

## EXPLORING GAMIFICATION IN EDUCATION: AN INVESTIGATION OF RESEARCH TRENDS AND VISUALISATION NETWORKS

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### ABSTRACT

*Gamification in education has gained significant traction in recent years, driven by advancements in digital technology. In contemporary education, gamified elements increasingly shape the structure and effectiveness of digital learning environments. Despite its rising importance, there is a notable gap in the systematic evaluation of gamification's evolution and impact on pedagogy, specifically in the aspect of its subject focus, conceptual development and research output over time. This study addresses this gap by conducting a bibliometric analysis of gamification in education, using data from the Scopus database and analyzed with VOSviewer software. The primary objectives are to examine publication trajectories, forecast future advancements, and elucidate predominant themes within the research domain. The methodology consists of three main phases: document retrieval and refinement, systematic data extraction, and detailed analysis of emerging trends. Findings reveal a steady growth in publications, with projections indicating a 42% increase by 2028. The United States leads in research output, followed by Spain and the United Kingdom. A keyword analysis of 344 terms highlights "gamification" as the central theme, surrounded by significant terms like "education" and "human." This bibliometric study highlights the continuous expansion of gamification in educational contexts and provides valuable insights to guide future research and applications in this field.*

Keywords: Gamification, Education, Research Trends, Visualisation Networks

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### INTRODUCTION

It is widely acknowledged that Information Systems (IS) play a crucial role in organizational systems. According to Piccoli et al. (2018), IS are conceptualized as formalized, sociotechnical organizational frameworks that facilitate the acquisition, processing, storage, and dissemination of information. Alternatively, they can be regarded as integrated assemblages of components designed for data aggregation, preservation, and manipulation, often incorporating digital solutions to bolster informed decision-making (Encyclopaedia Britannica, 2020). In essence, IS engages with data by transforming it into information that contributes to knowledge. IS analysts have expanded their focus beyond functional estimation to include the hedonic value of IS, which encompasses the experiential aspects of fun and playfulness (Poncin et al., 2017). This extension of IS evaluation incorporates values related to enjoyment and engagement. One prominent development in this area is gamification, which has garnered significant attention from researchers exploring its implications. Gamification refers to the use of game design elements and dynamics in non-game contexts to engage users (Hsu and Chen, 2018).

Gamification has emerged as a prominent trend in electronic markets and commerce. A review of trends and applications in e-commerce reveals that research in gamification continues to expand annually (Rahmadhan et al., 2023). This growth is attributed to the potential of gamified marketing methods to enhance cognitive and emotional responses to brands, thereby increasing sales (Huotari and Hamari, 2017; Noorbehbahani et al., 2019). Further insights into the current and future directions of gamification in marketing are provided by Santos et al. (2024). In addition to marketing, gamification is widely applied in education, often referred to as gamification-based learning. The increasing popularity of this concept, along with its positive outcomes and growing interest in educational games, has led to the development of numerous gamification-based learning resources (Saleem et al., 2021). A substantial body of research supports the use of games as teaching tools. For instance, Klock et al. (2019) proposed a framework for client-focused gamification in educational settings, while other studies have developed game-based methods to enhance student interaction (Wulantari et al., 2023; Gulinna and Lee, 2020), engagement (Rivera and Garden, 2021; Bouchrika et al., 2021), and satisfaction (Qiao et al., 2023). Evidence suggests that gamification supports not only pedagogical and cognitive aspects of learning but also affects learners' motivation (Ansar and George, 2022) and satisfaction (Aguilar-Castillo et al., 2021). Nah et al. (2013) further emphasized that gaming activities must be grounded in sound educational

principles to serve as effective pedagogical tools. Panme and Waluyo (2022) also support the use of gamification in vocabulary learning and training in higher education.

