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From Engagement to Innovation through Gamified Learning Review: A Bibliometric Analysis of Trends, Themes, and Trajectories on Advancing Quality Education

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Abstract. The use of gamification to improve engagement, motivation and learning in education is a growing phenomenon. With gamified strategies increasingly being applied to educational reform in countries around the world, it is critical to map the changing research landscape. This research undertook a bibliometric study of gamification in learning to map research trends, leading authors and institutions, and emerging themes – with a specific focus on their relevance to Quality Education (SDG 4). This study extracted information from the SCOPUS database and used VOSviewer to map and visualize 2,324 peer-reviewed publications from 2000 to 2025 (Hwang et al., 2020) The U.S. is the

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world's leading contributor (434 documents) and Acosta et al. (2025) (16 documents) are the most productive authors. The VOSviewer analysis identified four distinct clusters: Cluster 1 focuses on student engagement, active learning, and instructional design, highlighting gamification's impact on student motivation and performance; Cluster 2 relates to gamification in medical and nursing education, using simulation and clinical training; Cluster 3 investigates immersive technologies, including augmented reality and virtual reality; and Cluster 4 relates to gamification in corporate and professional workforce development – a new research trajectory that is seeing a rapid increase in research. This study affirms the close alignment between emerging research themes on gamification and the principles of Quality Education (SDG 4). This bibliometric study offers educators, policymakers, and researchers' evidence-based insights to guide the development of efficient, responsive, and inclusive gamification approaches for various learning contexts.

Keywords: Gamification Learning; Bibliometric Analysis; Education Reform; VOSviewer; Education Quality; student Engagement

1. Introduction

Gamification (the use of game elements in non-game contexts) is a revolutionary approach in modern education. Through the integration of interactive features like scoring, badging, leaderboards, challenges, and rewards, gamification transforms learning into an engaging and immersive experience that enhances student motivation, engagement, and performance (Febriansah et al., 2024; Montenegro-Rueda et al., 2023)). Drawing on Self-Determination Theory (SDT), which suggests intrinsic motivation, competence, and relatedness are core motivators for human behaviour, gamification offers a psychologically sound approach to improving learning outcomes at various levels of education (Soriano-Pascual et al., 2022). In the last ten years, the rapid pace of technological innovation has also sped up the integration of gamification in online learning, digital platforms, and adaptive learning systems (Ghoulam et al., 2024).

Once considered a novelty in experimental business training and online learning programmes, gamification has now become mainstream in the classroom. Originally, it was viewed as a supplementary teaching approach, but later studies established its potential to greatly enhance student motivation and engagement in learning (Boltyshev, 2022). The advent of the COVID-19 pandemic represented a pivotal moment, demonstrating the growing need for engaging online teaching methods as education shifted to remote and hybrid formats.

As a result, gamification approaches grew in popularity as educators looked to address the decrease in student engagement, a phenomenon reported in education systems around the world, with some studies documenting a 40% reduction in engagement during the pandemic (Park & Kim, 2021). Increasing global recognition of the importance of Quality Education, which the United Nations has adopted as Sustainable Development Goal 4 (SDG 4), adds to the imperative of new approaches such as gamification. The SDG 4 aims to ensure inclusive, equitable quality education and promote opportunities for lifelong

learning for all – outcomes that gamified learning environments are well-equipped to support through enhanced access, engagement and retention across a range of learners (Tjoa & Poecze, 2020).

While the body of gamification research is growing rapidly, current bibliometric reviews are disjointed and lack a comprehensive approach. Existing reviews have tended to focus on specific sub-disciplines, such as gamification in higher education (Guerrero-Alcedo et al., 2022) or mathematics (Supriyadi et al., 2023), or geographic areas, rather than on a holistic, historical overview of the entire gamification-in-education research field. While prior studies like those of Al-Hafdi & Alhalafawy (2024) and Trinidad et al., (2021) provide useful insights, they do not explicitly link research trends to the outcomes of quality education or examine the evolution of the field over 25 years. No prior study has combined bibliometric analysis of publication, topic, geographic and SDG 4 alignment over the entire 2000–2025 timeframe. This study aims to fill this gap.

This study has the following Research Objectives:

1. To map the temporal distribution of gamification studies in education between 2000 and 2025.
2. To map the intellectual structure of the field with an overview of the clusters and distributions of keywords.
3. To identify the top countries, institutions and authors in gamification research.
4. To identify trends of gamification research (namely, past, present and future trends) during the period of study.
5. To assess how increasing gamification research has conformed to Quality Education (SDG 4) principles and goals.

A significant gap in the field of bibliometric analysis is the lack of a longitudinal and systematic study that traces the entire evolution of the gamification research in education field, and explicitly links those trajectories to the Quality Education principles of SDG 4 (Kalaivani et al., 2026; Shaiakhmetov et al., 2024). Conventional education systems face challenges with maintaining student engagement and retention, especially in online and blended learning environments. Existing bibliometric research on gamification has focused on specific areas with limited spatial and temporal perspectives, which fail to reflect the full structure of the field, its global nature or its interdisciplinary character. Our research aims to address this gap by using science mapping methods to map 2,324 Scopus-indexed documents, to provide the most detailed bibliometric review of educational gamification.

Research Questions. This study aims to answer these questions:

1. **RQ1:** What is the chronological trend in publication output on gamification in education from 2000 to 2025?
2. **RQ2:** What is the distribution of keywords and thematic clusters in gamification research within educational contexts?
3. **RQ3a:** Which countries and academic institutions lead research activity in the field of educational gamification?

4. **RQ3b:** Which individual authors have made the most significant contributions to gamification scholarship?
5. **RQ4:** To what extent does the growing body of gamification research align with developments in Quality Education (SDG 4) standards?

This research uses VOSviewer to map concept associations, clusters and author networks from SCOPUS data between 2000–2025. The article is organized as follows: the Literature Review explores theoretical backgrounds and previous bibliometric studies; the Methodology describes the search strategy and selection criteria, as well as the analysis methodology; the Results provide an overview of publication trends, cluster analysis, and contributor analysis; the Discussion considers the findings in the context of the RQs and SDG 4; and the Conclusion outlines future research directions.

2. Literature review

2.1 Foundations and Evolution of Gamification in Learning

Gamification is generally defined as the use of game-design elements such as points, badges, leaderboards, challenges, and rewards in non-game contexts to improve motivation, engagement and actions (Deterding et al., 2011). This core definition, first specified in human-computer interaction research, has been embraced and expanded in the education research community. Menon & Romero (2021) developed the idea for educational purposes, defining gamification as the application of game-based mechanics, aesthetics and mindset to engage people, motivate action, and solve problems. The idea had been pre-emptively nurtured by Grey et al. (2017) in their research on digital game-based learning, suggesting that game structures are well suited to the way the young learn and acquire skills (Platz & Juettler, 2025).

Gamification was initially developed in the realm of entertainment and marketing, using game mechanisms to increase user engagement and brand loyalty (Nobre & Nobre, 2022). It made its way into education slowly but surely. Pioneers in corporate learning and online education have shown that leaderboards, achievement points and narrative-based assignments can enhance engagement and learning outcomes (Ghoulam et al., 2024). Modern gamification in education includes rewards and achievement points, levelling systems and story-driven tasks that help keep learners engaged and promote competitive and collaborative approaches to learning (Febriansah et al., 2024). This shift in gamification from gaming utility to learning strategy is part of a larger shift in attitude that engagement in learning is not an add-on, but a core part of the process.

