidence has further strengthened the argument that gamification can contribute to educational outcomes while simultaneously demonstrating that its effectiveness depends on contextual and design-related factors. Sailer and Homner (2020), through a meta-analysis of gamification in learning, found positive effects across cognitive, motivational, and behavioral outcomes. More recently, Li et al. (2023) synthesized 41 studies involving more than 5,000 participants and reported a significant overall effect of gamification on learning outcomes, with an effect size of $g = 0.822$. Importantly, their findings

indicated that the effectiveness of gamification was moderated by factors including learner type, educational discipline, design principles, duration of the gamified experience, and learning environment. These findings indicate that the educational value of gamification cannot be separated from the way game elements are designed and implemented within specific pedagogical contexts.

Beyond academic achievement, gamification has increasingly been investigated from the perspective of motivation and psychological experiences. Game elements may support learners' perceptions of autonomy, competence, and relatedness, which are closely associated with self-determination theory. A recent meta-analysis by Sailer and colleagues found that gamification can positively influence intrinsic motivation, particularly perceptions of autonomy and relatedness, although its effect on perceived competence is comparatively limited. This finding suggests that the effectiveness of gamification should not be evaluated solely through examination scores but should also consider motivational, behavioral, and affective dimensions of learning (Sailer & Homner, 2020). Recent evidence similarly demonstrates that gamification can produce positive effects on autonomy and relatedness, although the magnitude of these effects varies across outcomes and learning contexts.

Nevertheless, the growing popularity of gamification has also generated important theoretical and methodological concerns. Dichev and Dicheva (2017) argued that the implementation of gamification in education has progressed faster than researchers' understanding of its underlying mechanisms, while evidence regarding its long-term educational benefits remains limited. Similarly, Zainuddin et al. (2020) identified inconsistencies in the empirical literature and emphasized the importance of theoretical foundations, appropriate game mechanics, learner characteristics, and educational context. These observations are important because gamification should not be regarded as a universally effective instructional strategy; rather, its outcomes depend on the interaction between game elements, pedagogical objectives, learner characteristics, and the learning environment.

The development of digital education has subsequently expanded the application of gamification across online learning, mobile learning, learning management systems, higher education, K-12 education, language learning, STEM education, and professional training. This expansion has also diversified the research agenda from simple questions concerning whether gamification works toward more sophisticated questions concerning which game elements work, for whom, under what conditions, and through which mechanisms. Li et al. (2023),

for example, demonstrated that educational discipline, user characteristics, duration, design principles, and learning environment can moderate the effectiveness of gamification. Consequently, contemporary gamification research increasingly emphasizes the importance of context-sensitive design rather than the indiscriminate application of points, badges, rankings, or rewards.

Despite the substantial growth of empirical studies, the intellectual structure of gamification research remains fragmented across disciplines, educational levels, technologies, theoretical perspectives, and research objectives. Existing systematic reviews and meta-analyses have primarily concentrated on particular dimensions, including learning outcomes, motivation, engagement, or instructional effectiveness (Bai et al., 2020; Sailer & Homner, 2020; Zainuddin et al., 2020). Although these studies provide important evidence concerning the effectiveness of gamification, they do not fully explain how the global knowledge structure of gamification in education has evolved, which countries and research communities have contributed most significantly, how major concepts are interconnected, and which topics constitute the emerging research frontier. A bibliometric approach is therefore valuable for providing a broader intellectual and conceptual map of the field.

Accordingly, this study, entitled “Gamification in Education: Mapping Global Research Trends, Intellectual Structures, and Emerging Topics Through Bibliometric Analysis,” aims to examine the development and intellectual structure of global research on gamification in education. Specifically, the study maps publication trends, geographical contributions, dominant keywords, keyword co-occurrence patterns, conceptual clusters, thematic development, and emerging research topics. By integrating bibliometric mapping with an interpretation of the evolving literature, this study seeks to identify the major trajectories of gamification research and reveal emerging areas such as learning engagement, motivation, personalized learning, digital learning, artificial intelligence, immersive learning, and technology-enhanced education. The findings are expected to contribute to a more comprehensive understanding of how gamification has developed as an educational research domain and to provide directions for future scholarship and pedagogical practice.

II. LITERATURE REVIEW

Gamification has emerged as an influential approach in educational research, particularly in the context of technology-enhanced and learner-centered education. The concept was initially developed in the broader field of human-computer interaction and refers to the use of game-design elements in non-game contexts (Deterding et al., 2011). In education, gamification involves incorporating elements such as points, badges, leaderboards, levels, challenges, rewards, competition, and immediate feedback into learning activities to encourage participation and engagement. Dichev and Dicheva (2017) emphasize that educational gamification should not simply be understood as making learning into a game, but rather as strategically applying game mechanics to influence learners' motivation and behavior. This distinction is important because the pedagogical value of gamification depends on how game elements are connected to learning objectives rather than on the presence of game features alone.

The theoretical foundation of educational gamification is frequently associated with Self-Determination Theory (SDT), particularly the psychological needs of autonomy, competence, and relatedness (Deci & Ryan, 2000). Gamified learning environments can potentially support these needs by providing learners with meaningful choices, achievable challenges, immediate feedback, and opportunities for social interaction. Sailer et al. (2017) demonstrated that different game-design elements can influence different psychological outcomes, suggesting that game elements should be selected according to the motivational mechanisms they are intended to activate. From this perspective, gamification is not a homogeneous intervention; points, badges, leaderboards, challenges, and collaborative elements may generate different motivational responses depending on learners and contexts. This theoretical perspective has subsequently influenced research examining the relationship between gamification, motivation, engagement, and learning behavior.

Empirical research generally indicates that gamification can produce positive educational outcomes, although the magnitude and consistency of these effects vary. Bai et al. (2020), through a meta-analysis, reported a positive effect of gamification on student learning performance while also identifying potential negative experiences such as anxiety and jealousy. Similarly, Sailer and Homner (2020) found positive effects of gamification on cognitive, motivational, and behavioral learning outcomes. More recently, Li et al. (2023) confirmed the overall effectiveness of gamification in educational settings and demonstrated that its

effects can vary according to learner characteristics, educational disciplines, intervention duration, design principles, and learning environments. These findings suggest that the effectiveness of gamification should be interpreted through a contextual rather than universal perspective.

