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Bibliometric Analysis of Gamification in Education: Trends, Collaboration, and Future Directions

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Abstract

In the past decade, gamification has emerged as an innovative approach in education aimed at enhancing student motivation, engagement, and learning outcomes. By integrating game elements like points, badges, leaderboards, and levels into learning activities, gamification creates a more interactive and engaging learning experience. This study explores the bibliometric analysis of research on gamification in education, with a particular focus on trends, collaboration networks, and future directions. The objective is to identify significant research patterns, major contributors, and the evolution of themes in gamification studies. The research method employs a bibliometric approach, using Scopus and Web of Science databases to gather data from publications between 2022 and 2025. Results indicate a substantial increase in publications on gamification, especially in higher education, medical training, and digital learning technologies. The analysis shows that countries like the United States, Spain, and the United Kingdom lead international collaborations, with journals like *BMC Medical Education* and *PLOS ONE* playing a significant role. A key novelty of this study is the integration of bibliometric analysis and network visualization to map the relationships between research topics and authors. This paper contributes to the literature by offering a comprehensive map of gamification research, addressing gaps in the current studies and providing insights into future interdisciplinary research directions, including AI, VR, and social-emotional learning in educational gamification.

Keywords: *Gamification, Education, Bibliometric Analysis, Collaboration Networks, Future Research Directions*

1. Introduction

In the past decade, gamification has evolved into an innovative approach in the field of education to enhance motivation, engagement, and learning outcomes for students. This approach integrates game elements such as points, badges, leaderboards, and levels into learning activities to create a more interactive and engaging learning experience. Globally, research on gamification shows a rapid increase, with over 2,400 publications indexed in Scopus from 2000 to 2023, signaling a significant surge in academic interest

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in applying game elements to online and hybrid education (Christopoulos & Mystakidis, 2023).

In the context of higher education, bibliometric analysis of various publications reveals that the peak of research occurred between 2021 and 2023, with significant growth in the areas of language learning, medicine, and educational technology (Zolfaghari et al., 2025). Stable annual growth and the dominant contributions from countries such as the United States, Spain, and the United Kingdom highlight the global dynamics and strong collaborative potential in the development of educational gamification (Fernández Vázquez et al., 2024).

The application of gamification in education holds strategic value not only for modern learning theories but also in supporting the strengthening of Science and Technology-based Human Resources (SDM Iptek), as outlined in the National Master Plan for Research (RIRN) in the priority area of Information and Communication Technology (ICT). Gamification contributes to the digital transformation of education by creating adaptive, collaborative learning processes that help build 21st-century skills. Additionally, this approach supports the achievement of Sustainable Development Goal (SDG) 4: Quality Education, which emphasizes equitable access and the improvement of learning quality through innovative technology. This effort aligns with Asta Cita No. 4, which aims to strengthen human resources, science, technology, and education to accelerate national independence. The increase in international publications and cross-border collaborations indicates the potential of gamification in expanding the global-oriented digital education ecosystem (Martin et al., 2024) Therefore, comprehensive studies on trends, collaboration networks, and future directions of gamification research are crucial to strengthening national research productivity and the effective application of technology in education (Karimian et al., 2025).

Recent studies show that gamification has become a central theme in technology-based educational research. Several studies identify emerging research trends, such as the use of artificial intelligence (AI) in gamification, integration with e-learning, and the exploration of 3D virtual learning environments that support student engagement (Christopoulos & Mystakidis, 2023). Furthermore, analysis shows strong international collaboration among researchers from the United States, the United Kingdom, China, Spain, and Canada, illustrating that gamification research has become a global, multidisciplinary field. Other studies have found that keywords such as motivation, higher education, and engagement are the most dominant in academic publications in this field (Zolfaghari et al., 2025) However, significant geographical gaps remain—especially in Africa and Southeast Asia, which suggests the need to expand gamification research into underrepresented regions (Martin et al., 2024).

Moreover, recent research emphasizes the importance of bibliometric approaches and network visualization for understanding relationships between researchers and the evolution of research themes (Karimian et al., 2025). Studies by (Alzahrani & Alhalafawy, 2023). highlight that faculty motivation and technical barriers are key factors in the successful implementation of gamification based on learning management systems. In

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addition, most research focuses on higher education contexts, while applications in primary and vocational education have been less explored (Romero-Alemán, 2024).

Although research on gamification in education continues to grow, most studies still focus on descriptive analyses of publication trends without connecting them to collaboration networks and comprehensive future research directions. Few studies use bibliometric-network visualization approaches to trace relationships between researchers, disciplines, and the interconnections of research topics (Karimian et al., 2025). (Fernández Vázquez et al., 2024). Additionally, the integration of quantitative analysis (such as publication productivity and citations) with qualitative analysis (such as topic mapping and the evolution of research themes) has not been extensively developed. This methodological gap creates a need for new research that can provide a holistic view of the scientific landscape of gamification in education, including trends, collaborations, and future development directions (Zolfaghari et al., 2025).

The main issue in this research is the lack of comprehensive studies mapping trends, collaborations, and research directions in gamification in education. Despite the sharp increase in publications, there has been no bibliometric analysis that combines thematic mapping and collaborative networks visually to depict the knowledge structure of the field. If this gap is not addressed, the potential for the development of theories and innovations based on gamification in education systems will be hindered. Educational institutions may also risk missing opportunities to optimize evidence-based learning strategies. Theoretically, the absence of an integrative research map will obstruct the development of conceptual models and frameworks for international collaboration in the future.

This research aims to comprehensively analyze the landscape of gamification research in education using bibliometric and scientific network visualization approaches. Its primary objectives include:

The research identifies significant trends in the increase of publications on gamification, with key areas of focus including education, health, and technology, and highlights the leading contributions from countries like the United States, the United Kingdom, and European nations in international collaborations. It also analyzes author productivity and citations, revealing that influential authors such as Craig, Karimian, and Mitchell dominate, particularly in the contexts of medical education and digital learning. Prominent journals like BMC Medical Education and PLOS ONE are identified as major sources, with high-impact articles discussing the application of Self-Determination Theory (SDT) in gamification design. The research explores key themes such as the effects of gamification on motivation, engagement, and learning outcomes, with a focus on the interconnected concepts of autonomy, competence, and relatedness in higher education and medical training. Additionally, future research directions are likely to expand into the integration of technologies like AI and VR in gamification, along with deeper exploration of gender dynamics, empathy, and emotional well-being in gamified learning environments. The study encourages transdisciplinary research that blends technology,

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psychology, and education to drive more holistic and innovative pedagogical approaches to contemporary challenges.

This research contributes to the academic literature by presenting a scientific map that integrates publication trend analysis, research collaboration, and thematic relationships in the field of educational gamification. The results are expected to enrich conceptual and methodological understanding of how gamification research develops and interacts across disciplines. Practically, the findings can serve as a reference for policymakers, educational institutions, and learning technology developers in designing strategies to strengthen ICT and digital education research. This study also supports national efforts to enhance the quality of science and technology-based human resources, in line with Asta Cita No. 4 and the priority RIRN in the ICT sector.