2.2 The Role of Gamification in Education

Gamification has been increasingly incorporated into K-12, tertiary and online education, with studies showing that it is effective in enhancing student engagement and retention of knowledge (Soriano-Pascual et al., 2022). Research has shown it to be effective in a broad spectrum of subjects: Bai (2023) reported substantial gains in student motivation for STEM and language learning, and Lai et al. (2023) observed that gamification mechanisms maximise both cognitive and

social engagement as well as teamwork skills. Hope et al. (2023) also confirmed that gamification helps students develop their analytical, problem-solving and collaboration skills, which are essential for academic and career success.

Importantly, gamification is not a one-size-fits-all approach. A number of studies warn that poorly implemented gamification, especially models that focus heavily on competition ranking (leaderboards), can lead to increased anxiety, diminished intrinsic motivation and, ultimately, can disadvantage low-achieving students (Bai, 2023). (Nobre & Nobre, 2022) found that the benefits of gamification on attendance and performance are more significant in more self-directed learning environments, such as blended and virtual learning, which indicates that gamification design and fit for context are equally important as the incorporation of game elements. These cautionary studies highlight that gamification design should be learner-centred and flexible rather than following a "one-size-fits-all" approach.

2.3 Theoretical Frameworks Underpinning Gamification in Learning

A number of well-researched psychological and behavioural theories support the gamification impact on learning. The following table summarises the key theories and how they apply to gamified learning.

Table 1: Major Framework for Gamification in Learning

Theory	Core Proposition	Application in Gamification	Key Limitation
Self-Determination Theory (Gao, 2024)	Intrinsic motivation, competence, and relatedness drive behaviour	Personalized challenges, peer collaboration, and autonomy-supportive design	Overuse of extrinsic rewards can undermine intrinsic motivation
Flow Theory (Chalco Challco et al., 2023)	Optimal engagement occurs when challenge matches skill level	Progressive difficulty, checkpoints, and real-time feedback	Difficult to calibrate universally across diverse learners
Operant Conditioning (Skinner, 1963)	Behaviour is shaped by reinforcement and reward	Points, badges, and leaderboards as behavioural reinforcers	Risk of dependency on external rewards; may reduce deep learning
Cognitive Load Theory (Sweller, 2011)	Effective learning requires managing mental effort	Scaffolded tasks and staged challenges reduce extraneous load	Gamification elements can increase rather than reduce cognitive load if poorly designed

Self-Determination Theory (SDT) states that a sense of autonomy, competence, and relatedness are critical factors for engagement (Al Mawadieh et al., 2026)(Soriano-Pascual et al., 2022). Gamification facilitates these conditions through learners' personalised challenge levels, opportunities for social learning and feedback about their achievements. But a key weakness of SDT-based gamification is that extrinsic rewards (if not carefully balanced) can undermine intrinsic motivation, in what is known as the "over-justification effect." The

interplay between extrinsic and intrinsic motivation is a hot topic in gamification (Soriano-Pascual et al., 2022).

Flow Theory suggests optimal engagement or "flow" occurs when challenge is optimally matched to the learner's skill level (Chalco Chalco et al., 2023). Gamification puts this theory into practice with progressive difficulty levels, checkpoints and real-time feedback, preventing boredom or frustration. However, at scale flow can be difficult to achieve as learners in the same classroom have different skill levels and gamification systems need to be adapted to individual performance (Soriano-Pascual et al., 2022).

Gamification's reward structures (points, badges and leaderboards), most visibly present to the user, are theorized through the framework of operant conditioning developed by (Pasam et al., 2025) as part of the behaviourist tradition. Although reinforcement-based gamification systems succeed in producing short-term behaviour change, some are concerned that pure reinforcement-based gamification may encourage surface rather than deep learning (Ghoulam et al., 2024). Theoretically robust gamification design encompasses all three types of mechanisms.

2.4 Gamification as a Catalyst for Quality Education

A rich body of studies explores the role of gamification in Quality Education, the focus of SDG 4, which aims to provide inclusive, equitable and lifelong learning opportunities for all. Gamification promotes these outcomes in a number of ways. (Soriano-Pascual et al., 2022) found that gamified teaching methods positively impact both student motivation and learning outcomes compared to traditional teaching methods, while decreasing classroom misbehaviour. (Ghoulam et al., 2024) demonstrated that gamification in e-learning platforms can address educational equity issues in the developing world, where traditional approaches are limited by inadequate infrastructure and human resources. These studies suggest that gamification can be more than a tool for engagement; they can also be a tool for social equity.

However, gamification's use is fraught with structural issues. Competitive elements can create a non-inclusive learning environment, with more capable students benefiting more from leaderboard-based gamification (Bai, 2023). Complex gamification technologies are expensive and require technical resources. Finally, there is little research on the sustained effects of gamification on learning outcomes, as most studies only report results from short-term interventions (Hope et al., 2023).

Recent interdisciplinary developments are beginning to overcome some of the challenges. (Basha et al., 2025) showed that speech emotion cues can be identified with high precision using deep learning models (CNN-LSTM architectures), making the creation of emotion-sensitive gamified systems possible, which dynamically respond to students' emotional states. This is a highly technical contribution, but relevant to the bibliometric dynamics highlighted in Cluster 3 of

the current study, which reveal immersive and AI-powered learning technologies as a key research focus.

3. Methodology

This study assesses the growth of gamification in education, examining how gamification contributes to improving quality learning by analysing the SCOPUS online database. SCOPUS was chosen for this research as it is a multidisciplinary database that covers a wide range of peer-reviewed journals in education and technology, and can be used for bibliometric analysis via tools like VOSviewer (Van Eck & Waltman, 2010). Although Web of Science (WoS) is a major academic database, SCOPUS was chosen as it has a more extensive index of social science and education-related journals, making it more apt for capturing gamification research in education (Guerrero-Alcedo et al., 2022; Irwanto et al., 2023). This is in line with other bibliometric research on gamification that has used SCOPUS as a primary data source because of its authority and coverage in education literature (Swacha, 2021).

The research period was set from 2000 to 2025 to encompass the entire gamification research in education. Digital game-based learning started to be reported in the literature in 2000; the research period ends with the most recent available data at the time of the search (2025) (Luo, 2021). This period enables a thorough examination of the development of gamification as an educational strategy over the past 25 years (Al-Hafdi & Alhalafawy, 2024; Trinidad et al., 2021). This wide timespan is in line with existing bibliometric research that suggests considering a significant publication history to identify trends and topic shifts in a field (Aria & Cuccurullo, 2017). Researchers conducted literature screenings in the SCOPUS database. The search engine was used on 3 February 2025. The systematic search related to gamification and quality education for the years 2000-2025 enabled researchers to find publications about the impact of learning gamification on quality education (Goi, 2023).

The newly crafted search string: TITLE-ABS-KEY ("gamification" OR "game-based learning" OR "serious games" OR "game mechanics" OR "educational games") AND TITLE-ABS-KEY ("learning" OR "education" OR "teaching" OR "student engagement" OR "instruction" OR "pedagogy" OR "academic performance") AND TITLE-ABS-KEY ("quality education" OR "educational quality" OR "student success" OR "learning outcomes" OR "21st-century skills" OR "competency-based education" OR "higher-order thinking") AND PUBYEAR > 2000 AND PUBYEAR < 2025 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (LANGUAGE, "English")) showed 2,324 documents.