A significant body of literature has consequently shifted attention from whether gamification works toward how and under what conditions it works. The design of game elements, the duration of implementation, learner characteristics, and pedagogical context can substantially influence outcomes. Zainuddin et al. (2020) emphasize that gamification research needs stronger theoretical foundations and more rigorous empirical designs to distinguish the effects of particular game mechanics. Similarly, Dichev and Dicheva (2017) identified inconsistencies in the literature concerning research designs, theoretical perspectives, and the sustainability of motivational effects. These concerns indicate that gamification should be integrated with instructional design principles rather than applied as an isolated technological intervention.

Recent research has also expanded gamification beyond conventional classroom settings toward online learning, mobile learning, learning management systems, higher education, K–12 education, language learning, and STEM education. This development reflects the increasing convergence between gamification and digital learning environments. The emergence of adaptive learning, artificial intelligence, immersive technologies, and personalized learning has further created opportunities for more sophisticated forms of gamification. Rather than relying exclusively on standardized rewards or rankings, contemporary approaches increasingly consider learner profiles, behavioral data, personalized feedback, and adaptive challenges. Consequently, gamification has become increasingly connected to broader discussions of educational technology, digital pedagogy, student experience, and learning analytics.

Nevertheless, the literature also identifies several limitations and challenges. Excessive emphasis on extrinsic rewards may undermine intrinsic motivation, while competitive elements such as leaderboards may generate negative emotional responses among some learners (Bai et al., 2020; Sailer & Homner, 2020). Furthermore, the novelty effect of gamification may decline over time, raising questions about its long-term sustainability and educational value (Dichev & Dicheva, 2017). Differences in educational culture, age, discipline, technological access, and learner characteristics may also explain why similar gamification strategies produce different outcomes across contexts. These

limitations demonstrate the need for research that examines gamification not merely as a collection of game mechanics but as a complex pedagogical and technological phenomenon.

Although systematic reviews and meta-analyses have provided substantial evidence regarding the effects of gamification, the literature remains fragmented across disciplines, countries, educational levels, technologies, and theoretical perspectives. Existing reviews have largely focused on specific dimensions such as motivation, engagement, learning performance, or instructional effectiveness (Bai et al., 2020; Sailer & Homner, 2020; Zainuddin et al., 2020). A bibliometric perspective can complement these studies by examining the broader intellectual structure of the field, identifying dominant research themes, mapping relationships among concepts, and revealing emerging research frontiers. Therefore, mapping the global literature on gamification in education is important for understanding how the field has evolved and identifying future research opportunities at the intersection of gamification, digital learning, artificial intelligence, personalized learning, learning analytics, and educational innovation.

III RESEARCH METHODOLOGY

This study employed a bibliometric analysis to examine the development, intellectual structure, research trends, and emerging topics in global research on gamification in education. Bibliometric analysis is appropriate for systematically examining large volumes of scientific publications and identifying patterns of knowledge development, influential themes, and relationships among research concepts (Donthu et al., 2021). The study focused on publications related to gamification in educational contexts and used Scopus as the primary bibliographic database because of its extensive multidisciplinary coverage and standardized bibliographic information.

The data were collected from Scopus using relevant keywords related to gamification and education. The search strategy was designed to capture publications discussing the application, implementation, effectiveness, and development of gamification within educational settings. The retrieved records were subsequently screened according to predefined criteria, including publication year, document type, language, subject area, and source type. Duplicate and irrelevant records were excluded where necessary to ensure that the final dataset represented the research domain being investigated. Bibliographic

information including authors, titles, publication years, affiliations, countries, sources, abstracts, and keywords was exported for subsequent analysis.

The analysis consisted of descriptive bibliometric analysis and science mapping. Descriptive analysis was used to identify publication trends, major contributing countries and institutions, document types, and dominant publication sources. Meanwhile, keyword co-occurrence analysis was conducted to identify the conceptual structure of gamification research and to determine relationships among frequently occurring research themes. The analysis also examined the temporal development of keywords to identify established themes and emerging topics. These procedures enabled the study to distinguish between mature research areas and newer research frontiers within the field of educational gamification.

For visualization and network analysis, VOSviewer was employed to construct and visualize keyword co-occurrence networks. The software was used to generate Network Visualization, Overlay Visualization, and Density Visualization. Network Visualization was used to identify relationships and thematic clusters among keywords; Overlay Visualization illustrated the temporal development of research themes; while Density Visualization highlighted areas with high concentrations of frequently occurring keywords. The interpretation of these visualizations was combined with the descriptive findings to provide a comprehensive understanding of the evolution and intellectual structure of global gamification-in-education research.

The methodological procedure followed a systematic sequence consisting of database identification, literature retrieval, screening and refinement, bibliographic data extraction, descriptive analysis, bibliometric mapping, visualization, and interpretation. This approach enables the study to move beyond a simple literature summary by quantitatively mapping the structure and evolution of the research field. Following the recommendations of Donthu et al. (2021), the bibliometric findings were subsequently interpreted in relation to existing literature to identify dominant themes, emerging research directions, and potential gaps for future research.

IV. RESULTS AND ANALYSIS

Descriptive Overview

The Scopus search identified 444 documents published between 2012 and 2026, indicating that research on gamification in education has developed into an increasingly multidisciplinary field. The distribution by subject area shows that Computer Science represents the largest contribution with 262 documents, followed by Social Sciences (238) and Engineering (120). Other relevant areas include Mathematics (55), Decision Sciences (31), Arts and Humanities (28), Business, Management and Accounting (27), and Psychology (22). The presence of these diverse subject areas indicates that gamification in education is positioned at the intersection of educational research, digital technology, computational sciences, engineering, behavioral studies, and decision sciences. Particularly, the dominance of Computer Science and Social Sciences suggests that research simultaneously emphasizes the technological development of gamified learning environments and their educational, behavioral, and social implications.