2. Research Method

This study employs a bibliometric approach to analyze publication trends regarding gamification in the context of education. The bibliometric method was chosen for its ability to systematically and quantitatively identify topic developments, author collaborations, and potential future research directions (Ahmed Dahri et al., 2025). The study follows the PRISMA 2020 guidelines, which include four main stages: identification, screening, inclusion, and reporting of results (Rafi et al., 2025).

During the identification stage, literature was searched in two major scientific databases, Scopus and Web of Science (WoS), which are widely recognized for their coverage and indexing quality. The search strategy used was as follows: (TITLE-ABS-KEY (Gamification) AND TITLE-ABS-KEY (Education)) AND PUBYEAR > 2021 AND PUBYEAR < 2026

AND (LIMIT-TO (SUBJAREA, "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))

This criterion was designed to ensure that the analyzed articles are scholarly (article type), in English, within the social sciences field, and relevant to the topic of gamification in education for the period 2022–2025. The selection of open-access (OA) articles was not further restricted to ensure open access to the gathered literature. This strategy aligns with previous bibliometric studies emphasizing the importance of transparency in screening scientific literature (Rafi et al., 2025).

Following the identification stage, screening was conducted to remove duplicates and publications that did not meet the inclusion criteria. This step was performed manually using EndNote reference management software. Irrelevant articles were reviewed based on titles and abstracts, and confirmed through full-text reviews when necessary. The inclusion stage retained only articles that explicitly discussed the application or theoretical studies of gamification in both formal and non-formal education (Rodrigues et al., 2022).

The data that passed the selection process were then analyzed using Bibliometrix software within RStudio and VOSviewer for network analysis. The analysis covered

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metrics such as the number of publications per year, country distribution, institutional affiliations, author collaboration, and co-occurrence analysis of keywords. Visualizations were generated to show clusters of key topics, international collaboration relationships, and temporal keyword trends. This approach has been widely used in contemporary bibliometric studies to understand the knowledge landscape within a specific domain (Irhadtanto et al., 2024).

Finally, the results of the analysis were reported according to the PRISMA structure, accompanied by a PRISMA 2020 flow diagram that outlines the number of articles at each stage (identification, screening, final inclusion). This process is designed to ensure high transparency and replicability of the research methods (Pek et al., 2025). The approach used in this study allows for identifying knowledge gaps, mapping global collaborations, and projecting future research directions related to gamification in education.

3. Result

3.1 Publication Trends and Global Collaboration in Gamification Research

Figure 1 illustrates the year-on-year growth in the number of publications related to gamification, as well as the level of international collaboration in this field. This analysis provides an overview of the growing research interest in gamification and the extent to which global cooperation has contributed to the advancement of the field.

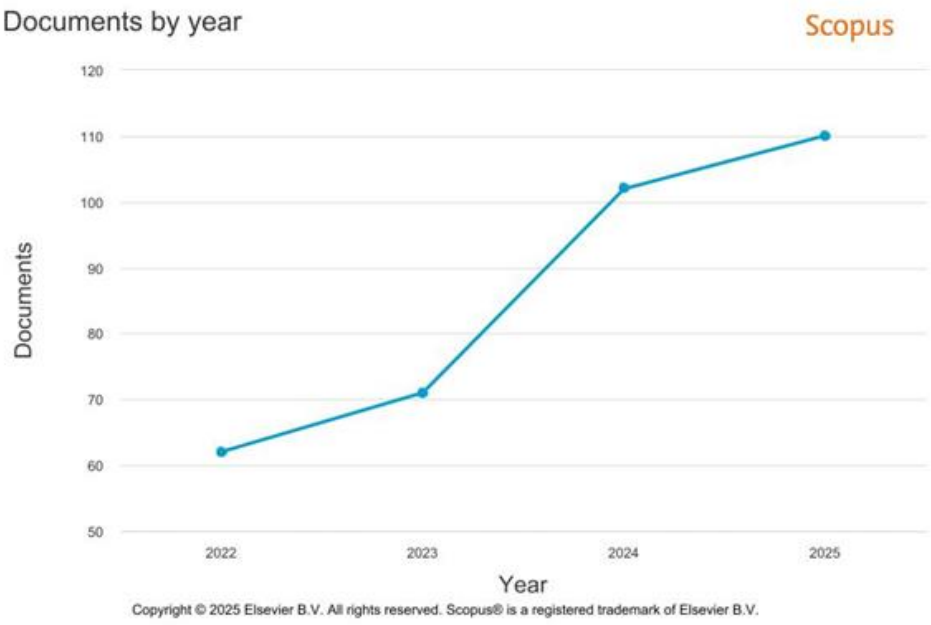

Figure 1

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Based on Figure 1, it is evident that the number of publications related to gamification shows a consistent upward trend from 2022 to 2025. In 2022, the number of recorded documents was approximately 63 publications, gradually increasing to around 71 publications in 2023. A significant spike occurred in 2024, with more than 100 publications, reflecting growing academic attention toward the gamification topic. This trend continues into 2025, with the number of publications reaching approximately 110 documents.

This steady increase indicates that gamification has become an increasingly relevant research focus across various disciplines. This trend can also be interpreted as a result of the growing application of gamification in education, business, and technology, as well as the expanding global collaboration among researchers in developing innovative approaches based on motivation and interactivity.

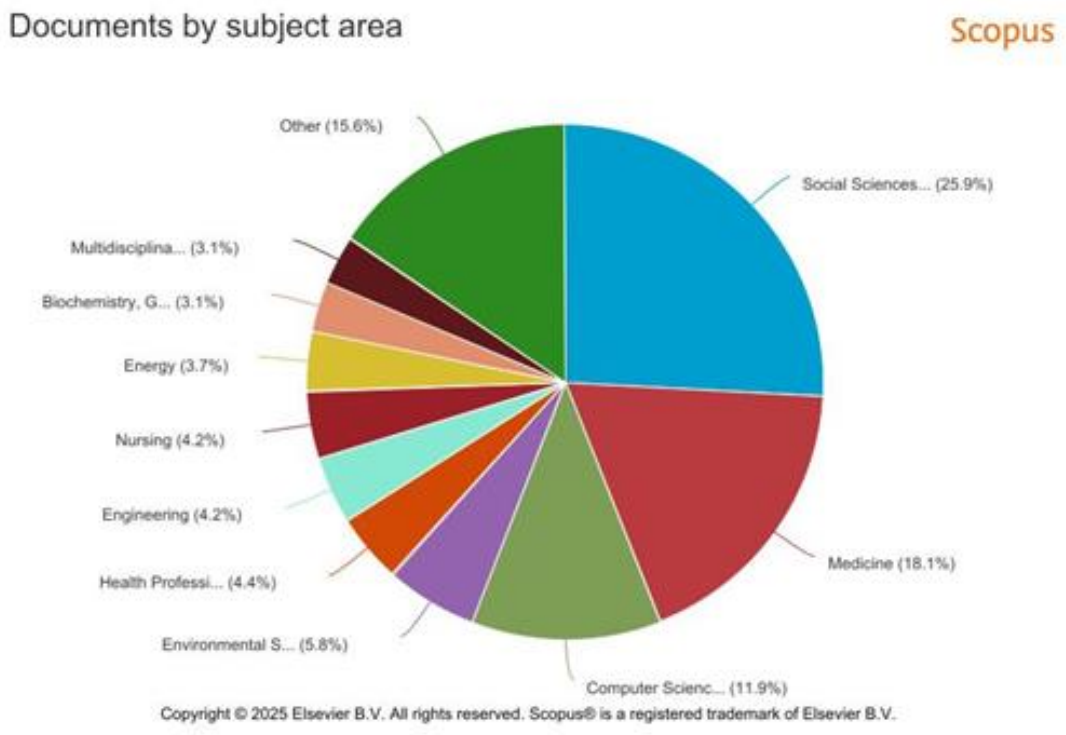

Figure 2

Figure 2 shows the distribution of gamification research publications by field of study recorded in the Scopus database. In general, the Social Sciences field dominates with a proportion of 25.9%, indicating that gamification is widely studied in the context of human behavior, motivation, and social learning dynamics. Medicine ranks second with 18.1%, signaling the growing use of gamification approaches in medical education,