The study sample restricted itself to published documents because the removal of grey literature and non-peer-reviewed documents provides validity for the final number of documents (Grosseck et al., 2020; Sergeeva et al., 2024). The data was exported to VOSviewer (version 1.5.5) to be analysed in CSV format (Van Eck & Waltman, 2010). Documents were filtered to obtain final documents. The total number of initial records (2,324 documents in this case from the SCOPUS search query) was refined by screening to remove duplicates, records with missing

metadata, and publications without direct engagement with gamification for educational purposes (Hu & Fu, 2024). We checked for duplicates, then checked for irrelevant records, ensuring that all remaining records had the required metadata about authors, abstract and citations (Herlambang, 2024; Jantakoon et al., 2024). To ensure that all the relevant studies in educational gamification were included in the final collection, the authors undertook a rigorous review, in line with the best practices of bibliometric studies (Por et al., 2025).

Bibliometric studies offer statistical techniques that researchers can use to assess research articles and identify emerging trends in current industry and author collaboration (Giovanni, 2017). Gamification research examination includes recognition of the main authors from various institutions in numerous international countries (Ren et al., 2024). Investigation of gamification development in education is performed via analysis of citation count, co-authorship collaborations and keyword search (Supriyadi et al., 2023). The VOSviewer is used to develop the bibliometric networks to represent the visual interconnections of research (Van Eck & Waltman, 2010).

The main bibliometric approaches used include co-occurrence maps, which show the connections among frequently used keywords, identifying the key research themes and topics of interest in gamification and education; citation networks, which represent the citation relationships between key publications, showing the influential research and authors in the field; and co-authorship networks, which display the collaboration patterns among researchers and organisations, showing the key players in the domain (Aria & Cuccurullo, 2017; Yadav, 2025; Yazdi et al., 2024).

In the keyword co-occurrence analysis, we applied a threshold of 30 for the number of times a word was used to determine what words to map. This decision ensured that only those keywords with a high enough occurrence across the dataset were selected, thus providing a clear and well-organized representation of the key research topics (Irwanto et al., 2023). Keywords with counts below 30 were deemed too rare to contribute meaningfully to the keyword clustering process (Al-Hafdi & Alhalafawy, 2024; Hu & Fu, 2024). Further, a thesaurus file was used in VOSviewer to consolidate keywords that were synonyms or variants of each other.

For instance, keyword forms like "game-based learning," "game based learning" and "GBL" were merged as a single node; "higher education" and "higher-ed" were unified; and "student engagement" and "learner engagement" were unified (Sergeeva et al., 2024). This standardization technique resulted in a reduction of redundancy and greater accuracy of the co-occurrence network, with thematic terms grouped together based on conceptual rather than terminological differences (Swacha, 2021; Trinidad et al., 2021).

The bibliometric data was cleaned and refined after the data collection. The cleaning process removed duplicate records and cleaned the irrelevant and incomplete articles, enhancing the co-authorship analysis precision by

normalising the authors' names and affiliation (Guerrero-Alcedo et al., 2022). The study removed articles that were not focused on gamification in education to narrow down the research to a specific area of interest for quality improvement in education (Goi, 2023; Grosseck et al., 2020). Although this research study has several strengths, it also has several limitations: the study may not include some important findings as it is limited to the SCOPUS database, which does not include conference proceedings and non-peer-reviewed articles (Luo, 2021). The keywords used to develop the dataset have a considerable effect on the final dataset by potentially omitting research that may not use the same keywords as the ones selected (Jantakoon et al., 2024; Ren et al., 2024).

The use of VOSviewer visualisations is a limitation in that the software may not be able to fully represent the research connections across large datasets (Van Eck & Waltman, 2010). Furthermore, the restriction of the search to English language research means the results will not represent all the research worldwide and will create a language bias (Por et al., 2025; Yazdi et al., 2024). The assessment uses bibliometric methods and data visualisation to provide a comprehensive report of education-based gamification research (Aria & Cuccurullo, 2017). The research evaluation will provide insights into the progress of gamification as an approach to learning, the key players, and the general trends of the major themes that affect the improvement of education quality (Al-Hafdi & Alhalafawy, 2024; Herlambang, 2024; Supriyadi et al., 2023).

Table 2 highlights the process of the bibliometric analysis that was carried out in a step-by-step manner, as well as the inclusion and exclusion criteria and the number of studies that were initially found, and the final number of articles to be reviewed (Trinidad et al., 2021). It provides an in-depth description of the process of selecting the major research trends, most-cited works, and emerging themes in the field of gamification in education (Guerrero-Alcedo et al., 2022; Swacha, 2021).

Table 2: Summary of the Bibliometric Analysis Procedure of Gamification in Learning

Methodology Step	Details
Database	SCOPUS (selected for its extensive multidisciplinary coverage and superior indexing of education and social science publications compared to Web of Science, making it more suitable for capturing gamification research in educational contexts)
Search Period	From 2000 to 2025 (chosen to capture the full trajectory of gamification research, from the emergence of digital game-based learning in the early 2000s to the most current available data)
Search Fields	Article title, abstract, and keywords
Search Query	TITLE-ABS-KEY ("gamification" OR "game-based learning" OR "serious games" OR "game mechanics" OR "educational games") AND TITLE-ABS-KEY ("learning" OR "education" OR "teaching" OR "student engagement" OR "instruction" OR "pedagogy" OR "academic performance") AND TITLE-ABS-KEY ("quality education" OR "educational quality" OR "student success" OR "learning outcomes" OR "21st-century skills" OR "competency-based education" OR "higher-order thinking") AND PUBYEAR >

	2000 AND PUBYEAR < 2025 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (LANGUAGE, "English"))
Total Initial Records	2,324 (total records retrieved from the SCOPUS search query before filtering)
Final Documents for Analysis	2276 documents (records retained after removal of duplicates, irrelevant entries, and publications with incomplete metadata)
Data Filtering Process	Removed duplicates, irrelevant records, and ensured inclusion of necessary metadata (author info, abstract, citation count)
Data Analysis Tool	VOSviewer Software (Version 1.5.5)
Data Format	CSV
Keyword Co-occurrence Threshold	Minimum of 30 occurrences per keyword, ensuring only sufficiently represented terms are included in thematic mapping
VOSviewer Thesaurus File	Applied to merge synonymous keyword variants (e.g., "game-based learning" / "GBL"; "higher education" / "higher-ed"; "student engagement" / "learner engagement") to reduce redundancy and improve network accuracy
Bibliometric Techniques Applied	Co-occurrence maps (to identify research themes and emerging topics); Citation networks (to reveal influential studies and authors); Co-authorship networks (to highlight key collaborations)
Data Quality Control	Removal of duplicates and irrelevant data; standardization of author names and affiliations for co-authorship analysis
Limitations	Focus limited to SCOPUS database (excludes conference proceedings and non-peer-reviewed literature); Language bias due to English-language restriction; VOSviewer's visualization limitations with large datasets
Scope of Research	Focused specifically on gamification in quality educational contexts, excluding irrelevant publications
Expected Outcome	Understanding the evolution of gamification in education, identifying key contributors and major research themes influencing educational quality improvement

4. Results

4.1 Publication per year

4.1.1 RQ1. What pattern has the publication output regarding gamification shown through 21st-century time?

Research about gamification in education shows a large, positive growth pattern in academic publications from the year 2000 to the present day. Figure 1 indicates that the publication numbers remained low during the time period from 2000 to 2008, as the count reached only single digits per year. At the beginning of 2010, research interest in gamification started to expand while average publication quantities increased substantially. Based on published documents between 2013 and 2020, academic interest in gamification as an educational research field grew progressively. This pattern matches the growth of digital learning systems and teaches how to incorporate technology in classrooms and adopt game-based educational approaches.