In addition to supporting pedagogical tools, gamification offers direct benefits to students. According to Anastasiadis et al. (2018), gamification in education engenders several benefits, including enhanced digital competency, cognitive maturation, acquisition of interpersonal skills, improved problem-solving and decision-making capacity, augmented teamwork and communication, bolstered competitive capabilities, elevated self-perception, and reinforced learning via feedback and incentives. Similarly, Putz et al. (2020) demonstrated that the infusion of gamified elements into workshops significantly augmented knowledge retention among secondary and tertiary students specializing in supply chain management. Landers et al. (2018) posited that the overarching objective of gamification is to modulate behavior to fulfill predetermined outcomes, with its pedagogical application aiming to enrich the learning experience. Nevertheless, despite a rise in research output, the scarcity of comprehensive understanding of the thematic and structural evolution of gamification research in education is still evident. To date, there are not many research that offer a thorough analysis utilizing bibliometric techniques to comprehend major topics, new directions and patterns of collaboration.

To understand the contribution of gamification in educational contexts, a comprehensive examination of related keywords and bibliometric indicators such as authors and citations is valuable. Bibliometric analysis is a method that can visualize the development and popularity of gamification in learning. While bibliometric analysis is commonly regarded as a statistical assessment of bibliographic data (Talan & Demirbilek, 2023), it is a method used to quantitatively and qualitatively evaluate the attributes, structure, relationships, patterns, and trends within academic disciplines (Zhang et al., 2021). It involves the application of quantitative techniques, such as citation analysis, to manage large volumes of scientific data. Conversely, gamification involves utilizing game elements to engage users (Toimah et al., 2021) or learners in educational processes. Gamification has been widely applied across various knowledge domains. Therefore, it is beneficial to review recent research on gamification and learning. Various authors have assessed gamification-based learning differently. For example, Sailer and Homer (2020) conducted a meta-analysis to examine the effects of gamification on cognitive, motivational, and behavioural learning outcomes. Instead of a meta-cognitive analysis, a bibliometric approach could provide insights into these knowledge domains. However, a comprehensive bibliometric analysis of the themes within gamification and learning remains unexplored in the existing literature. Thus, this paper aims to offer evidence on the use of gamification in learning through bibliometric analysis. Focusing on research patterns and visualization networks enables an empirical, data-driven knowledge of the transforming context of gamification in education. These strategies assist in identifying major contributors, influential works, and thematic focuses, laying the groundwork for strategic academic planning and future study. Specifically, the objectives are to:

- i) Examine the trend forecasting of publications on gamification in learning.
- ii) Identify the popularity of gamification in learning based on bibliometric themes.
- iii) Visualize the weights of occurrences, citations, and authorships in the bibliometric data of gamification-based learning.

This study contributes to the knowledge domain of ‘gamification and learning’ by presenting descriptive analyses, trend forecasting, and weights of bibliometric networks across different themes. Bibliometric analysis offers a rigorous literature review by providing detailed analyses and visualizations that ensure the quality of the information used.

## MATERIALS AND METHODS

Bibliometric analysis is acknowledged as an intellectual domain dedicated to mapping the structural dimensions, evaluation, and quantification of academic knowledge (Van Raan, 2014). Hence, bibliometric analysis is chosen in this study due to its capacity to capture both quantitative and qualitative aspects of scholarly communication. VOSviewer was chosen for its ability to map co-authorship, co-citation, and keyword co-occurrence networks, which are critical for showing the interrelated nature of gamification research in education. The method relies on extracting bibliographic data from scholarly outputs. A pivotal component of bibliometric analysis is mapping, which reveals the networked structures and their temporal evolution. In this study, VOSviewer software (Van Eck & Waltman, 2010) was employed for constructing and visualizing bibliometric networks and clusters, enabling the meticulous examination of authorship, journal impact, keyword interrelations, and citation patterns. The procedure for conducting the bibliometric analysis was organized into three distinct phases, as outlined in Table 1.