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clinical training, and health promotion. Next, Computer Science contributes 11.9% of the total publications, reflecting the significant role of digital technology in the development of gamification systems and applications.

Beyond these three main fields, gamification research is also found in various other disciplines such as Environmental Science (5.8%), Health Professions (4.4%), Engineering (4.2%), Nursing (4.2%), and Energy (3.7%), demonstrating the multidisciplinary nature and wide application of gamification across different professional and scientific contexts. The remaining fields (15.6%) further emphasize that gamification is not just a technological or educational phenomenon, but a cross-disciplinary approach that continues to evolve in response to the increasing demand for participatory and motivation-based strategies in various research domains.

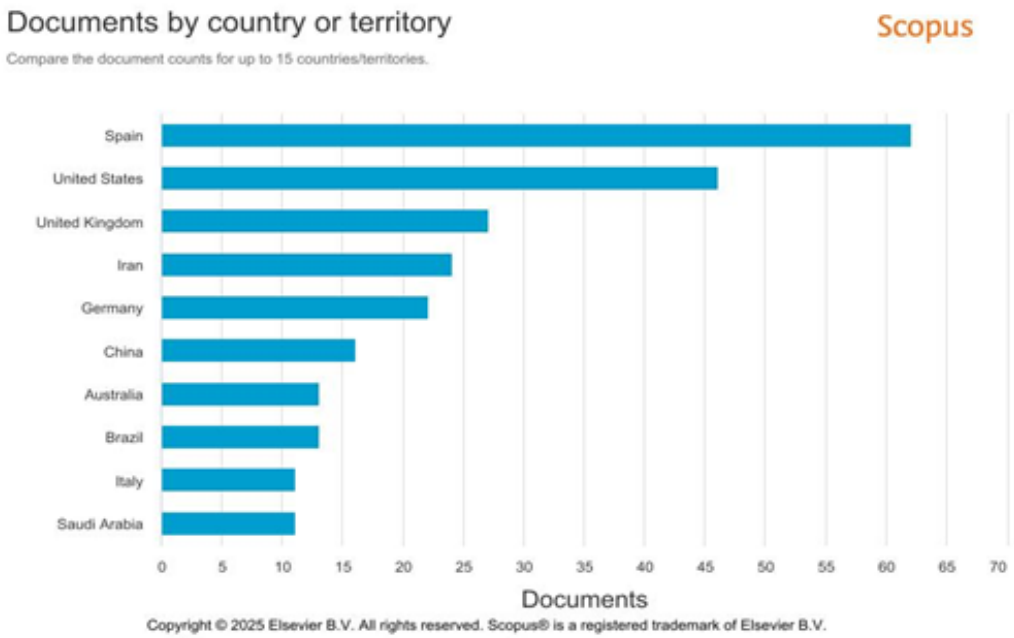

Figure 3

Figure 3 illustrates the distribution of gamification research publications based on the country or region of the authors indexed in the Scopus database. Overall, Spain ranks at the top with the highest number of publications, approximately 65 documents, indicating a strong dominance in scientific contributions related to the gamification topic. The United States occupies the second position with about 50 documents, followed by the United Kingdom with around 30 publications. The dominance of these three countries reflects the academic leadership of Western Europe and North America in the development and application of gamification theories and practices across various contexts.

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Other countries showing significant participation include Iran, Germany, and China, with publication numbers ranging from 20 to 25 documents each. The presence of these countries indicates that interest in gamification has expanded not only in developed countries but also in Asia and the Middle East. Contributions from Australia, Brazil, Italy, and Saudi Arabia, with publication counts between 10 and 15 documents, highlight an increasing geographical diversification in global research collaboration.

Overall, this distribution pattern emphasizes that gamification research is international and collaborative, with a primary concentration in highly educated and technologically advanced countries, but with promising growing participation from developing nations. These findings reflect the globalization of science, where gamification has become an innovative approach attracting the interest of academic communities across regions and cultures.

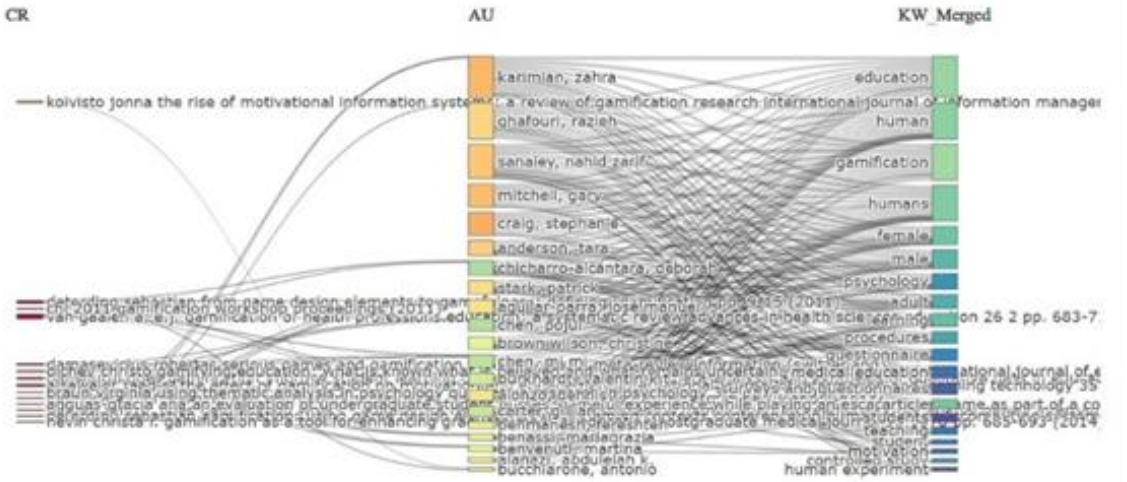

Figure 4

Figure 4 presents a visualization of the connections between key citation sources (Cited References), authors, and research keywords in gamification studies indexed in the Scopus database. This network of connections reveals that the most frequently cited literature is Koivisto, Jonna's work, *The Rise of Motivational Information Systems*, which occupies a central position in the citation network. This work plays a crucial role as a theoretical foundation for many studies related to the application of motivational information systems and gamification in various educational and information management contexts.