A rapid increase in research documents about gamification appears from 2021, resulting in a 2024 peak, which delivered around 400 published documents per year, as shown in Figure 1. A sudden surge in research publications regarding

gamification emerged as hybrid and online learning structures became prevalent after the pandemic, motivating educators and researchers to seek new student engagement approaches. The year 2025 shows a major decrease in research publications, possibly because numerous studies might still be undergoing review or publication (Figure 1). The increase in academic interest through publications demonstrates that education professionals view gamification as a key approach for engaging students and enhancing their outcomes and twenty-first-century skill development.

Documents by year

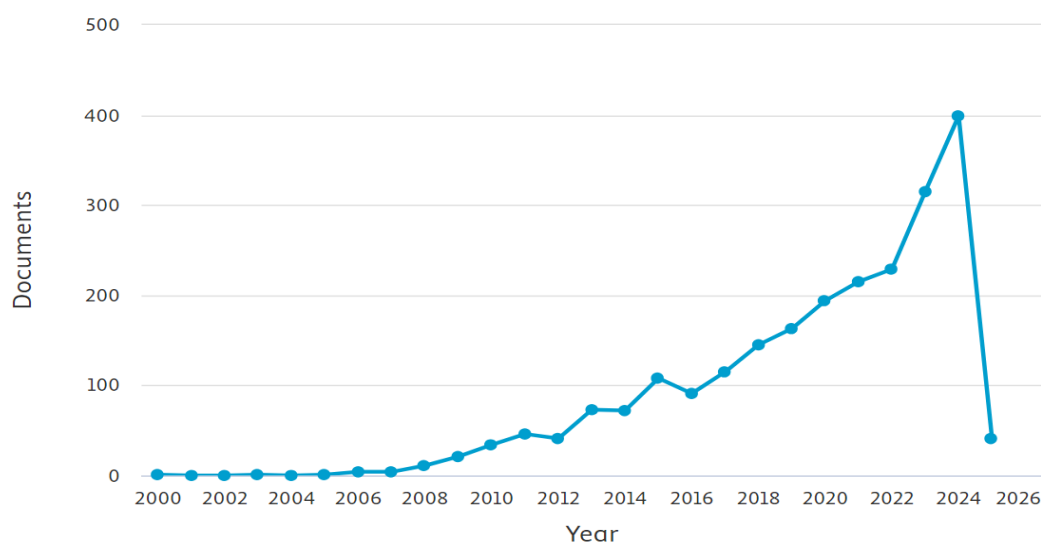


Figure 1: Annual Publications

Source: SCOPUS Database

4.2 Documents by Affiliation

4.2.1 RQ3a: Which countries and academic institutions lead research activity in the field of educational gamification?

Bibliometric analysis requires institutional ranking based on publication numbers to show leadership positions within the gamification in education discipline. The contributions follow a hierarchical distribution that demonstrates which institutions prioritize research about game-based learning methodologies and their research interests. The research outcomes reveal fundamental details about worldwide academic activities by identifying major research institutions that prioritize gamification research.

Figure 2 displays a breakdown of institutional gamification research in education by evaluating the most productive contributors to this field. An evaluation of institutional contributions spanning 24 years can be accomplished through the extended time span of the dataset. This research used bibliometric data as the backbone for its quantitative descriptive analysis method. The leading institution regarding publications is NC State University, which produced 29 documents.

The National Taiwan University of Science and Technology and Tampere University follow NC State University with 26 publications and 24 documents,

respectively. The identified educational institutions contribute extensively to gamification research in educational settings as they have produced vital academic findings. Two institutions follow the leaders with 22 publications each: the University of Central Florida, along with Universität Bremen. The University of the West of Scotland, along with the University of Hong Kong and Aalborg University, are noteworthy contributors with 20, 19, and 18 published research documents, respectively. The research documents developed by Universidad Complutense de Madrid and the University of Macedonia number 18 and 17, respectively, demonstrating their impact on this domain.

Documents by affiliation

Compare the document counts for up to 15 affiliations.

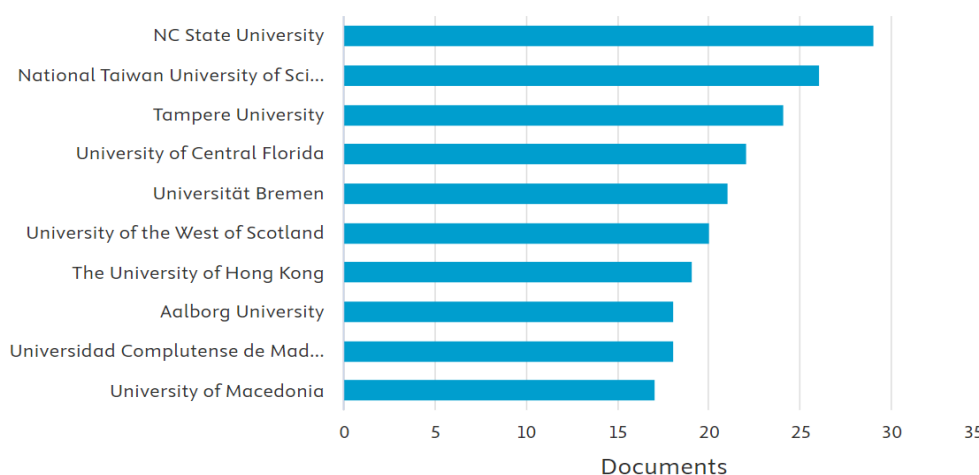


Figure 2: Documents by Affiliation

RQ3b: Which individual authors have made the most significant contributions to gamification scholarship?

4.3 Documents by Author

Figure 3 illustrates the authors who lead research on gamification in education, while Figure 4 shows country-wise international contributions. The analysed data shows which researchers contributed the greatest number of documents in the field, giving insight into the prominent contributors. The main authors in this field (Acosta et al., 2025) who have published twenty documents. The research work of (Hwang et al., 2021) features 16 published publications with a focus on game-based learning and its effects on student engagement. (Azevedo et al., 2017) are in third position among the most productive researchers with 14 published documents that concentrate on technology-enhanced learning methodologies. (Hauge et al., 2013; Vold et al., 2024) are also significant authors, with 12 documents and 11 documents published, respectively.

The research publication count serves as a systematic classification of authors who lead the field of gamification studies. The educational field of gamification research benefits from the active work of investigator S. Arnab, along with F. Bellotti, T. Hainey, and T. Lim who have each published 10 documents. With nine publications, J. Hamari, too, has become one of the major scholars in game-based

learning and digital engagement strategies. The bibliometric analysis reveals essential scholars in this field as it displays researchers who significantly shape current academic discussions regarding gamification in education.