**Table 1. Search and Analysis Procedures**

Phases	Activities
Phase I: Document Retrieval and Selection	<ul style="list-style-type: none"> <li>▪ Select bibliometric database or source (Scopus)</li> <li>▪ Select the keywords ‘gamification’, ‘learning’, ‘education’</li> <li>▪ Select the period of Search</li> <li>▪ Use Boolean logical operators</li> <li>▪ Apply search that limit to criteria of language and type of documents</li> </ul>
Phase II: Data Extraction	<ul style="list-style-type: none"> <li>▪ Save as the data in CSV file</li> <li>▪ Collect all bibliographic data</li> <li>▪ Identify number of publications</li> </ul>

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Phase III: Analyses using MS Excel and VOSviewer	<ul style="list-style-type: none"><li>▪ Descriptive Analyses and Results</li><li>▪ Trend forecasting</li><li>▪ Highly cited article</li><li>▪ Active authors</li><li>▪ Bibliometric Mapping and Results</li><li>▪ Occurrences of keywords</li><li>▪ Authors and networks</li><li>▪ Citations Map</li></ul>
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Details of the above procedures are given as below.

### Phase I: Document Retrieval and Selection

Selecting a reliable database is essential for bibliographic data extraction. In this study, Scopus was chosen for its adherence to rigorous quality standards, extensive coverage, ease of data retrieval, and robust representation of technology-oriented journals (Baas, 2020). The bibliometric data were collected for the period from 2011 to 2023. The year 2011 was selected as the starting point because gamification first emerged in academic discussions and gained significant traction around early 2010 (Kim, 2015). The search was conducted in mid-2024, justifying the exclusion of publications from the incomplete year of 2024.

In the data retrieval process, the choice of descriptors is as important as the database. This study utilized descriptors found in titles, abstracts, and keywords, specifically using terms such as 'gamification,' 'learning,' and 'education. An initial corpus of documents was refined by applying exclusion criteria, focusing on peer-reviewed journal articles published in English. This ensured that the dataset was reliable, credible, and academically rigorous. Furthermore, English was selected as the language criterion, given its prevalence in scientific publications (Ramírez-Castañeda, 2020).

Once the descriptors, keywords, search period, and criteria were established, Boolean logical operators were used to enhance the search comprehensiveness. The Boolean model of information retrieval, a classical and widely adopted approach (Buttcher et al., 2016), was applied to ensure thoroughness and inclusivity. The search was refined with specific limitations and exclusions: documents were restricted to those published between 2011 and 2023, limited to journal articles, and only final publications in English. The search query was as follows: (TITLE-ABS-KEY (gamification) AND TITLE-ABS-KEY (learning) OR TITLE-ABS-KEY (education)) AND PUBYEAR > 2011 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")). A total of 2,818 documents were retrieved and incorporated into the bibliometric analysis.

### Phase II: Data Extraction

The extracted data were rigorously validated to ensure their pertinence to the research focus. Bibliographic details for 2,818 documents were downloaded in CSV format, a universally recognized standard for bibliometric mapping and productivity assessment (Moral-Muñoz et al., 2020). This dataset encompassed essential elements such as authorship, titles, journal sources, publication years, keywords, citation counts, and temporal citation distributions.

### Phase III: Analyses and Visualization Results

Bibliometric analysis is a technique employed for multidisciplinary evaluations through metrics such as citations, authorship, and occurrences, ensuring transparent and reliable results that significantly contribute to research on a given topic. In this research, data in CSV format were examined to discern research trends, project future publications, and compute basic descriptive statistics such as frequencies and percentages. VOSviewer software was employed to construct and visualize bibliometric networks due to its proficiency in handling data and generating bibliometric mappings (Gandasari et al., 2024). This tool has been widely utilized across various academic disciplines, including computer-based technologies (McAllister et al., 2022). The creation of bibliometric maps was facilitated by VOSviewer, which supported techniques such as author co-authorship and keyword co-occurrence analyses. The descriptive analysis employed linear regression to predict publication growth and network analysis to find intellectual structures and patterns of collaboration. Clustering in VOSviewer was based on link strength, providing information about thematic similarities between writers and keywords. Documents were examined for relationships and combinations, enabling the software to group related terms and visualize clusters in various colours, thus facilitating the analysis of these groupings or clusters (Huang et al., 2022).