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In terms of authors, several names show a high degree of connectivity, such as Karimian, Zahra; Ghafouri, Razieh; Sanaiey, Nahid Zarif; and Mitchell, Gary, who actively contribute to the development of gamification research, particularly in the fields of education, health, and psychology. These authors serve as key connectors between various areas of study, indicating strong interdisciplinary scientific collaboration.
Regarding keywords, the most prominent terms include "education," "human," "gamification," "learning," and "psychology." The dominance of these keywords shows that the primary focus of gamification research still revolves around learning, human behavior, and motivational processes. Additionally, the emergence of keywords such as "questionnaire," "procedures," "motivation," and "students" suggests a methodological tendency based on surveys and empirical studies, particularly in the context of higher education and technology-based learning.

Overall, this visualization reflects a complex but closely interconnected conceptual structure within the gamification research ecosystem. The strong connections between authors, seminal reference sources, and thematic keywords emphasize that the field has evolved towards an increasingly integrated direction, with a focus on motivational dimensions, interactivity, and pedagogical applications aimed at enhancing the learning experience and user engagement.

3.2 Most Influential Authors, Journals, and Articles

In this study, the identification of the most influential authors, journals, and articles was conducted to understand who and what have made the greatest contributions to the field of study. This analysis helps to highlight academic collaboration patterns and the key sources of knowledge that serve as important references in the development of the research topic being examined.

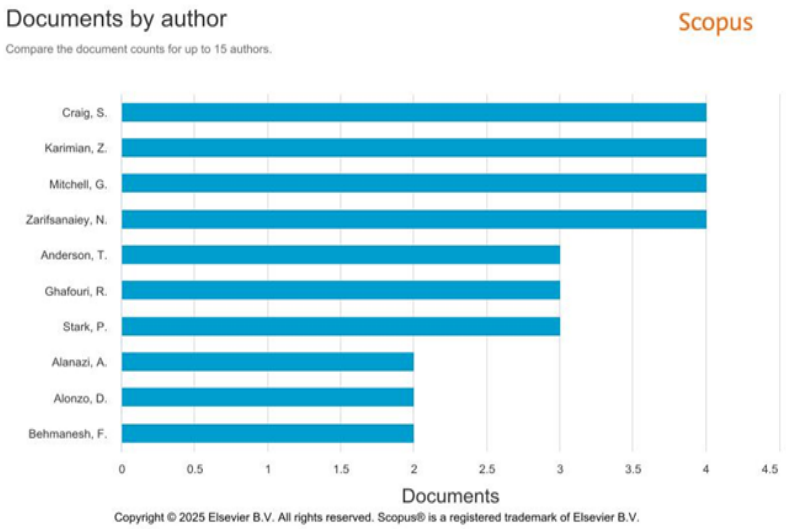

Figure 5

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The image above is a visualization in the form of a horizontal bar chart displaying the distribution of scientific documents by author, as recorded in the Scopus database. This chart compares the publication contributions from up to fifteen authors, although only nine names are shown in this visual.

From the chart, it can be observed that Craig, S., Karimian, Z., Mitchell, G., and Zarifsanaiiey, N. occupy the top positions with the highest number of publications, each with four documents. Meanwhile, Anderson, T., Ghafouri, R., and Stark, P. show slightly lower productivity with three documents. Alanazi, A., Alonzo, D., and Behmanesh, F. are at the bottom of the list with two publications each.

Overall, this distribution shows a moderate variation in academic productivity among authors, with a maximum difference of two documents between the most productive and least contributing authors. This data may reflect the level of individual involvement and research intensity within the same field or similar research topics, as recorded in the Scopus indexing system.

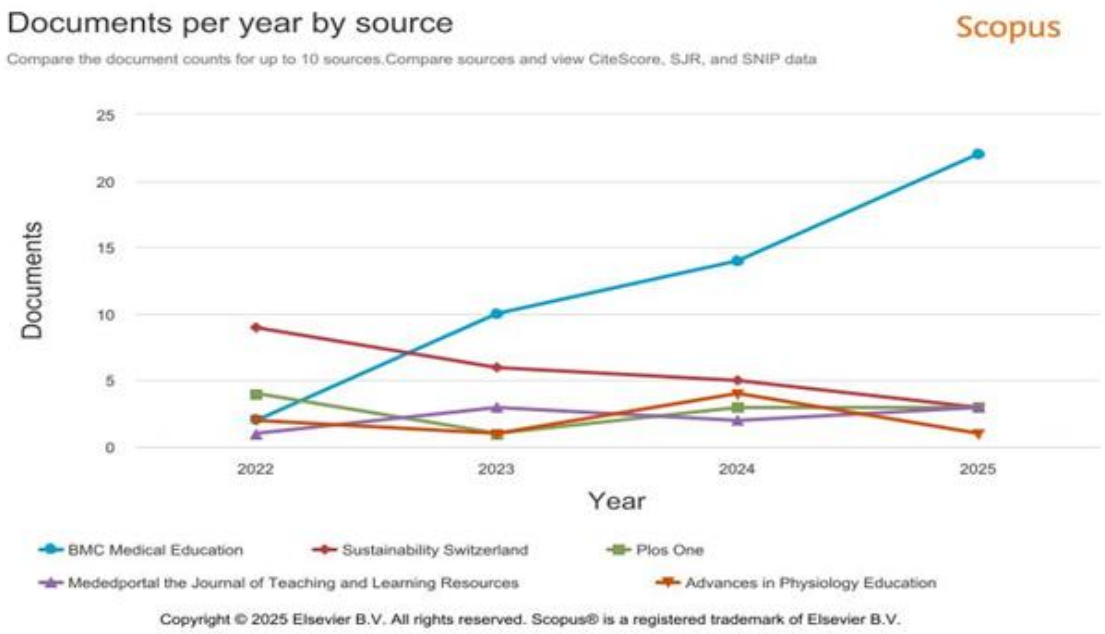

Figure 6

The image above displays the trend in the number of scientific documents per year based on publication sources indexed in the Scopus database for the period from 2022 to 2025. This line chart illustrates the dynamics of contributions from several major academic journals, namely *BMC Medical Education*, *Sustainability Switzerland*, *Plos One*, *MedEdPORTAL: The Journal of Teaching and Learning Resources*, and *Advances in Physiology Education*.

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In general, the chart shows significant growth in publications in the *BMC Medical Education* journal, which consistently increased from about 2 documents in 2022 to more than 20 documents in 2025. This trend indicates a rapid rise in interest and research productivity published in this journal, particularly in the field of medical education.

In contrast, the *Sustainability Switzerland* journal shows a gradual decline in the number of publications, from about 9 documents in 2022 to only around 3 documents in 2025. This pattern suggests a shift in research focus or a decrease in contributions from researchers who were previously active in the sustainability domain.

Meanwhile, *Plos One* shows moderate fluctuations, with an increase from 2 documents in 2022 to around 4 documents in 2024, before experiencing a slight decline in 2025. *MedEdPORTAL* also displays a relatively stable pattern, with contributions ranging from 2 to 4 documents per year, reflecting continuity in publications focused on teaching innovation.