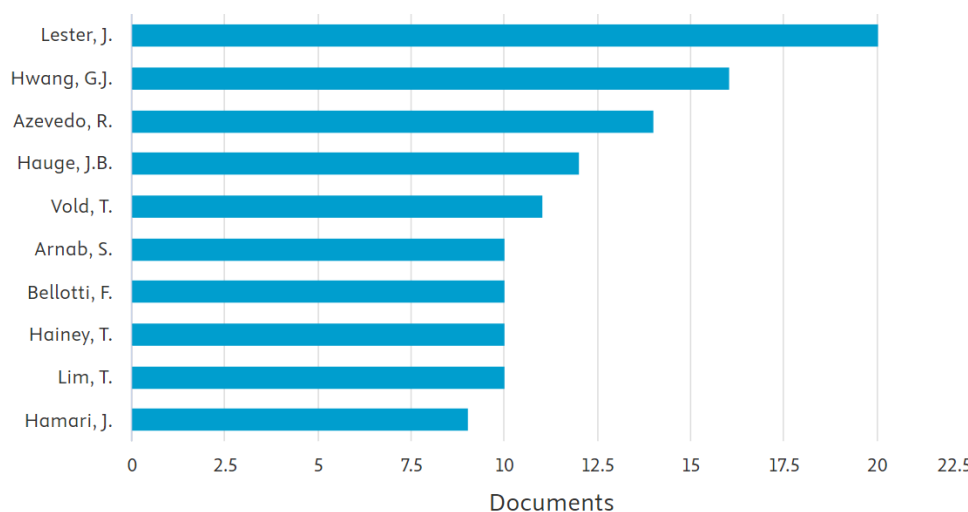


Figure 3: Documents by Author

RQ3a: Which countries and academic institutions lead research activity in the field of educational gamification?

4.4 Documents by Country

Figure 4 displays research contributions about gamification in education distributed across different countries. This dataset shows both the significant publishing countries and the worldwide academic distribution in the gamification of the education field. The United States leads in scholarly publications about gamification and education, with 434 research documents published. The United Kingdom is the second leading country in terms of academic publications about digital learning, with a total of 180 documents. Germany is third with 150 documents published about technology-driven educational research methods.

The total research publications in gamification amount to 143 from Taiwan and to 138 from Spain, placing them in positions four and five. The high profile of Spain could be attributed to the fact that the government and institutions have been very supportive of educational innovation, as well as a rising number of Spanish researchers who have been prolific in implementing gamification in pedagogical reform agendas (López-Belmonte et al., 2020). The total number of published documents indicates strong research activity focused on understanding gamification effects on educational learning. Research activity concerning the field is increasing in Southeast Asia, as indicated by the 119 published documents from Indonesia.

A significant number of relevant research publications were produced by Greece, China, and Malaysia with statistics amounting to 107, 104, and 94, respectively. Research efforts on gamification are increasing because of expanding interest in applying gamification theory to current educational models. Education in

Australia dedicated 77 publications to game-based learning approaches, showing continuous commitment to the subject. Research publications originating from different countries across the world reflect the widespread readership of gamification research. The growing interest in gamification as an essential educational practice is evident through significant contributions to research by numerous countries, demonstrating increased student motivation and improved learning outcomes. The dataset offers worldwide insights into national research activities, which aligns leading research nations to their contributions regarding gamification trend development globally (Gaonkar et al., 2022; Montenegro-Rueda et al., 2023).

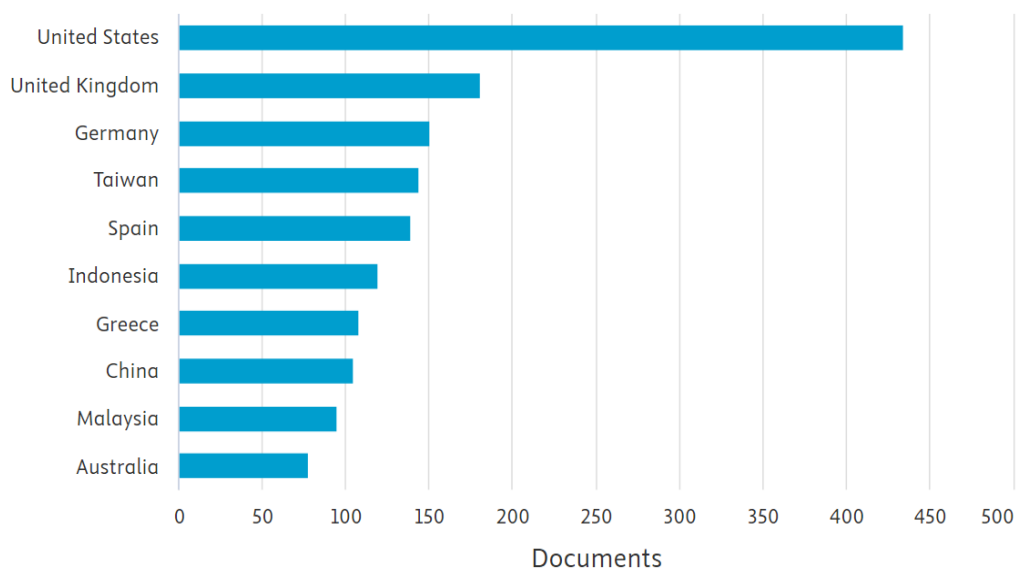


Figure 4: Documents by Country

4.5 Documents Per Year by Source

Figure 5 depicts the leading sources that generate research in gamification. Proceedings of the European Conference on Games-Based Learning starts the list with 160 articles, accompanied by Lecture Notes in Computer Science (154). The research field also depends significantly on the ACM International Conference Proceeding Series (49), Computers and Education (40), and Education and Information Technologies (32) for its content. Gamification research draws significant contributions from Sustainability Switzerland and CEUR Workshop Proceedings, with 30 and 29 documents, respectively, alongside conference proceedings and specialized journals as key research elements.