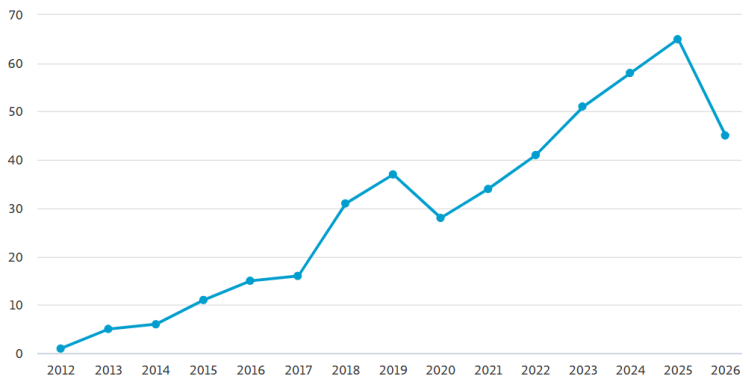


Figure 1. The Number of Publication Yearly

The geographical distribution demonstrates a relatively broad international interest in gamification research. Spain contributes the largest number of publications with 42 documents, followed by the United States and Malaysia with 36 documents each, Brazil (32), India (28), the Russian Federation (21), Turkey (19), and Indonesia (18). The strong representation of both developed and emerging economies indicates that gamification has become a global research topic rather than one limited to particular educational systems. The substantial

contributions from Malaysia, Indonesia, India, Turkey, and Brazil are particularly noteworthy because they demonstrate the growing interest in gamified education across Asian and emerging educational contexts. Meanwhile, the contributions from Spain and the United States indicate the continuing role of established research communities in shaping the international knowledge base.

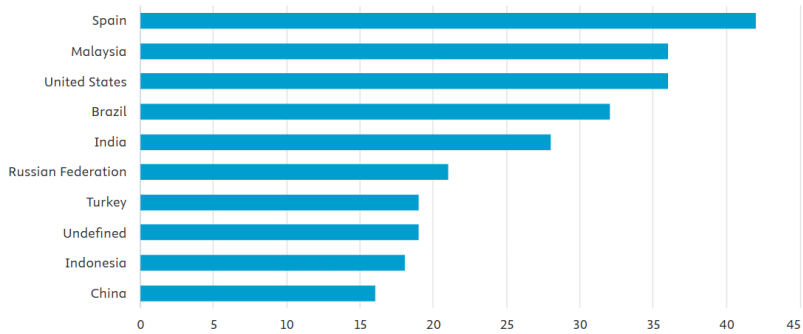


Figure 2. Geographical Distribution

In terms of publication outlets, the dataset is dominated by journals with 206 documents, followed by conference proceedings with 137 documents, book series with 65 documents, and books with 34 documents, while trade journals account for only 2 documents. The relatively high proportion of conference proceedings is consistent with the strong contribution of Computer Science and Engineering to the field, where conference publications frequently serve as important channels for disseminating technological innovations. At the same time, the substantial number of journal publications indicates that gamification in education has developed beyond an emerging technological topic and has increasingly become an established area of academic inquiry. Overall, the descriptive findings demonstrate that gamification in education is characterized by multidisciplinary participation, broad international distribution, and strong connections between educational sciences and technological research, providing a foundation for further analysis of keyword networks, thematic clusters, and emerging research frontiers.

Keyword Co-Occurrence

The Network Visualization generated using VOSviewer reveals a highly interconnected conceptual structure in the global literature on gamification in education. The keyword “gamification” appears as the dominant node,

characterized by its large size and central position, indicating that it functions as the primary conceptual anchor of the research field. Closely connected terms such as “gamification in education,” “education,” “e-learning,” “educational technology,” “teaching,” “learning systems,” “game elements,” and “game design” demonstrate that research has primarily positioned gamification as an instructional and technological approach for enhancing learning processes. The dense connections among these keywords further suggest that gamification research is not developed as an isolated topic but is strongly integrated with broader discussions of digital learning and educational innovation.

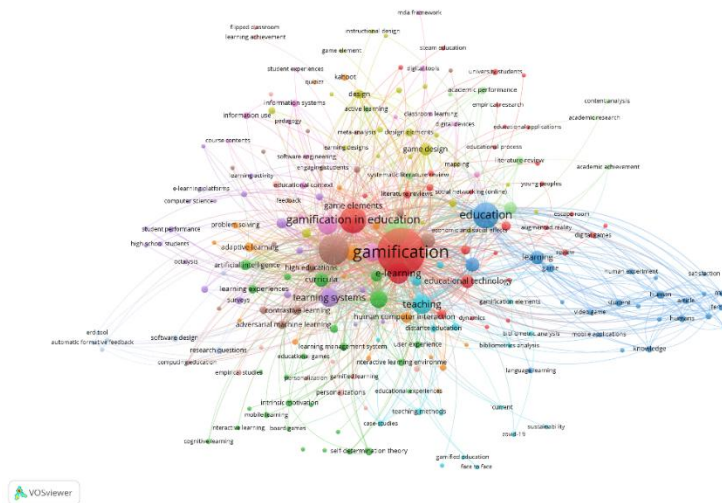


Figure 3. Network Visualization

A prominent thematic structure can also be observed around learning and instructional design. Keywords including “active learning,” “instructional design,” “learning designs,” “classroom learning,” “teaching methods,” “learning activity,” “feedback,” “problem solving,” and “student experiences” indicate that a substantial body of research examines how gamification can be embedded into pedagogical strategies. The appearance of “game design,” “game elements,” “design,” and “educational context” suggests a shift from simply asking whether gamification is effective toward investigating how gamified learning environments should be designed and implemented. This indicates that the research field increasingly recognizes the importance of matching game mechanics with instructional objectives rather than treating gamification merely as an additional technological feature.

Another important cluster is associated with e-learning and educational technology. The co-occurrence of “e-learning,” “educational technology,” “digital tools,” “digital devices,” “learning management system,” “interactive learning environment,” “mobile applications,” and “human computer interaction” demonstrates the close relationship between gamification and digital learning infrastructures. Gamification appears to function as a mechanism for increasing interaction within technology-mediated learning environments. The presence of “software engineering,” “computer science,” “information systems,” and “information use” further confirms the multidisciplinary character of this research area, particularly the integration between educational objectives and technological system development.