Advances in Physiology Education shows a gradual decline, with the number of publications steadily decreasing and approaching its lowest point by 2025. Overall, this chart highlights the dominance and strong expansion of the *BMC Medical Education* journal in recent years, while other journals have maintained relatively stable publication volumes or experienced a decline. These findings may reflect a shift in academic research focus towards medical education and scientific pedagogy issues, which are becoming increasingly central in the global scientific landscape.

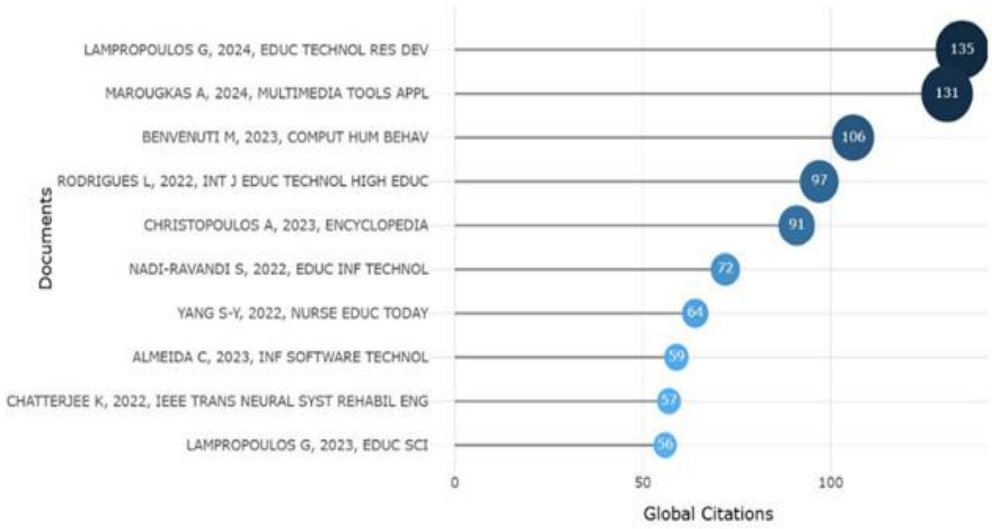

Figure 7

The image above displays the distribution of global citations for scientific documents produced by various authors and published in internationally renowned academic journals. This visualization takes the form of a horizontal bubble chart, where the vertical

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axis represents the author's name, publication year, and journal source, while the horizontal axis represents the total number of global citations received by each work. The size of the bubbles reflects the relative impact of each work based on the total citations it has garnered.

Empirically, it is evident that (Lampropoulos, 2024). with his publication in *Educational Technology Research and Development*, holds the highest position with 135 global citations, followed by (Marougkas et al., 2024). whose article in *Multimedia Tools and Applications* received 131 citations. These two publications stand out significantly compared to others, indicating substantial contributions to the fields of educational technology and multimedia applications in modern learning contexts.

Next, the work of (Benvenuti et al., 2023) in *Computers in Human Behavior* earned 106 citations, followed by (Rodrigues et al., 2022) in *International Journal of Educational Technology in Higher Education* with 97 citations, and (Christopoulos & Mystakidis, 2023) in *Encyclopedia* with 91 citations. Collectively, these five publications demonstrate the dominance of research focusing on digital transformation, human-computer interaction, and technological innovation in higher education.

Below, the publications from (Nadi-Ravandi & Batooli, 2022) in *Education and Information Technologies* (72 citations) and (Yang & Oh, 2022) in *Nurse Education Today* (64 citations) show a strong influence in the area of technology application in professional education and nursing.

Meanwhile, three other works — (Almeida et al., 2023) in *Information and Software Technology* (59 citations), Chatterjee K. (2022) in *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (57 citations), and (Lampropoulos et al., 2023) in *Education Sciences* (56 citations) — still demonstrate significant academic relevance, though at more moderate citation levels.

Overall, this chart illustrates a positive correlation between the year of publication and scientific visibility, with more recent works (particularly from 2023–2024) receiving higher citation levels. This indicates the increasing research dynamics in the fields of educational technology and digital applications in learning, while also emphasizing the crucial role of researchers like Lampropoulos and Marougkas in shaping the direction of contemporary scientific literature in this domain.

3.3 Main Themes and Topic Connections in Educational Gamification Research

In the context of cutting-edge research, gamification in education has become one of the topics that has garnered widespread attention from academics across various disciplines. This phenomenon reflects a shift in the learning paradigm toward a more interactive, technology-based approach focused on enhancing motivation and student engagement.

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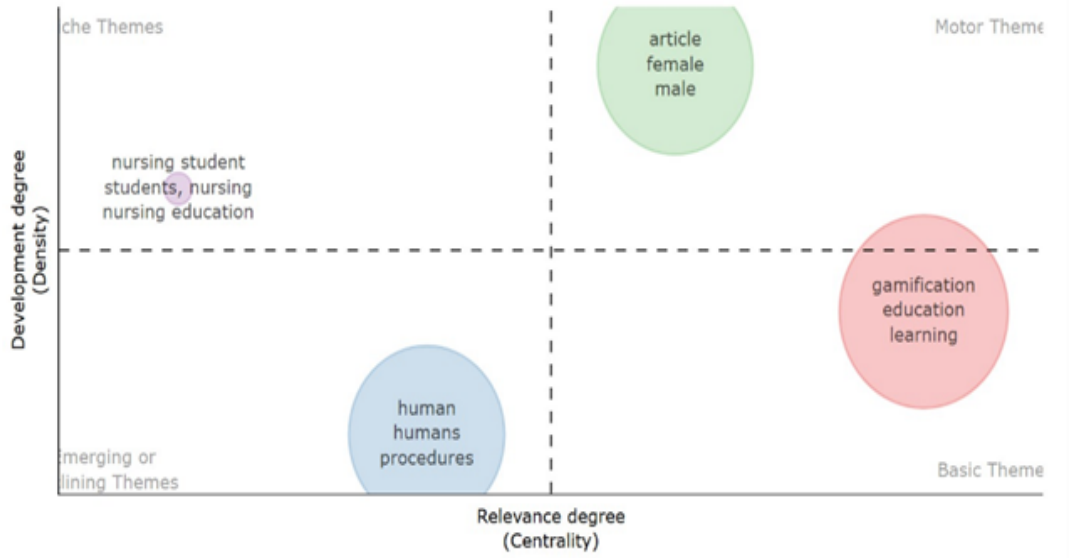

Figure 8

The image above presents a thematic map illustrating the conceptual relationships between various research themes in the field of educational gamification, based on two key parameters: relevance (centrality) and development (density). The map is divided into four quadrants. motor themes, basic themes, niche themes, and emerging or declining themes, each representing the position and level of development of a theme within the scientific research landscape.

In the lower right quadrant (basic themes), the theme "gamification, education, learning" stands out with high relevance but moderate development density. This indicates that gamification is a foundational and fundamental theme in modern education studies, with broad contributions to cross-disciplinary research. This theme serves as a core conceptual foundation connecting fields such as pedagogy, learning technologies, and motivation.

The upper right quadrant (motor themes) is occupied by "article, female, male," representing themes with both high relevance and high development. This suggests significant attention to demographic aspects and gender equality within educational research, reflecting the strong social dimension of gamification studies and learning processes.