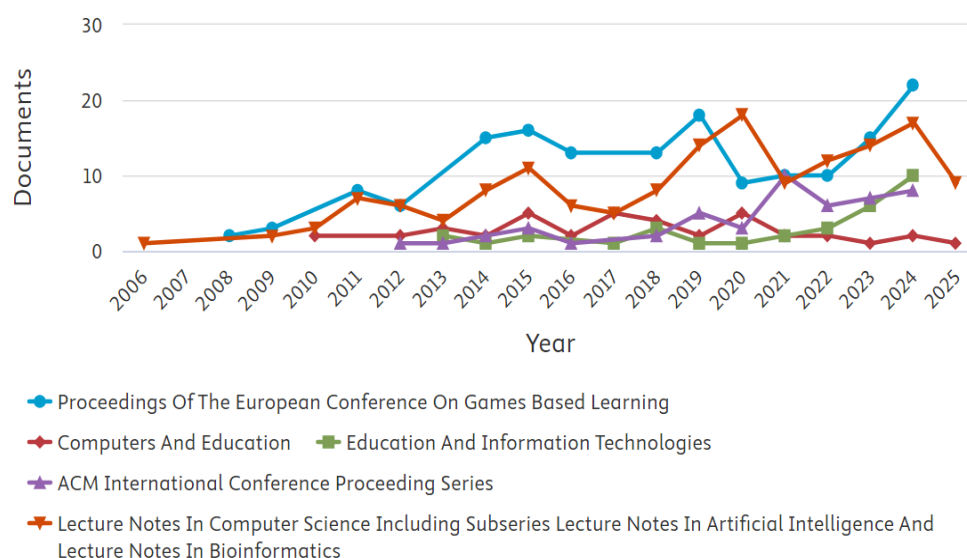


Figure 5: Documents Per Year by Source

4.5.1 RQ2. *What is the distribution of keywords and themes when studying gamification in the learning context?*

Two different analytical methodologies were used for the study: the first method studies keyword relations in co-occurrence mapping, and the second method analyses writer connections and country contributions through co-authorship mapping (Van Eck & Waltman, 2010). Bibliometric data becomes more understandable through graphical visualization, which VOSviewer scientific software effectively generates from the data (Giovanni, 2017). VOSviewer performed data mining operations as well as mapping and clustering of articles derived from the database.

The full counting method operated on all co-occurring terms for the mapping process. The analysis included limitations for accuracy improvement, which required a minimum of thirty occurrences of every keyword present in the study. The evaluation used a VOSviewer thesaurus file to combine synonyms with abbreviations and spelling variations but excluded unimportant keywords. A total of 93 keywords from the 6615 performed successfully according to this analysis method.

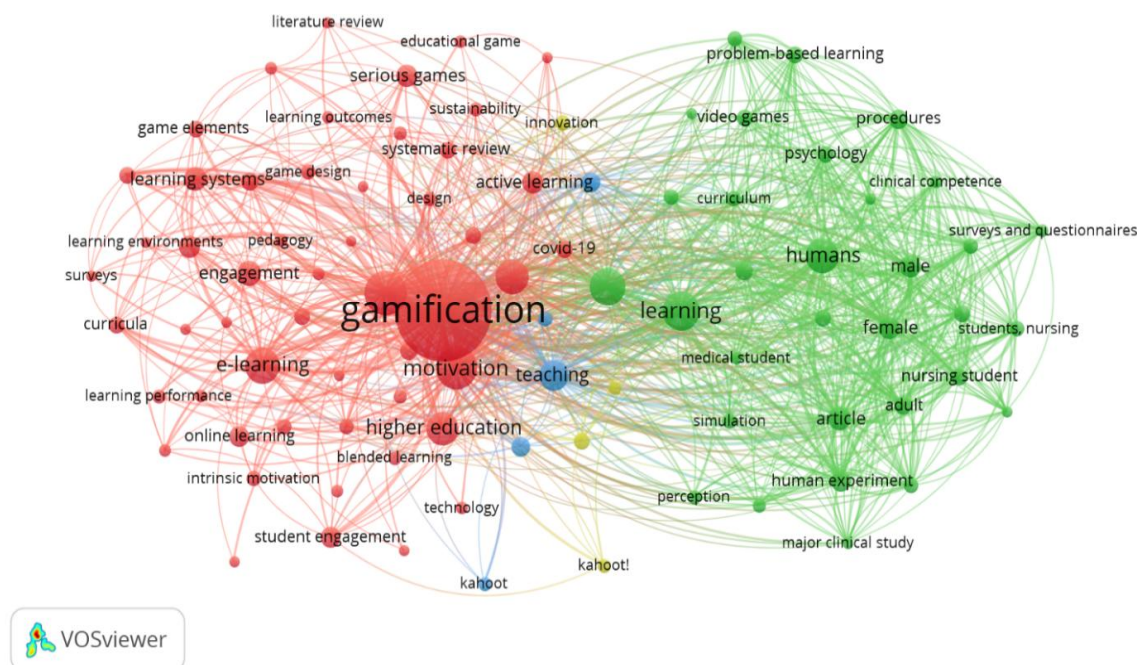


Figure 6: Network Visualization

Research on gamification in education contains four distinctive clusters identified through clustering analysis. Figure 6 presents the scientific papers as their network visualization representation. The cloud map provides visual information about word frequency within articles, together with the interrelation between keywords. Every network term appears as a circular shape, with its size indicating how many publications contain that particular term. Each colour in the network visualization represents clusters of unified terms, while the length of curved lines indicates the approximate repetition of the term, and the thickness of lines indicates keyword or topic relationship strength.

The 52 central research topics in educational science make up Cluster 1 and are expressed in red. This research cluster focuses on three main aspects: student engagement, gamification techniques, and instructional design. This cluster demonstrates the use of gamification in teaching approaches for better student learning, together with motivational improvement. The core themes of this cluster are the topics of academic performance, active learning together with artificial intelligence, and blended learning, collaborative learning, e-learning, engagement, problem-based learning, and flipped classroom and gamified learning (Grosbeck et al., 2020; Ren et al., 2024; Swacha, 2021). The studies within this cluster demonstrate how gamified learning affects educational results and student drive because gamification represents a vital element for progressive learning methods today.

Cluster 2 contains 32 items presented in green and focuses on medical and nursing education through studies that demonstrate simulation-based learning as well as clinical training and problem-based learning. Modern healthcare education depends more heavily on gamification because it aids both the creation of clinical competence and the improvement of learning methods in medical and nursing

courses. This cluster focuses on clinical competence and controlled studies as well as curriculum development, nursing and medical education, together with human experiment research and studies on medical students and nursing education, and studies on perception psychology satisfaction and surveys (Hu & Fu, 2024; Supriyadi et al., 2023; Swacha, 2021). Research findings show that healthcare training is enhanced through gamification implementation because it increases both participant engagement and informational retention, thus becoming an essential educational tool.

Because interest in immersive learning technologies has been increasing, Cluster 3 represents five items arranged in blue that focus on augmented reality and virtual reality, together with game-based learning. Researchers in this cluster explore the interactive techniques of using augmented reality (AR) and virtual reality (VR) equipment to boost student engagement and develop their experiential education. The key terminology from this cluster comprises augmented reality, game-based learning, Kahoot, teaching, and virtual reality, according to (Ren et al., 2024). The combination of AR with VR finds its best application within gamified STEM learning because such simulated environments and interactive scenes promote better understanding of concepts.

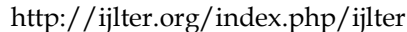
The yellow Cluster 4 contains four items that focus on the fundamental role of educational technology and innovation together with professional training in gamification development. The cluster integrates technology and education to evaluate how gamified systems help students develop expertise in numerous academic fields. Educational technology features as the primary research theme here, with innovation, Kahoot!, and training as other major subjects, according to (Al-Hafdi & Alhalafawy, 2024; Herlambang, 2024; Trinidad et al., 2021). The adoption of gamification techniques in training programmes has expanded to corporate learning and skill enhancement programmes because of its universal relevance.

The VOSviewer system examines each keyword by evaluating its linked terms, their combined connection power, and their occurrences with different keywords. The occurrences show the number of articles that contain the keyword, and each record ends with the total link strength in parentheses. Table 2 presents the list of keywords that occur most frequently with other terms: gamification (1487 occurrences, 3921 total link strength), students (299 occurrences, 1636 total link strength), humans (174 occurrences, 1596 total link strength), learning (226 occurrences, 1508 total link strength), education (214 occurrences, 1209 total link strength), motivation (267 occurrences, 1200 total link strength), article (89 occurrences, 1002 total link strength), teaching (146 occurrences, 987 total link strength), female (78 occurrences, 932 total link strength), and male (76 occurrences, 899 total link strength) are the most highly co-occurring keywords.