## RESULTS

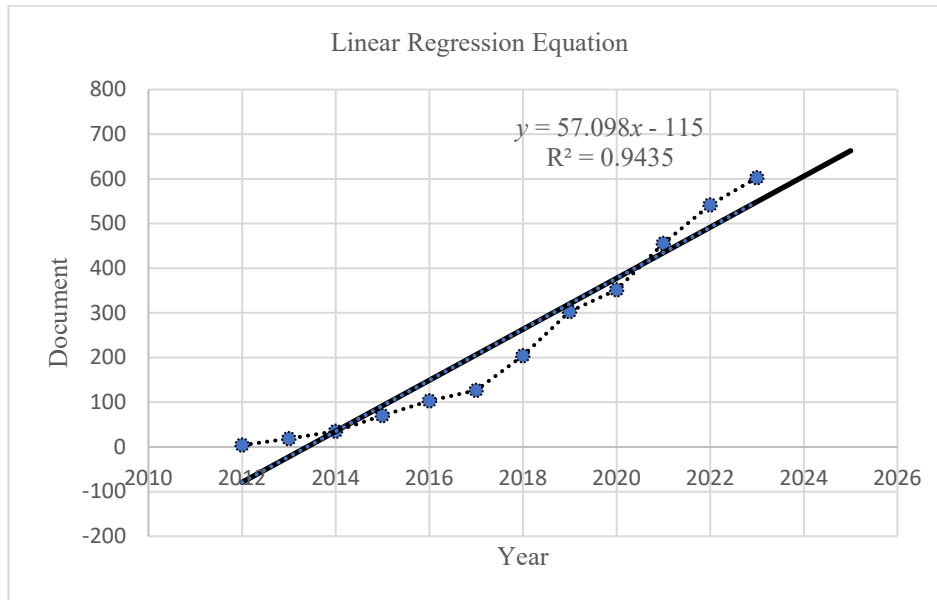
The first part of this section presents the results of publication trends and forecasts the number of future publications. Additionally, this section provides descriptive statistics on authors' production, highly cited articles, and the countries where these articles are produced. Beyond descriptive statistics, this section is complemented by visualizations of bibliographic data, which include network maps, bubble sizes (representing weights), and clusters, allowing for a comprehensive observation of the data.

### Publication Trends and Prediction

The publication pattern of scientific production was analysed based on the number of publications recorded each year. To investigate this pattern, a statistical approach was employed, specifically using a simple linear regression model. This model was selected for its ability to explain the behaviour of publication numbers and provide manageable predictions. To determine if the

trend in scientific productivity followed a linear growth pattern, the analysis focused on the period from 2011 to 2023, which encompasses the majority of the documents. A linear regression equation was estimated to represent this pattern. The linear regression equation is a statistical model used to estimate the relationship between two variables. In this case, the two variables are the number of publications (documents) and the year of publication. The resulting linear regression equation is  $y = 57.098x - 115$ , where 57.098 represents the regression coefficient (or gradient) and -115 is the y-intercept. Figure 1 illustrates the publication pattern according to this equation.

**Figure 1. Linear Regression Equation of Documents Verses Year**



It was also found that the coefficient of determination,  $R^2$  is 0.9435, indicating a high degree of predictability for the variation in the number of documents based on the variable year. This equation allows for effective prediction of future values. Specifically, we computed the number of publications projected for the next five years from the current year (2023). The predicted number of publications is presented in Table 2.

**Table 2. Predicted Number of Documents For Year 2024-2028**

Year	2024	2025	2026	2027	2028
Predicted Value	627	684	741	799	856

Based on these results, it can be concluded that the growth pattern of gamification in learning shows an upward trend, with an approximate annual growth rate of 8%. Additionally, projections indicate that the number of publications will reach 856 by 2028, representing a 42% increase compared to the current year. Notably, the number of publications for the year 2023 stands at 603 documents.

### Top Cited Articles

Among the 2,818 scientific documents analyzed, the top 10 most highly cited articles for the established period were identified. The survey article 'Gamification in Theory and Action: A Survey' by Seaborn and Fels (2015) ranks highest with 1,559 citations (see Table 3).