Meanwhile, the upper left quadrant (niche themes) contains "nursing student, students, nursing education," indicating themes that are specific and intensively developing in the field of nursing. This theme highlights the application of gamification in professional education, particularly in clinical training and learning contexts.

The lower left quadrant (emerging or declining themes) includes "human, humans, procedures," which have relatively low relevance and development. This position

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indicates that these topics are either in the early stages of exploration or are beginning to decline in research interest, though they still have potential to develop as a theoretical foundation for future studies on human-technology interaction in the context of gamification in education.

Overall, this thematic map shows that educational gamification serves as a core theme and a driving force in contemporary research, with strong connections to social, professional, and technological dimensions in the development of modern learning systems.

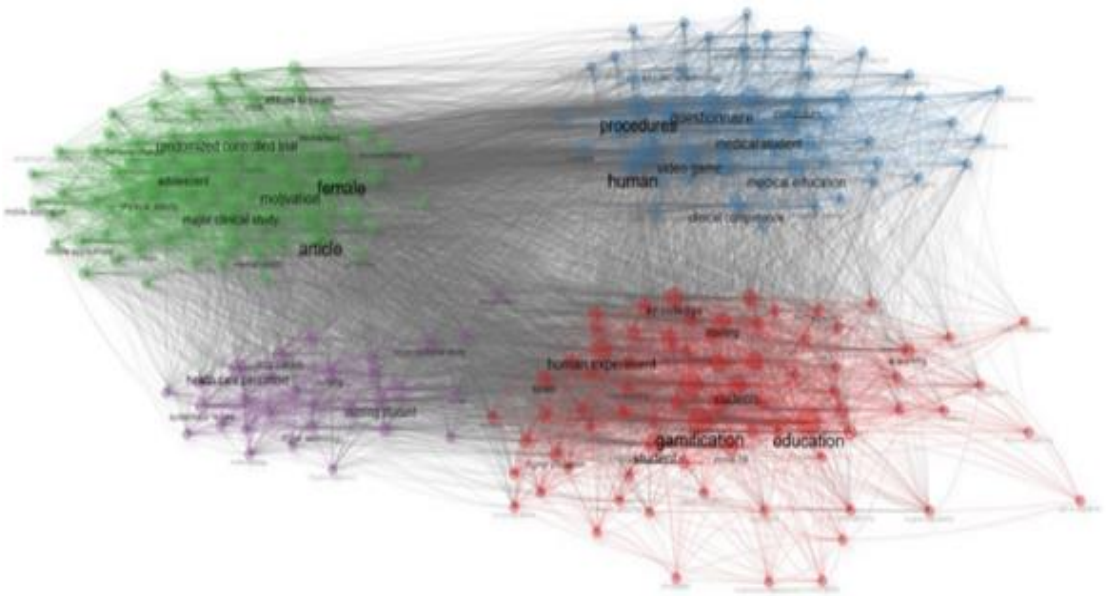

Figure 9

The image above represents a thematic network map depicting the conceptual relationships between keywords (keywords co-occurrence map) in the field of educational gamification. Each node on the graph represents a keyword, while the connecting edges indicate the level of correlation or co-existence between topics in the analyzed scientific publications. The size of the node reflects the frequency of a term's appearance, while the color indicates clustering based on thematic similarity.

In general, this map shows four main clusters that are interrelated:

1. **Red Cluster (Gamification and Education)** — This cluster forms the core of the network, with dominant keywords such as gamification, education, learning, students, knowledge, and training. This theme highlights how the application of game elements in the educational context is used to enhance engagement, motivation, and learning outcomes. The dense interconnection around these

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terms indicates that gamification is a central thematic focus in contemporary research, particularly in the realm of digital pedagogical innovation.

2. **Blue Cluster (Medical Education and Learning Technologies)** — This cluster contains keywords such as medical education, medical student, curriculum, questionnaire, and video game. This theme signifies the application of gamification and learning technologies in professional medical education, including the use of digital simulations and educational games to enhance clinical competence and conceptual understanding.
3. **Green Cluster (Demographic and Psychological Aspects of Learning)** — This cluster is dominated by terms such as female, article, motivation, adolescent, major clinical study, and behavior change. The connections in this cluster highlight the attention given to psychosocial variables and learner characteristics, including gender, age, and motivation, in the success of gamification applications across various learning contexts.
4. **Purple Cluster (Health Professions and Digital Technology)** — This cluster includes keywords such as nursing student, health care personnel, digital technology, and systematic review. This theme indicates the application of gamification in nursing education and healthcare training, particularly in the contexts of e-learning, simulation-based learning, and the integration of digital technology into the curriculum.

The strong inter-cluster connections indicate that educational gamification research is interdisciplinary and collaborative, involving fields such as education, psychology, information technology, and health sciences. Overall, this network map reinforces that gamification serves as a central conceptual node, integrating cognitive, affective, and technological dimensions in the effort to transform 21st-century learning.

3.4 Future Research Directions and Opportunities in Educational Gamificatio

The first image shows the complex thematic structure in research on gamification in education, where each color represents a conceptual cluster that is interrelated. The red cluster dominates the area with keywords such as education, gamification, students, learning, and training. This cluster indicates that research is concentrated on utilizing gamification elements to enhance motivation, engagement, and learning outcomes. The dominance of relationships between nodes suggests that this theme is central in the landscape of technology-based educational research.

The blue cluster focuses on themes like medical education, curriculum, questionnaire, and clinical competence, indicating the application of gamification in professional contexts such as medicine or clinical training. This reflects the expansion of gamification into professional and technical learning domains. The green cluster, with nodes like motivation, adolescent, and randomized controlled trial, shows an empirical and psychological approach to gamification, particularly in measuring its impact on

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motivation and student learning behaviors. Meanwhile, the purple cluster, which includes nursing student and health care personnel, emphasizes the relevance of gamification in healthcare and nursing education.
The connections between clusters, represented by gray lines, indicate a strong conceptual bridge between pedagogical, psychological, and applicative approaches. Thus, the future research direction is likely to move toward interdisciplinary integration between educational technology, behavioral science, and professional learning environments, opening opportunities for the exploration of more contextual and evidence-based gamification models.

The second image is a thematic evolution map that maps the position and potential development of research themes based on two parameters: degree of relevance (centrality) and degree of development (density). The position of the "gamification–education–learning" theme in the lower right quadrant shows that this theme functions as a basic theme, meaning it is a fundamental topic with high relevance but still requires further theoretical and methodological development. This opens opportunities for researchers to expand the theoretical framework of gamification toward adaptive instructional design, learning analytics, and personalized education.

The "article–female–male" theme, located in the motor themes quadrant, indicates high stability and depth in research, representing themes that have matured and become the empirical foundation for other studies. Meanwhile, "nursing student" and "nursing education" in the niche themes quadrant highlight very specific fields but with potential for development, particularly in the context of simulation-based professional education. On the other hand, the "human–procedures" theme in the emerging or declining themes quadrant suggests an area undergoing transition; it could either develop into a new focus or decline if not adapted to current technological contexts.