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RQ3a: Which countries and academic institutions lead research activity in the field of educational gamification?

Table 2: Top 10 Countries with the Highest Number of Publications

Country	Documents	Citations	Total Link Strength
Spain	298	7594	161727
United States	304	11233	155138
China	100	2327	73252
Turkey	78	1919	69913
United Kingdom	113	2642	65834
Hong Kong	63	2803	61058
Malaysia	120	1259	60680
Taiwan	99	2214	60016
Germany	67	2098	52857
Canada	60	1550	40656

Table 2 presents the top 10 countries that contributed to the total number of documents. As of 2025, the United States had the most publications, followed by Spain, Malaysia, the United Kingdom, China, Taiwan, Turkey, Germany, Hong Kong, and Canada. The dominant role of the United States is probably associated with the well-developed research infrastructure, large investment in educational technology, and the early institutional implementation of game-based learning models in higher education (Herlambang, 2024).

In terms of citations, the United States again leads with the highest citation count, followed by Spain, Hong Kong, the United Kingdom, China, Taiwan, Germany, Turkey, Canada, and Malaysia. The high scores in citation performance and the level of publication output in Spain indicate that Spanish scholars have not merely been prolific but have also created impactful work, which was probably encouraged by the robust support of the government in the areas of educational innovation and the active inclusion of gamification in the agenda of the educational reforms.

5. Discussion, Limitations and Implications

5.1 RQ4: To what extent does the growing body of gamification research align with developments in Quality Education (SDG 4) standards?

The impact of the research question addressed in this study is evident in the bibliometric evaluation, which shows significant changes in educational gamification research from 2000 to 2025. This steady upward trend in the number of publications addressed RQ4 demonstrates that the rise in gamification research is not coincidental but is structurally integrated with global efforts towards quality education outcomes, including UNESCO's Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive, equitable and quality education for all (Supriyadi et al., 2023).

The congruence between the growing number of gamification publications and the growing institutional mandate for competency-based and student-centred learning approaches suggest that researchers are heeding the same global call for quality education initiatives as policy-making bodies. This synergy is not just

temporal; it is a targeted scholarly focus on answering questions about how interactive and engaging teaching strategies can resolve the shortcomings of traditional teaching, such as student motivation, retention, and equity in learning outcomes (Irwanto et al., 2023; Ren et al., 2024).

The results of this study validate and build on previous bibliometric studies of gamification. (Swacha, 2021) noted an increasing trend in gamification studies until 2020, and this study confirms that the trend has continued to grow and strengthen up to 2025. Likewise, (Trinidad et al., 2021) observed the preference for higher education as a research context, which this study confirms, and also highlighted the broadened research context of gamification into vocational, medical and K-12 education. Guerrero-Alcedo et al. (2022) highlighted the dominance of gamification studies in the SCOPUS-indexed publications from 2012 to 2022.

This study builds on this finding to show that growth in publications has become more geographically diverse with the emergence of Southeast Asian researchers. What this study adds to this body of literature is its connection between the bibliometric trends and quality education standards, an aspect that has not been widely considered in previous reviews (Al-Hafdi & Alhalafawy, 2024; Herlambang, 2024).

5.2 Contributors and Role of Institutions

Authors with high research productivity and researchers from different academic institutions have driven the growth of gamification research. Our results verify that NC State University, National Taiwan University of Science and Technology and Tampere University are among the top gamification research institutions (Ren et al., 2024). These universities have pushed gamification forward as an interdisciplinary field that facilitates educational applications in various learning settings.

Pioneering scholars such as Acosta et al. (2025), Hwang et al. (2020), and Azevedo et al. (2017) have published highly cited articles on gamification for engagement, learning and online education that have laid the conceptual foundations for many of the empirical studies published today. The impact of these authors is not limited to the number of citations; their ideas have influenced the theories, methodologies and language of the field (Grosseck et al., 2020). This suggests that research performance assessment should not be founded on bibliometric metrics based on citations only, but should adopt other metrics, such as h-indexes, percentiles and altimetric indicators, for a more complete assessment of intellectual impact (Giovanni, 2017).

5.3 Geography and Language

Gamification research exhibits widespread international engagement with the USA, Spain and Taiwan playing leading roles (Irwanto et al., 2023). The increasing significance of Southeast Asia, especially Malaysia and Indonesia, further enhances the global acceptance of gamification in various educational settings, and suggests a growing trend towards global research (Por et al., 2025). However, it is crucial to note the country rankings in this study are limited by the language

bias of the search criteria, which was limited to English publications (as detailed in the method).

Nations with robust gamification research traditions but whose publications are typically not in the English language, such as Latin American, Eastern European and Asian countries, may be underrepresented. This implies that the leading positions of the US and the UK in the number of publications are partly due to their language advantage. Bibliometric analyses in the future should include a multilingual approach to search for a more balanced representation of the gamification literature (Guerrero-Alcedo et al., 2022; Swacha, 2021).

5.4 Clusters and their significance

The thematic analysis and the co-occurrence of keywords show four main research areas in the field of gamification: educational design and student engagement; nursing and medical education; virtual and augmented reality technology; and educational technology in professional training (Yazdi et al., 2024).

The first cluster, which includes student engagement, instructional design, active learning and blended learning, represents the "theoretical heart" of gamification studies. This cluster's literature consistently shows that game play elements increase student engagement, motivation and recall in diverse learning settings (Irwanto et al., 2023). The prominence of this cluster in the literature confirms that gamification's scholarly rationale is primarily centred on its ability to overcome engagement problems that negatively impact learning.

The second cluster, health and nursing, is worth further exploration owing to its representation in the data. The inclusion of medical and nursing education in the list of gamification's application areas speaks to the field's increasing recognition of the value of gamification as a professional development method to build clinical skills, increase procedural knowledge, and improve patient safety measures (Por et al., 2025). This is important for health education policymakers who can use gamification design principles to build health accreditation programmes, simulation training, and continuing professional education modules that are both engaging and can be quantified in terms of outcome measures. The emergence of this cluster also indicates that the academic community has evolved from considering gamification only as a tool suitable for classroom learning, to extending its use to high-stakes learning in professional contexts (Jantakoon et al., 2024).

The third cluster exemplifies the use of augmented and virtual reality technologies to enhance gamified learning environments, and signals an emerging future research trend that predicts the blending of immersive technology with gamified learning environments (Guerrero-Alcedo et al., 2022). The fourth cluster showcases the application of gamification in corporate learning, staff development and skill-building outside the confines of the classroom (Jantakoon et al., 2024). These four clusters demonstrate that research on gamification has evolved from a pedagogical curiosity to a structurally diverse

and interdisciplinary field with wide-ranging applications and relevance within and across institutions and sectors.