**Table 3. Top Ten Most Highly Cited Articles**

Authors (Year of Publication)	Article	Citation
Seaborn, K., & Fels, D. I. (2015)	Gamification in theory and action: A survey.	1559
Domínguez, A., Saenz-de-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013).	Gamifying learning experiences: Practical implications and outcomes.	1218
Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015).	Gamification in education: A systematic mapping study.	1169
Hanus, M. D., & Fox, J. (2015).	Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance.	1132

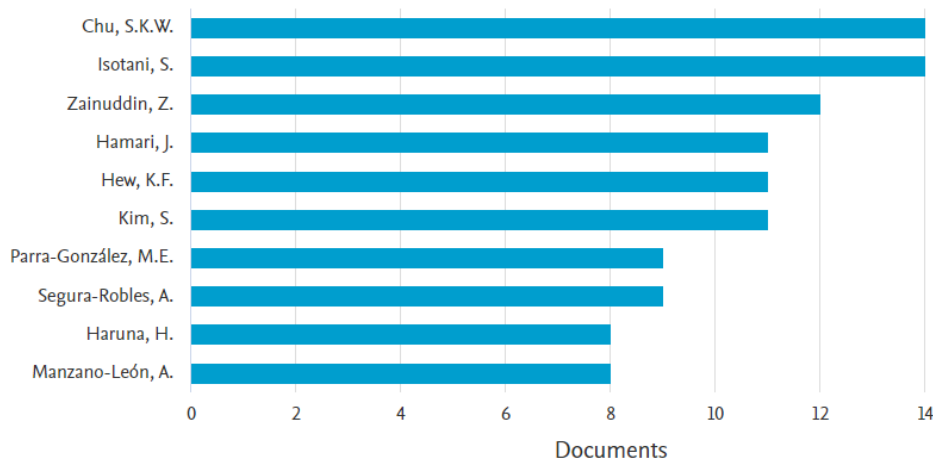
Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016).	Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning.	1087
Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015).	Foundations of game-based learning.	774
Koivisto, J., & Hamari, J. (2014).	Demographic differences in perceived benefits from gamification.	605
Simões, J., Redondo, R. D., & Vilas, A. F. (2013).	A social gamification framework for a K-6 learning platform.	555
Landers, R. N. (2014).	Developing a theory of gamified learning: Linking serious games and gamification of learning.	542
Sailer, M., & Homner, L. (2020).	The gamification of learning: A meta-analysis	505

The article at the bottom of the top ten list is 'The Gamification of Learning: A Meta-Analysis,' authored by Sailer and Homner (2020).

### Most Productive Authors

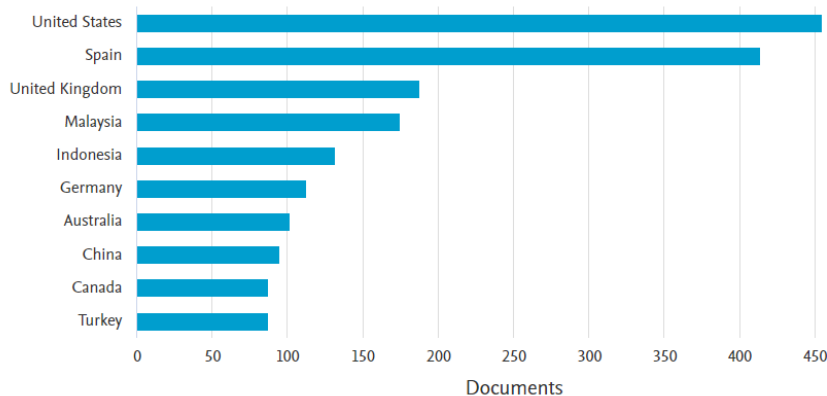
In the subsequent analysis, the most productive authors are identified based on their contributions during the period from 2011 to 2023. The term "productive author" refers to those who have published the highest number of articles worldwide during this timeframe. Figure 2 presents the top 10 most productive authors, with Chu S. K.W., and Isotani S. leading the list. Both authors contributed 14 articles during the investigated period. However, our observations indicate that neither of these authors served as the first author in those articles.

**Figure 2. Top Ten Most Productive Authors**



### Contribution by Country

By analysing author affiliations within the database, the top 10 contributing countries to the field from 2011 to 2023 were determined based on the volume of published documents per country. Figure 3 illustrates the ten leading countries in terms of published documents.