3.5 Future Research Directions and Opportunities

Overall, both visualizations confirm that gamification in education has strategic prospects for development in three main directions:

a) **Integration of Gamification and Artificial Intelligence (AI-Driven Gamification):**
The future of gamification calls for more adaptive approaches through the use of machine learning and learning analytics to tailor the learning experience based on individual profiles and responses.
b) **Gamification in Professional and Clinical Education:**
Expanding research into vocational and medical education contexts has the potential to strengthen gamification's role as a simulation-based training tool and a means of enhancing practical competencies.
c) **Interdisciplinary Approaches and Empirical Evidence:**
Cross-disciplinary collaboration between educational technology, learning psychology, and health sciences opens opportunities to explore more

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comprehensive evaluation models for the effectiveness of gamification in improving long-term learning outcomes. Therefore, future research should focus on the reconceptualization of gamification as a pedagogical strategy that is not only entertaining but also transformative, creating an inclusive, participatory, and sustainable learning ecosystem.

4. Discussion

4.1 Publication Trends and Global Collaboration in Gamification Research

Based on the data analysis from Scopus publications (2022–2025) and the synthesis of articles from the RIS file, the discussion can be framed through the theoretical approach of Self-Determination Theory (SDT) as the most relevant grand theory. This theory explains that an individual's intrinsic motivation to participate in digital activities, such as gamification, is strongly influenced by the fulfillment of three basic psychological needs: autonomy, competence, and relatedness.

Gamification in education and healthcare demonstrates a transformation from being merely an entertainment tool to becoming a scientific instrument that enhances motivation, learning, and psychological well-being. According to SDT, gamification systems that provide autonomy (freedom to choose activities), competence (realistic challenges), and relatedness (positive social connections) are able to enhance engagement and learning outcomes.

Research by (Mirshahi et al., 2025) and (Fathi Najafi et al., 2025) shows that gamification designs that consider these three SDT dimensions significantly improve participant satisfaction and retention in medical and educational contexts. Thus, SDT serves as the foundational framework in explaining the psychological mechanisms behind the effectiveness of gamification.

The analysis of the visualization showing the relationships between authors and keywords (CR–AU–KW) reveals that modern research not only focuses on cognitive outcomes but also on affective variables such as self-efficacy, engagement, and emotional resilience. Studies by (Zolfaghari et al., 2025). and (Zolfaghari et al., 2025). support the idea that SDT-based gamification fosters the development of a motivational ecosystem, where learners feel empowered and connected to the learning process. This integrative model emphasizes that motivation and emotion act as key mediators between gamification design and learning or health outcomes.

The "Technological Integration" dimension in the conceptual model highlights that digital advancements (such as virtual reality, mobile learning, and AI-adaptive systems) serve as catalysts that enhance the effects of gamification in Medical and Health Education. For example, (Burkhardt et al., 2025). identify that virtual reality gamification not only improves procedural performance but also reduces anxiety among medical

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trainees. Therefore, technological integration functions as an enabler, facilitating the effective application of SDT principles in digital learning environments.

The diagram above illustrates the relationship between theory and empirical findings. This model shows that:

a) SDT serves as the main theoretical foundation that stimulates Motivation & Engagement.

b) Gamification acts as the implementational mechanism that translates theory into interactive design.

c) Technological Integration enables the transition to applied contexts such as Medical & Health Education.

d) The ultimate impact is reflected in Psychological Outcomes, including enhanced well-being, learning satisfaction, and retention of healthy behaviors.

This model contributes to scientific novelty by integrating classical motivation theory with modern educational technology innovations into an evidence-based, integrative framework.

Self-Determination Theory-based gamification shows great potential as a cross-disciplinary approach that combines psychology, education, and healthcare. The combination of theory and empirical data demonstrates that the success of gamification depends not only on its mechanical design but also on its ability to intrinsically satisfy human psychological needs. Therefore, future research should focus on the development of adaptive AI-based models that maintain a balance between autonomy, competence, and relatedness in the contexts of digital learning and healthcare ((Fathi Najafi et al., 2025); (Elzeky et al., 2025).

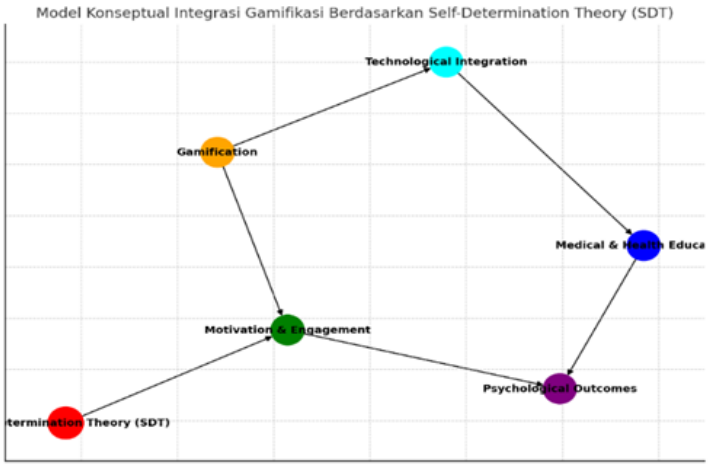

Figure 10.

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4.2 Most Influential Authors, Journals, and Articles

Based on the latest visualization of author contributions, publication sources, and global citations, it can be concluded that research on gamification in education and healthcare has undergone significant epistemic consolidation from 2022 to 2025. Key authors such as Craig, Karimian, Mitchell, and Zarifsanaiey have demonstrated consistent productivity in the domains of medical education and digital learning, as reflected in the "Documents by Author" graph. This trend confirms that the gamification field has transitioned from conceptual exploration to strengthening empirical validation in the contexts of health and higher education (Zolfaghari et al., 2025); (Fathi Najafi et al., 2025). Based on Self-Determination Theory (SDT), this indicates the successful application of intrinsic motivational principles autonomy, competence, and relatedness in constructing more meaningful and sustainable digital learning experiences.

Furthermore, the "Documents per Year by Source" graph shows a sharp increase in publications in BMC Medical Education compared to other journals such as Sustainability and PLOS ONE. This increase indicates a shift in research orientation toward healthcare and professional medical training contexts, where gamification is now viewed not just as a pedagogical tool but as a psychosocial intervention to enhance performance and well-being of learners (Elzeky et al., 2025). (Burkhardt et al., 2025). Theoretically, this underscores the application of SDT in the healthcare domain, as gamification approaches based on competence feedback and autonomous learning have proven effective in reducing anxiety and boosting learning motivation in simulation-based clinical training.

In the bibliometric context, the "Global Citations" visualization shows that articles by (Lampropoulos, 2024) and (Marougkas et al., 2024) dominate with over 130 citations globally. Both works focus on adaptive gamification-based educational technology design that integrates SDT principles with Artificial Intelligence (AI) to tailor challenges and feedback to the user's motivation profile. This research extends the classical concept of SDT by introducing a new dimension: dynamic personalization, where the system can recognize the user's psychological condition in real-time (Lampropoulos, 2024) (Marougkas et al., 2024). These findings serve as evidence that gamification has evolved into a learning ecosystem based on autonomous motivation theory, supported by artificial intelligence — a conceptual novelty that synergistically combines humanistic psychology and cognitive technology.