5.5 Study Limitations

There are a number of limitations on this study. The use of the SCOPUS database hampers the evaluation since different databases use different classification rules. We recommend using other databases (Web of Science and Google Scholar) to complement the analysis (Giovanni, 2017). The language bias, which is limited to English papers, affects the results, as shown above. Finally, reliance on VOSviewer visualisations introduces challenges in the representation of the entire network of research connections in large datasets (Van Eck & Waltman, 2010).

Variations in citation practices between research disciplines also impact the comparison of influence measures, and future research should focus on refined bibliometric approaches that consider these variations. When it comes to the introduction of gamification in the learning environment, other issues to consider are related to ethics and governance, such as issues with student data privacy, concerns of bias in algorithms related to adaptive systems, and ensuring inclusivity for neurodiverse students and students from disadvantaged backgrounds (Sergeeva et al., 2024).

5.6 Implications

5.6.1 For Classroom Teachers and Educators

Our study has practical implications for teachers. The robust findings of the four narrative clusters verify that gamification features (points, badges, leaderboards, stories and challenges) are effective in enhancing student engagement and learning outcomes when carefully applied to course design (Irwanto et al., 2023). Educators should focus on gamification approaches that are better suited to achieving learning goals, ensuring game elements are used for the right reasons, rather than working on the surface of classroom activities. In practice, teachers can start gamifying their classrooms with low-tech methods, such as challenge-based assessment and quests, before moving to platform-based gamification, making it accessible for all classrooms, regardless of resources (Goi, 2023; Lopez De Coca et al., 2022).

5.6.2 For Policymakers and Institution Heads

This bibliometric research can be used by policymakers to create a roadmap for gamification research. The strong representation of developed nations in the publication rankings, partially due to language bias, suggests a need for research funding in gamification research in the developing world, especially Sub-Saharan Africa, South Asia, and resource-limited contexts of Latin America. The data on research clusters can guide policymakers to prioritise funding of research in less explored areas, such as gamification for neurodiverse learners and gamification in resource-poor educational contexts (Guerrero-Alcedo et al., 2022; Swacha, 2021).

The identified bibliometric patterns in this research clearly show the correlation between the growth of gamification research and SDG 4 targets and can be used to justify institutional funding for gamification infrastructure, teacher training

programmes, and digital learning platform development. The alignment of these bibliometric trends with policymaking to support research funding can facilitate the translation of gamification research into educational systems change (Ren et al., 2024).

5.6.3 Ethical Implications

As gamification continues to expand into adaptive and data-driven strategies, researchers must take the lead in anticipating and considering the ethics of gamification. The data collection and analysis of student data (behaviour and performance) in gamified systems raises concerns regarding privacy, consent, and the risk of algorithms perpetuating inequalities and disadvantages at the expense of already disadvantaged students (Yadav, 2025). Competitive features like leaderboards can de-motivate students with lower performance and increase rather than decrease educational equity. Thus, researchers and gamification developers need to prioritise ethical considerations in the design of gamified platforms, making data collection and use transparent, providing opt-out options for competitive gamification elements, and adhering to accessibility standards that cater for various learner requirements (Mohd Amin et al., 2025; Sergeeva et al., 2024).

5.6.4 Mapping Bibliometric Pathways to Policy

The bibliometric trends highlighted in this research are not just scholarly insights but have policy implications. The rapid increase in publications, the broadening geographical representation, and the growing focus on applications in professional and medical education all point to the fact that gamification has now achieved a critical mass of scholarly attention, and should be considered for policy integration (Hu & Fu, 2024). Education policymakers tracking these bibliometric trends can expect to see new research directions, align national education standards to evidence-driven gamification methods, and recognise institutional collaborations that foster innovation. The increasing participation, in particular from Southeast Asian countries, should encourage regional education policy bodies to establish gamification research consortia that can develop region-specific, culturally-sensitive gamification approaches (Jantakoon et al., 2024; Por et al., 2025).

6. Conclusion and Future Avenues

6.1 Conclusion

This research offers a bibliometric review of the gamification in the education field from 2000-2025, a longer time frame than most other reviews. Importantly, this is one of the first bibliometric explorations of gamification that explicitly considers it through the framework of SDG 4 (Quality Education), tying research trends directly to global educational quality goals, rather than viewing publication growth in isolation. The addition of 2024-2025 data significantly enhances the field's directional perspective, showing gamification has evolved from an add-on classroom tool to a structurally integrated pedagogical methodology in medical education, professional training and immersive technology-enhanced learning (Gaonkar et al., 2022).

Researchers' confidence in gamification as a valid approach is affirmed by continued growth, especially since 2010. The US, Spain and Taiwan are the most prolific research countries, with Southeast Asian countries, especially Malaysia and Indonesia, indicative of a global expansion. Four research clusters emerge: gamification for student engagement and learning design; medical and nursing education; incorporation of augmented and virtual reality; and professional training and corporate learning. The latter, Cluster 4, professional training, is a particularly emerging cluster, suggesting gamification has moved beyond education to the workplace and corporate training.

The evidence supports the key message that gamification has the potential to promote equitable, inclusive, and quality education around the world. However, access to gamified educational opportunities remains uneven across socioeconomic backgrounds, and this needs to be addressed by researchers and policymakers. Ethical use of artificial intelligence in gamified systems presents the best hope for providing personalised and scalable learning opportunities if embedded safeguards are in place.

6.2 Future Avenues

The analysis of research gaps in the four major clusters and density map reveals a number of future research opportunities. Bibliometric reviews should include other databases such as Web of Science, Google Scholar and regional databases (e.g., ERIC, Dimensions) to capture multilingual and non-indexed gamification studies (Guerrero-Alcedo et al., 2022; Swacha, 2021). The density map shows that the keywords "neurodiverse learners," "low-resource gamification," "formative gamification assessment" and "culturally adaptive game mechanics" are under-represented, signifying that they are emerging research areas that need to be explored (Irwanto et al., 2023).

Subtopics within the four clusters may need to be explored. Student engagement (Cluster 1) research focuses mainly on higher education, with little on secondary and elementary education, particularly in developing nations (Irwanto et al., 2023; Jantakoon et al., 2024). In Cluster 2, there is a need for longitudinal research on long-term clinical skills and patient safety impacts of gamified medical and nursing education (Por et al., 2025; Ren et al., 2024). Cluster 3 (AR/VR with gamification) needs models for resource-poor settings and frameworks to ensure immersive technologies do not further inequities (Guerrero-Alcedo et al., 2022; López-Belmonte et al., 2020). Cluster 4 is gamification for corporate training and development that requires assessment instruments for non-formal learning environments (Goi, 2023; Jantakoon et al., 2024).

Theoretically, research should create a Quality Education Gamification Framework to measure the impact against SDG 4 metrics (Aria & Cuccurullo, 2017). International organisations such as UNESCO should enable collaboration between gamification pioneers and underserved areas to generate culturally sensitive models (Irwanto et al., 2023; Sergeeva et al., 2024). Research should focus on issues of privacy and bias in algorithms and on the psychological impacts on vulnerable learners (Mohd Amin et al., 2025; Yadav, 2025). Gamification with AI

can provide personalised and inclusive learning. Lastly, empirical studies on K-12, college and professional use-cases are needed to justify gamification in quality education systems around the world.

Conflicts of Interest

The authors declare no conflict of interest.

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Ethical Approval

This study did not involve human participants or animals and thus did not require ethical approval.

Data Availability Statement

Data is available upon request.

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