The visualization also highlights a distinct learner-centered and motivational cluster. Keywords such as “intrinsic motivation,” “self-determination theory,” “learning experiences,” “student performance,” “engaging students,” “personalization,” “adaptive learning,” and “satisfaction” indicate that researchers have increasingly investigated the psychological and behavioral mechanisms underlying gamification. The connection between gamification and self-determination theory is particularly important because it suggests that researchers are interested not merely in increasing participation but also in understanding how game elements may influence learners' intrinsic motivation, autonomy, competence, and engagement. Meanwhile, the emergence of adaptive learning and personalization points toward a more individualized understanding of gamified education.

The network further demonstrates the emergence of artificial intelligence and intelligent learning technologies within the gamification research landscape. Although “artificial intelligence” is not as dominant as the core keyword “gamification,” its connection with adaptive learning, learning systems, educational technology, and personalization indicates an emerging intersection between gamification and AI-supported education. This suggests a potential transition from standardized gamified learning experiences toward adaptive and personalized gamification, where game mechanics may be adjusted according to learner characteristics, performance, preferences, or interaction patterns.

A further research stream concerns assessment and evidence-based evaluation. Keywords such as “academic performance,” “student performance,”

“learning achievement,” “empirical research,” “meta-analysis,” “systematic literature review,” “surveys,” and “contrasting learning” demonstrate that researchers increasingly seek empirical evidence concerning the effectiveness of gamification. The presence of meta-analysis and systematic literature review suggests that the field has reached a level of maturity where scholars are synthesizing accumulated evidence rather than relying exclusively on individual experimental or descriptive studies. Nevertheless, the network also shows that evaluation remains connected to multiple outcomes, including performance, engagement, satisfaction, and learning experience.

The right side of the network reveals a strong connection between gamification and students, human-computer interaction, and empirical evaluation. Keywords including “student,” “human,” “humans,” “human experiment,” “satisfaction,” “knowledge,” and “video game” suggest research focusing on learner responses and measurable outcomes. This cluster indicates that gamification is increasingly examined through the perspective of user experience and learner behavior, rather than solely from the perspective of technological implementation. The presence of “augmented reality,” “digital games,” “mobile applications,” and “language learning” also demonstrates the expansion of gamification across different technological environments and educational domains.

Thematic Evolution

The Overlay Visualization provides a temporal perspective on the development of gamification research in education, with the color scale ranging approximately from 2019 to 2024. The visualization indicates that the field has progressively shifted from foundational discussions of gamification and game-based learning toward more technology-oriented, personalized, and learner-centered themes. The central position of “gamification,” “gamification in education,” “education,” “e-learning,” and “learning systems” demonstrates the continuity of these concepts as the intellectual foundation of the field, while the changing colors of peripheral keywords reveal how research priorities have evolved over time.

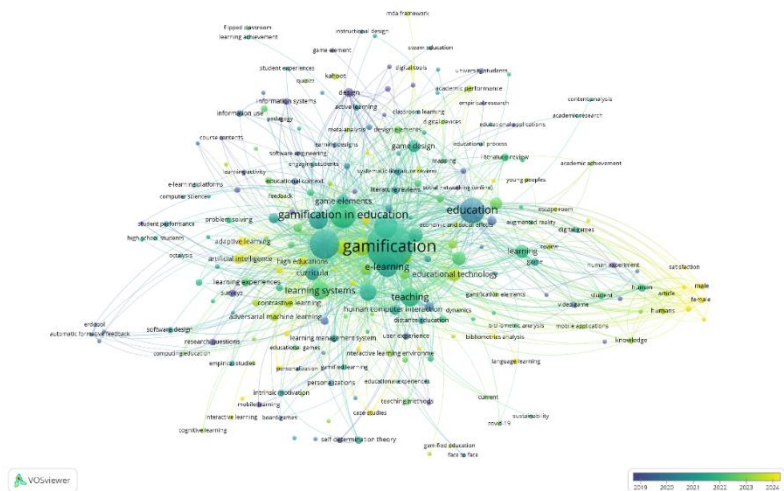


Figure 4. Overlay Visualization

The relatively earlier research themes are associated with foundational pedagogical and technological concepts, including “game elements,” “game design,” “learning systems,” “e-learning platforms,” “computer science,” “information systems,” “active learning,” and “instructional design.” These themes reflect an initial research concern with understanding how game mechanics could be incorporated into educational environments and how gamified systems could support teaching and learning. The prominence of game design and game elements suggests that early scholarship was strongly concerned with identifying appropriate mechanisms for translating game characteristics into non-game educational contexts.

As the research landscape developed, increasing attention can be observed around learning experiences, student engagement, adaptive learning, artificial intelligence, personalization, and interactive learning environments. The appearance of “adaptive learning” and “artificial intelligence” in the more recent portion of the network is particularly significant. It suggests that contemporary gamification research is moving beyond standardized game mechanics toward systems capable of responding dynamically to learners. Gamification is therefore increasingly connected with intelligent educational technologies that can personalize content, activities, feedback, and learning pathways.

Another notable temporal development concerns the growing relationship between gamification and digital educational technologies. Recent-oriented keywords include “digital tools,” “digital devices,” “mobile applications,” “augmented reality,” “interactive learning environment,” “learning management system,” and “educational technology.” This pattern indicates that gamification is increasingly embedded within broader digital transformation in education. Rather than being studied as an independent instructional technique, gamification is becoming part of an integrated ecosystem involving mobile learning, digital platforms, immersive technologies, and technology-mediated interaction.

The overlay visualization also demonstrates increasing interest in learner outcomes and experiences, reflected in terms such as “satisfaction,” “student,” “knowledge,” “academic achievement,” “learning achievement,” “student experiences,” and “user experience.” This development indicates a gradual movement from questions concerning the implementation of gamification toward questions concerning its educational effectiveness and learner impact. Contemporary studies appear increasingly interested in whether gamification produces meaningful improvements in engagement, satisfaction, achievement, motivation, and learning experiences rather than simply whether game elements can be incorporated into educational activities.