**Figure 3. Number of Documents Published by Country**

The analysis revealed that the United States dominated the field with 458 publications, followed by Spain with 412 and the United Kingdom with 175.

### Visualisation of Network

#### Keyword Co-Occurrence Mapping

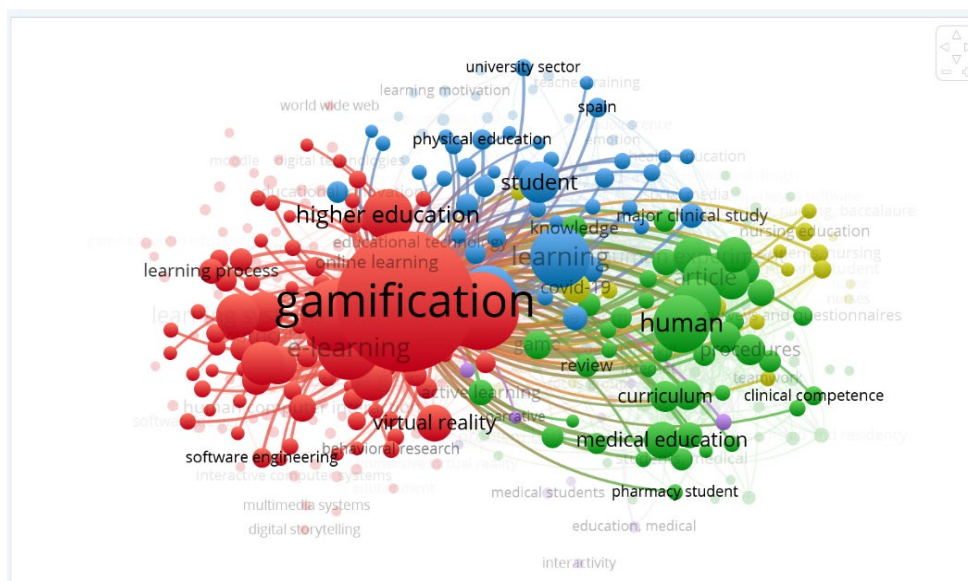
The co-occurrence analysis highlighted critical themes and their interconnectivity within the domain. The analysis identifies clusters containing keyword nodes that are interconnected. With a minimum keyword occurrence set at five, 344 out of 4,649 keywords meet the threshold. Figure 4 displays the top ten keywords ranked by their total link strength.

**Figure 4. Top-Ten Total Link Strength and Occurrences for Respective Keywords.**

Keyword	Occurrences	Total link strength
gamification	911	5211
education	280	2430
human	151	2320
students	236	2059
learning	168	1993
humans	112	1801
teaching	153	1612
article	89	1595
motivation	179	1594
e-learning	183	1408

The information that partly shown in the figure above is visualised further to show the weight of occurrences for keywords. Figure 5 provides a visualisation of weights of occurrences for respective keywords.