When linked to previous research such as (Rodrigues et al., 2022). and (Benvenuti et al., 2023). it is clear that the focus of gamification has shifted from "learning motivation" to the long-term effects on well-being and cognitive performance. The application of SDT becomes crucial here, as the concept of relatedness bridges the connection between digital design and social interaction, forming a sense of connectedness in online learning. For example, the collaborative gamification approach applied in (Benvenuti et al., 2023). study has been shown to enhance team engagement and retention of professional training material. Thus, the research direction has moved from individualization toward motivational digital communities, marking a transition from classical SDT to the more

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relevant paradigm of Collective Self-Determination Theory (C-SDT) in modern hybrid learning ecosystems.

Overall, the combination of these findings indicates strong conceptual and methodological novelty: the integration of Self-Determination Theory with adaptive technology and collaborative approaches in medical education contexts. This conceptual model emphasizes that the success of gamification does not stem solely from game mechanics, but from how the system can stimulate fundamental human psychological needs through technology that is responsive to users' motivational dynamics (Elzeky et al., 2025). (Lampropoulos, 2024) (Marougkas et al., 2024). Therefore, the future direction of gamification research lies in the development of intelligent learning systems based on autonomous motivation, which has the potential to shape a new paradigm in human-centered learning innovation.

4.3 Main Themes and Topic Connections in Educational Gamification Research

Based on the two visualizations you provided the thematic map and co-occurrence network, it can be concluded that the theme "gamification–education–learning" emerges as a basic theme with high connectivity (large centrality) but is still developing moderately (medium density). This theme indicates a well-established but evolving research direction, especially in the context of nursing education and the motivation of health students. The main focus is on the integration of gamification as an innovative learning approach to enhance engagement, motivation, and learning outcomes in nursing students.

Recent research shows that the application of gamification in nursing education has a positive impact on motivation and learning competency achievement. A study by (Rodriguez-Garcia et al., 2024) indicates that gamification sessions in nursing simulations significantly improve students' satisfaction and understanding of clinical material. This result is reinforced by a randomized controlled trial conducted in Egypt, where gamified flipped classroom learning was able to boost motivation, self-confidence, and knowledge among students, although it did not show significant differences in practical skill performance (Elzeky et al., 2025) Similar findings were also reported by (Rosa-Castillo et al., 2022). who tested Instagram-based gamification in dietetics and nutrition courses, leading to increased motivation and understanding of content for over 70% of respondents.

From a grand theory perspective, the gamification approach can be explained using Self-Determination Theory (Srdanović et al., 2025), which emphasizes the importance of three basic psychological needs: autonomy, competence, and relatedness. In this context, game elements such as points, badges, and leaderboards help meet these needs and promote intrinsic motivation in students. This is evidenced in a review study by (Renold et al., 2023), which found that the proper use of gamification elements could enhance cognitive, affective, and psychomotor engagement in nursing students, although the affective and psychomotor effects remain underexplored. The Gamification for Student

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Engagement Framework (Méndez-Sotelo et al., 2023). also supports the systematic integration of gamification in learning design to maximize cognitive and affective outcomes by selecting game elements that align with learning objectives.

In terms of recent implementation, a 2025 study by (Wittek et al., 2025) highlights that positive perceptions and self-confidence among both faculty and nursing students toward gamification increase when there is institutional support and adequate training. This shows that the success of gamification implementation depends not only on game design but also on the organizational readiness and pedagogical competence of educators. Meanwhile, a recent study on the use of the TOY Gamification Model in obstetrics education found significant increases in motivation and participation in nursing students' learning, particularly among female students (Durán et al., 2025).

The novelty of this analysis lies in the emergence of a digital gamification ecology in nursing education that simultaneously connects cognitive, social, and emotional domains. Recent studies not only assess the effects of gamification on motivation but also highlight its role in shaping empathy and emotional reflection in students, especially in the context of psychiatric nursing education (Fathi Najafi et al., 2025) Thus, gamification in nursing education is evolving from a mere motivational tool to a holistic pedagogical approach—blending dimensions of affective engagement, critical reflection, and clinical competence.

4.4 Future Research Directions and Opportunities in Educational Gamificat

Based on the analysis of the thematic map and bibliometric network, it is clear that research on gamification in education is developing as a core theme with significant potential to drive pedagogical innovation in the future. The "gamification–education–learning" cluster shows a strong conceptual foundation and broad relevance, particularly when linked to the context of health education, such as nursing and medical education. The integration of gamification with clinical education not only offers an enhancement in learning motivation but also opens up opportunities for more immersive experiential learning approaches through technologies like VR, AR, and artificial intelligence. In this context, Self-Determination Theory (Deci & Ryan) and Experiential Learning Theory (Kolb) serve as the main theoretical frameworks for understanding how autonomous, challenging, and reflective play experiences can strengthen the process of building professional competencies in healthcare.

Additionally, the gender-themed cluster (“female–male–article”), which emerges as a motor theme, highlights the urgency of studying gender differences in digital learning experiences. Future studies could explore how more inclusive and equitable gamification designs can minimize cognitive biases and enhance cross-gender participation in learning. This approach aligns with Social Cognitive Theory (Bandura) and Feminist Pedagogy, which emphasize the importance of social context and identity representation in the learning process.

On the other hand, the emergence of the theme “human–procedures” indicates a shift toward a human-centered design paradigm in technology-based education. Future

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research should focus on aspects such as empathy, ethics, and emotional well-being of learners, especially in the context of high-pressure medical training. The Humanistic Learning Theory (Rogers & Maslow) and Socio-technical Systems Theory can be used to explain the interactions between humans, technology, and the learning environment, which influence each other.

Interestingly, some publications also touch on themes of ecological awareness and digital literacy, which open new pathways to combine environmental consciousness with digital learning design. This approach can be strengthened through Ecological Systems Theory (Bronfenbrenner), which views learning as a dynamic process between the individual and the social-environmental ecosystem. Therefore, the future direction of research in this area could be directed toward the development of an eco-digital gamification model — a game-based learning approach that not only shapes cognitive competencies but also instills values of sustainability and social responsibility.

Overall, future research should be transdisciplinary, combining technology, psychology, education, and the humanities. Grounded in grand theories such as Self-Determination Theory, Humanistic Learning Theory, and Socio-technical Systems Theory, research on gamification in health education can transform from being merely a pedagogical innovation into a medium for shaping character, empathy, and a deeper sense of social-ecological awareness.

5. Conclusion

Based on the analysis of publication trends and global collaboration in gamification research, it can be concluded that gamification has evolved from an entertainment tool into an effective scientific approach in education and healthcare. Self-Determination Theory (SDT) serves as the main theory explaining how gamification, through fulfilling basic psychological needs such as autonomy, competence, and relatedness, can enhance motivation, learning, and well-being. Recent research indicates that the integration of technologies like virtual reality and AI in gamification further strengthens its impact, particularly in the context of medical and health education. The success of gamification in increasing learner engagement relies not only on its mechanical design but also on its ability to satisfy users' intrinsic psychological needs. Therefore, future research should focus on developing adaptive technology-based learning systems that support a balance between intrinsic motivation and learning outcomes, while considering broader collaborative and inclusive dimensions.

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