The emergence of “self-determination theory,” “intrinsic motivation,” “personalization,” and “gamified learning” also suggests a growing theoretical sophistication in the field. Gamification research increasingly seeks to explain why particular game mechanics influence learners and under what conditions those effects occur. This represents an important transition from technology-centered research toward a more psychologically and pedagogically grounded understanding of gamification. In particular, the relationship between gamification, intrinsic motivation, and self-determination provides a theoretical foundation for examining learner autonomy, competence, engagement, and sustained participation.

Recent themes also include “systematic literature review,” “meta-analysis,” “bibliometrics analysis,” “empirical studies,” and “academic research.” Their presence suggests that the field has entered a phase of knowledge consolidation, in which researchers are increasingly synthesizing accumulated evidence and evaluating the overall state of the literature. This is particularly important because the rapid expansion of gamification research has created a need to distinguish

robust findings from context-specific outcomes and to identify methodological and conceptual gaps.

Research Hotspots and Emerging Frontiers

The density visualization indicates that gamification remains the dominant research hotspot in the literature on gamification in education, as shown by the brightest concentration around the central term gamification. This central position is closely surrounded by gamification in education, education, e-learning, teaching, learning systems, educational technology, game elements, and game design. The strong density and proximity of these terms suggest that the research field has developed around the fundamental question of how game-based mechanisms can be integrated into formal teaching and learning environments. Rather than treating gamification simply as the incorporation of games into education, the literature increasingly frames it as an instructional design strategy involving game elements, learner interaction, motivation, engagement, and learning outcomes. This interpretation is consistent with meta-analytic evidence showing that gamification can generate positive effects on cognitive, motivational, and behavioral learning outcomes, although the magnitude of these effects varies according to design and contextual factors.

A second major hotspot is the intersection between gamification, e-learning, and educational technology. The visualization demonstrates a dense concentration of e-learning, learning systems, educational technology, learning management system, interactive learning environment, and digital devices. This pattern indicates a transition from conventional classroom gamification toward technology-mediated and digitally embedded gamification. In this context, gamification is increasingly integrated into online learning platforms, learning management systems, mobile applications, and digital educational environments. The prominence of user experience, interactive learning environment, and personalization further suggests that current research is moving beyond the question of whether gamification works toward understanding how digital gamified environments should be designed to produce meaningful learner experiences. Recent systematic evidence similarly indicates that gamified learning environments can enhance engagement, interaction, personalization, and collaborative learning when appropriately integrated with pedagogical approaches.

The visualization also identifies motivation and learner psychology as an important research hotspot. Terms such as intrinsic motivation, self-determination theory, learning experiences, student performance, satisfaction, and user experience indicate that psychological mechanisms remain central to understanding the effectiveness of gamification. Particularly, the presence of self-determination theory demonstrates the continuing importance of autonomy, competence, and relatedness in explaining why learners respond positively—or negatively—to gamified environments. This is supported by recent meta-analytic evidence showing that gamification can positively influence intrinsic motivation, autonomy, and relatedness, although its effect on perceived competence appears comparatively limited. The continued appearance of motivational theories within the research landscape is also consistent with systematic theoretical reviews identifying Self-Determination Theory, Flow Theory, experiential learning, and constructivist learning theory among the most frequently applied theoretical foundations in gamification research.

Another important hotspot concerns game design and instructional design. Terms including game design, design elements, instructional design, learning designs, game elements, active learning, feedback, and adaptive learning demonstrate that the research field is increasingly concerned with the design quality of gamified interventions rather than merely the presence of game mechanics. The prominence of feedback, active learning, and adaptive learning suggests that contemporary studies are examining how specific game mechanics can be aligned with pedagogical objectives. This is particularly important because gamification does not automatically produce better learning outcomes; its effectiveness depends on factors such as the type of game elements employed, duration of the intervention, learning environment, educational discipline, and design principles. Thus, the emerging research direction is shifting from “gamification as an intervention” toward “evidence-based gamification design.”

The visualization further reveals an emerging connection between gamification and artificial intelligence (AI). Although artificial intelligence is not yet as dominant as gamification or e-learning, its position within the research landscape indicates an important frontier. AI introduces the possibility of adaptive gamification in which difficulty levels, rewards, feedback, learning pathways, and game mechanics can be dynamically adjusted according to individual learner characteristics and performance. The emergence of adaptive learning, personalization, adversarial machine learning, and AI-related terminology

suggests that the field is beginning to explore the convergence between intelligent systems and gamified learning. This frontier has become particularly relevant in recent research on AI-supported gamified digital learning environments, where adaptive or generative AI is combined with game-based design to support personalized learning and student engagement. Consequently, AI-driven personalized gamification represents one of the most promising directions for future research.

Another emerging frontier is the integration of gamification with immersive and extended-reality technologies, particularly augmented reality, digital games, escape room, and related interactive technologies. Although these terms occupy a peripheral position compared with the central gamification cluster, their presence demonstrates the expansion of gamification toward more immersive learning environments. The combination of gamification and augmented reality can create contextualized learning experiences in which students interact with digital information while remaining connected to physical environments. Previous systematic research has documented growing interest in the integration of augmented reality and gamification, particularly in relation to engagement, motivation, knowledge acquisition, academic performance, and personalized learning. Similarly, the combination of virtual reality and gamification has emerged as a significant research frontier because immersive gamified environments can increase motivation, interaction, satisfaction, and opportunities for collaborative and personalized learning.

The emergence of escape rooms, digital games, mobile learning, and gamified education also suggests a movement toward experiential and situated learning. These approaches transform learners from passive recipients of information into active participants who solve problems, make decisions, receive feedback, and progress through structured challenges. In particular, the proximity of problem solving, learning experiences, active learning, and interactive learning environment to the central gamification cluster indicates that researchers increasingly conceptualize gamification as a mechanism for creating active and experiential learning environments. This is consistent with research on immersive gamified environments, which emphasizes the capacity of gamification to increase students' participation, curiosity, focus, interaction, and learning experiences.

A further frontier concerns personalization and adaptive gamified learning. The appearance of personalization, personalizations, adaptive learning, and gamified learning in the visualization indicates increasing attention to individual differences among learners. This direction is theoretically important because the same game mechanics may not produce identical effects for different learners. Personalized gamification allows instructional systems to adjust challenges, rewards, feedback, content, or progression according to students' abilities, preferences, motivation, or learning behavior. The recent development of AI-supported gamified learning strengthens this direction by enabling real-time adaptation based on learner data. Therefore, future studies could move toward learner-centered adaptive gamification, in which game mechanics are dynamically tailored rather than uniformly applied to all students.

The map also indicates the continued relevance of learning outcomes and academic performance. Terms such as student performance, academic achievement, learning achievement, academic performance, and satisfaction remain visible around the research network. This demonstrates that researchers continue to evaluate gamification through measurable educational outcomes. However, recent evidence suggests that the relationship between gamification and learning is not universally uniform. Meta-analytic research has found positive overall effects but also substantial variation associated with educational discipline, gamification design, duration, user type, and learning environment. More recent research focusing specifically on mathematics has likewise reported positive effects on motivation while highlighting limitations in the measurement of engagement. Thus, a promising research frontier is the development of more rigorous and multidimensional evaluation frameworks that measure not only achievement but also engagement, motivation, persistence, cognitive development, collaboration, and long-term learning retention.

Analysis

The bibliometric visualization demonstrates that gamification has developed into a mature and highly interconnected research domain within educational research, with gamification occupying the most prominent position at the center of the knowledge map. The strong connections between gamification, gamification in education, education, e-learning, teaching, learning systems, educational technology, and game elements indicate that the field has moved

beyond the initial conceptualization of gamification as simply the addition of game features to non-game contexts. Gamification was originally conceptualized as the use of game design elements in non-game contexts (Deterding et al., 2011), while subsequent educational research increasingly positioned it as a pedagogical and instructional strategy capable of influencing learners' motivation, engagement, behavior, and learning outcomes. The strong centrality of gamification in the present bibliometric map therefore reflects the consolidation of a research paradigm in which game-inspired design is examined as part of broader technology-enhanced learning environments. This development is consistent with systematic mapping studies that identified gamification design principles, game mechanics, educational contexts, implementation, and evaluation as major dimensions of the educational gamification literature (Dicheva et al., 2015).

The findings further suggest that the relationship between gamification and educational technology constitutes one of the principal intellectual structures of the field. The close positioning of e-learning, educational technology, learning systems, learning management systems, digital devices, mobile applications, and interactive learning environment indicates that gamification research has increasingly become embedded within digital learning infrastructures. This trajectory is particularly evident in higher education, where e-learning platforms provide an appropriate technological environment for integrating points, badges, leaderboards, levels, feedback, challenges, and other game mechanics. Subhash and Cudney (2018), for example, found that gamified learning in higher education was associated with improvements in student attitudes, engagement, and performance, while points, badges, and leaderboards were among the most frequently employed game elements. Similarly, Khaldi et al. (2023) demonstrate that the gamification of e-learning has become an important research direction as higher education institutions increasingly rely on digital learning environments.

This pattern is theoretically important because it shows that gamification is increasingly being treated as a component of learning-system design rather than an isolated classroom technique. Domínguez et al. (2013) demonstrated that gamification could be integrated directly into an e-learning platform, while later studies have increasingly explored how game mechanics interact with instructional design, digital learning environments, and user experience. The bibliometric map reinforces this evolution through the proximity of game design, design elements, instructional design, active learning, learning designs, and

educational process. Consequently, contemporary gamification research is increasingly concerned with the alignment between game mechanics and pedagogical objectives. In other words, the central question is gradually changing from “Does gamification work?” to “How should gamification be designed and integrated into learning systems so that it produces meaningful educational outcomes?” This shift is consistent with the broader literature, which emphasizes that gamification outcomes depend considerably on design, context, implementation, and learner characteristics (Dicheva et al., 2015; Zainuddin et al., 2020).

Another important finding is the strong presence of motivation, engagement, and psychological mechanisms in the research landscape. Terms such as intrinsic motivation, self-determination theory, learning experiences, satisfaction, user experience, and student performance demonstrate that gamification research continues to be strongly influenced by psychological perspectives. This is particularly significant because gamification is frequently justified on the assumption that game elements make learning more motivating and engaging. Krath et al. (2021), in their systematic review of theoretical foundations in gamification, serious games, and game-based learning, identified 118 different theories and found that self-determination theory, flow theory, experiential learning theory, and constructivist learning theory were among the most frequently used theoretical foundations. The prominence of self-determination theory in the present visualization therefore indicates that researchers increasingly recognize that the effectiveness of gamification cannot be adequately explained through technological features alone; rather, it must also be understood through the psychological processes activated by those features.

Nevertheless, the literature indicates that gamification does not automatically produce intrinsic motivation. This is an important qualification to the dominant positive narrative surrounding gamified education. Mekler et al. (2017), for example, found that points, levels, and leaderboards could increase performance quantity without necessarily increasing intrinsic motivation or perceived competence. Similarly, Hanus and Fox's longitudinal study found that students exposed to a gamified course experienced declines in motivation, satisfaction, and empowerment over time compared with students in a non-gamified course. These findings are especially relevant to the bibliometric prominence of intrinsic motivation, satisfaction, and self-determination theory, because they demonstrate that the psychological consequences of gamification are

context-dependent. Game mechanics may function as extrinsic incentives rather than as mechanisms that genuinely support autonomy, competence, and relatedness. Therefore, future research should pay greater attention to the distinction between short-term behavioral activation and sustainable intrinsic motivation.

The positive side of the evidence, however, should not be underestimated. Meta-analytic research provides substantial support for the educational potential of gamification. Sailer and Homner (2020) reported significant positive effects of gamification on cognitive, motivational, and behavioral learning outcomes, although the magnitude of effects varied and considerable heterogeneity remained across studies. Bai et al. (2020) similarly reported a positive overall effect of gamification on student learning performance, while noting that shorter interventions tended to produce larger effects. Zainuddin et al. (2020) identified three particularly consistent positive themes in educational gamification research: student engagement and motivation, academic achievement, and social connectivity. Thus, the centrality of student performance, academic achievement, learning achievement, and engagement in the bibliometric visualization reflects a substantial empirical research tradition rather than merely a conceptual interest.

At the same time, the evidence suggests that the effectiveness of gamification is heterogeneous rather than universal. The systematic review by Alomari et al. (2019) explicitly noted mixed findings and argued that inappropriate selection or implementation of gamification techniques may explain some of the inconsistencies. Sailer and Homner (2020) similarly identified significant heterogeneity across cognitive, motivational, and behavioral outcomes. The bibliometric visualization supports this interpretation because it contains a broad range of concepts surrounding the central gamification cluster, including feedback, adaptive learning, problem solving, learning experiences, personalization, active learning, human-computer interaction, and user experience. This suggests that gamification outcomes are mediated by multiple design and contextual variables. Accordingly, future studies should avoid treating gamification as a homogeneous intervention and should instead examine specific mechanics, specific learners, specific pedagogical settings, and specific learning outcomes.

One of the most significant developments visible in the research map is the emergence of personalization and adaptive gamification. The presence of

adaptive learning, personalization, personalized gamified learning, and learning management systems indicates a transition toward learner-centered gamification. Earlier gamification systems often provided the same points, badges, challenges, and rankings to all students. However, individual learners differ in personality, prior gaming experience, learning preferences, competitiveness, motivation, and technological familiarity. Buckley and Doyle (2017) demonstrated that the effectiveness of gamification varies according to individual attributes and argued that gamification needs to be implemented in a nuanced manner. More recently, Hong et al. (2024) found that personalized and adaptive gamification research is increasingly concerned with user modeling and dynamic student data, although many studies remain at the modeling stage rather than full implementation. This represents an important frontier because it shifts gamification from one-size-fits-all design toward individualized learning experiences.

The emergence of artificial intelligence as a research frontier further reinforces this transition. Although artificial intelligence does not possess the same density as the central gamification term in the visualization, its connection with adaptive learning, personalization, digital tools, and learning systems indicates a potentially transformative direction. Babu and Moorthy (2024) specifically examined the application of AI to adaptive gamification and found that AI can support the dynamic adaptation of game mechanics according to learners' personality, needs, values, performance, and motivation. This is particularly relevant to the current evolution of educational technology because AI can potentially transform gamification from a static collection of predetermined rewards into a dynamic system that continuously interprets learner behavior and adjusts challenges, feedback, content, and progression. Recent research further highlights architectures involving recommender systems, real-time behavioral adaptation, affect-aware feedback, predictive modeling, and algorithmic content generation.

This development suggests that the next generation of gamification research should investigate AI-supported adaptive gamification rather than merely AI-assisted gamification. The distinction is important. AI-assisted gamification may use AI as a tool for creating educational content or designing game elements, whereas AI-supported adaptive gamification uses learner data to dynamically modify the learning experience. Such systems could theoretically identify declining engagement, detect excessive difficulty, recommend alternative learning activities, modify reward structures, or adjust feedback in real time.

However, this frontier also introduces important concerns regarding data privacy, algorithmic bias, transparency, surveillance, and equity. Recent reviews of AI-supported gamified learning highlight precisely these issues, suggesting that technological sophistication must be accompanied by responsible data governance and attention to cognitive load and equitable access.

Another notable research direction is the convergence of gamification with immersive technologies, particularly augmented reality and digital games. The bibliometric visualization identifies augmented reality, digital games, escape room, video game, and mobile applications around the broader educational technology cluster. This indicates that gamification is increasingly being combined with immersive and experiential learning technologies. Lampropoulos et al. (2022), in a systematic review of 670 studies, found that the combination of augmented reality and gamification can contribute to engagement, motivation, active participation, knowledge acquisition, enjoyment, academic performance, and learning outcomes when implemented through student-centered educational approaches. Similarly, meta-analytic evidence on augmented reality in education indicates positive effects on student performance, although outcomes vary according to implementation and treatment duration.

The emergence of escape rooms and experiential learning is also theoretically meaningful. Gamified escape rooms transform learning into a problem-solving process in which students must collaborate, interpret information, make decisions, and achieve goals within constraints. The proximity of problem solving, active learning, learning experiences, team-based activities, and escape room in the visualization suggests that gamification is increasingly connected with experiential and collaborative pedagogies. This is consistent with Krath et al. (2021), who identified experiential learning and constructivist learning among the important theoretical foundations of gamification research. Therefore, gamification's educational value may increasingly depend not on superficial rewards but on its capacity to structure meaningful learner activity, feedback, collaboration, experimentation, and progressive mastery.

The visualization also demonstrates that e-learning and gamification have become particularly important in higher education. The presence of university students, higher education, academic performance, learning management systems, and e-learning platforms indicates that universities represent a major application

context. This is consistent with the systematic review by Khaldi et al. (2023), which identifies gamification as an increasingly important strategy within higher education e-learning environments. The shift toward online and blended learning has created an environment in which gamification can address some of the challenges associated with learner isolation, reduced interaction, limited feedback, and declining engagement. However, the literature also indicates that simply adding points or badges to an LMS does not guarantee meaningful learning. Effective integration requires alignment between game mechanics, course objectives, assessment, learner characteristics, and instructional design.

An important implication of the bibliometric structure is therefore the need to strengthen the pedagogical foundations of gamification research. Zainuddin et al. (2020) observed that a substantial proportion of educational gamification studies lacked explicit theoretical grounding. This concern is particularly important given the expansion of research into AI, adaptive learning, augmented reality, mobile learning, and other technologies. Without strong theoretical foundations, research risks becoming technology-driven rather than learning-driven. The theoretical review by Krath et al. (2021) provides an important foundation for addressing this issue by demonstrating that gamification can be understood through multiple complementary theories, including self-determination theory, flow, experiential learning, and constructivism. Future bibliometric and empirical research should therefore examine not only which technologies dominate the field but also which learning theories explain why particular gamification mechanisms work under particular conditions.

The map also points toward an important critical research agenda. The dominance of positive terms such as motivation, engagement, satisfaction, and performance can potentially create a bias toward viewing gamification as inherently beneficial. Yet critical scholarship has repeatedly emphasized that gamification can generate negative or unintended consequences. Toda et al. (2019), for instance, highlighted potential negative effects associated with gamification in education, while Hanus and Fox (2015) demonstrated that poorly designed or excessively competitive gamification can negatively affect motivation over time. The research agenda should therefore include questions concerning over-competition, reward dependency, anxiety, social comparison, gaming fatigue, inequitable participation, and the potential displacement of intrinsic learning goals by extrinsic rewards.

V. CONCLUSION AND RECOMMENDATION

This bibliometric study demonstrates that research on gamification in education has developed into a broad and increasingly interdisciplinary field, with strong connections to educational technology, e-learning, learning systems, teaching, game design, active learning, human-computer interaction, and student learning experiences. The bibliometric mapping indicates that gamification and gamification in education remain the central intellectual nodes, while the surrounding research structure increasingly incorporates adaptive learning, artificial intelligence, mobile learning, personalized learning, augmented reality, digital games, and interactive learning environments. The temporal visualization further suggests a transition from foundational discussions of game elements and learning motivation toward more technology-intensive and learner-centered applications. Thus, contemporary gamification research is no longer limited to the simple incorporation of points, badges, leaderboards, or game mechanics into instruction, but is increasingly positioned as part of broader digital learning ecosystems.

Future research should therefore move toward evidence-based, personalized, and technologically integrated gamification. Researchers are encouraged to investigate how gamification interacts with artificial intelligence, adaptive learning, learning analytics, immersive technologies, mobile learning, and personalized educational systems, while also examining long-term learning outcomes rather than short-term engagement alone. Greater attention should also be given to differences in learner characteristics, educational levels, disciplines, cultural contexts, and accessibility. In addition, future studies should employ longitudinal, experimental, mixed-method, and comparative designs to strengthen evidence regarding the effectiveness and sustainability of gamified learning. Particular opportunities exist in examining ethical issues, learner autonomy, privacy, digital well-being, algorithmic personalization, and the risk of excessive competition. Such directions can help shift the field from “gamification as a collection of game elements” toward “gamification as an evidence-based pedagogical and technological strategy for meaningful, personalized, and sustainable learning.”

REFERENCES

- Alomari, I., Al-Samarraie, H., & Yousef, R. (2019). The role of gamification techniques in promoting student learning: A review and synthesis. *Journal of Information Technology Education: Research*, 18, 395–417.
- Babu, S. S., & Moorthy, A. D. (2024). Application of artificial intelligence in adaptation of gamification in education: A literature review. *Computer Applications in Engineering Education*, 32, e22683. <https://doi.org/10.1002/cae.22683>
- Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, 30, 100322. <https://doi.org/10.1016/j.edurev.2020.100322>
- Buckley, P., & Doyle, E. (2017). Individualising gamification: An investigation of the impact of learning styles and personality traits on the efficacy of gamification using a prediction market. *Computers & Education*, 106, 43–55. <https://doi.org/10.1016/j.compedu.2016.11.009>
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “gamification.” In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). ACM. <https://doi.org/10.1145/2181037.2181040>
- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education*, 14, 9. <https://doi.org/10.1186/s41239-017-0042-5>
- Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society*, 18(3), 75–88.
- Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J.-J. (2013). Gamifying learning experiences:

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- Practical implications and outcomes. *Computers & Education*, 63, 380–392. <https://doi.org/10.1016/j.compedu.2012.12.020>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Evans, W., Castelli, D. M., et al. (2021). Effects of gamification on behavioral change in education: A meta-analysis. *International Journal of Environmental Research and Public Health*, 18(7), 3558.
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. In 2014 47th Hawaii International Conference on System Sciences (pp. 3025–3034). IEEE.
- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, 80, 152–161.
- Hong, Y., Saab, N., & Admiraal, W. (2024). Approaches and game elements used to tailor digital gamification for learning: A systematic literature review. *Computers & Education*, 212, 105000. <https://doi.org/10.1016/j.compedu.2024.105000>
- Khaldi, A., Bouzidi, R., & Nader, F. (2023). Gamification of e-learning in higher education: A systematic literature review. *Smart Learning Environments*, 10, 10. <https://doi.org/10.1186/s40561-023-00227-z>
- Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, 45, 191–210. <https://doi.org/10.1016/j.ijinfomgt.2018.10.013>
- Krath, J., Schürmann, L., & von Korflesch, H. F. O. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior*, 125, 106963. <https://doi.org/10.1016/j.chb.2021.106963>

- Lampropoulos, G., Keramopoulos, E., Diamantaras, K., & Evangelidis, G. (2022). Augmented reality and gamification in education: A systematic literature review of research, applications, and empirical studies. *Applied Sciences*, 12(13), 6809. <https://doi.org/10.3390/app12136809>
- Landers, R. N. (2014). Developing a theory of gamified learning: Linking serious games and gamification of learning. *Simulation & Gaming*, 45(6), 752–768.
- Leitão, R., Maguire, M., Turner, S., et al. (2022). A systematic evaluation of game elements effects on students' motivation. *Education and Information Technologies*, 27, 1081–1103. <https://doi.org/10.1007/s10639-021-10651-8>
- Li, M., Ma, S., & Shi, Y. (2023). Examining the effectiveness of gamification as a tool promoting teaching and learning in educational settings: A meta-analysis. *Frontiers in Psychology*, 14, 1253549. <https://doi.org/10.3389/fpsyg.2023.1253549>
- Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, 71, 525–534. <https://doi.org/10.1016/j.chb.2015.08.048>
- Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review*, 32, 77–112. <https://doi.org/10.1007/s10648-019-09498-w>
- Sailer, M., & Sailer, M. (2021). Gamification of in-class activities in flipped classroom lectures. *British Journal of Educational Technology*, 52(1), 75–90.
- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, 69, 371–380.
- Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*, 74, 14–31.
- Subhash, S., & Cudney, E. A. (2018). Gamified learning in higher education: A systematic review of the literature. *Computers in Human Behavior*, 87, 192–206. <https://doi.org/10.1016/j.chb.2018.05.028>

- Toda, A. M., Valle, P. H. D., & Isotani, S. (2017). The dark side of gamification: An overview of negative effects of gamification in education. In *Researcher Links Workshop: Higher Education for All* (pp. 143–156). Springer.
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30, 100326. <https://doi.org/10.1016/j.edurev.2020.100326>