**Figure 5. Weights of Occurrences of Keywords**

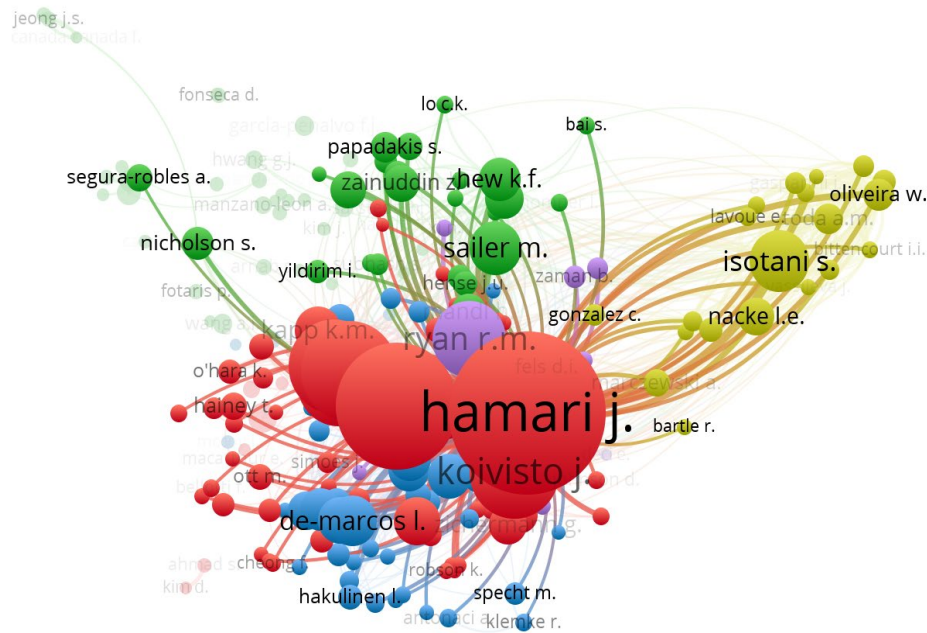


Among the 344 keywords, 'gamification' had the highest number of occurrences, as reflected by the largest bubbles and clusters (depicted in red in Figure 5). The figure also highlights the formation of two additional, closely related clusters. The next most significant keywords in terms of occurrences are 'education' and 'human', represented by blue and green bubbles, respectively.

#### Author Citation Metrics

To complement the co-occurrence results, this subsection identified the most impactful authors, setting a minimum citation threshold of 30. A total of 206 authors surpassed this benchmark with Figure 6 illustrating the most frequently cited contributors.

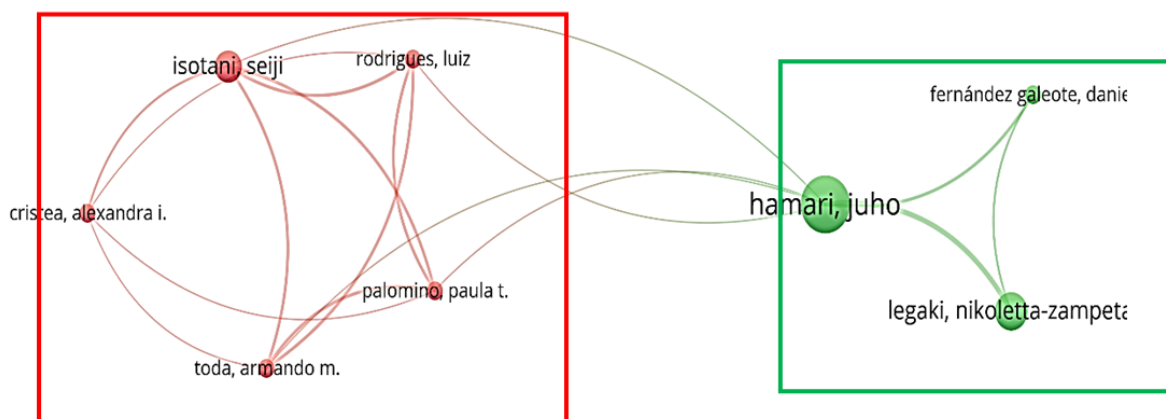


**Figure 6. Weights of Citations of Authors**

The analysis reveals that Hamari received the highest number of citations, followed by Deterding. Additionally, four primary clusters of authors with varying citation weights can be identified. These clusters demonstrate that authors tend to form their own collaborative networks within their publications.

#### Co-Authorship Analysis

The bibliometric analysis conducted using VOSviewer is further reinforced through the inclusion of co-authorship analysis. This approach highlights the collaborative relationships between authors within the shared research field. Among the 3,448 authors present in the database, only 70 have contributed to at least three documents, with a minimum of one citation, either as sole authors or in collaboration with others. Figure 7 illustrates two interconnected groups among these 70 authors, with eight authors demonstrating close collaborative relationships.

**Figure 7. Relationship Among Authors and Weights of Citations of Authors**

The analysis reveals two distinct clusters of authors based on their collaborative efforts. Cluster 1, represented in red, comprises five authors, with Isotani identified as the most influential contributor within the research field. Isotani's work has garnered 129 citations and established seven collaborative connections, reflecting a strong network with other authors in the cluster. Notably, within Cluster 1, the author Cristea has four collaborators and received the fewest citations. Meanwhile, Cluster 2, shown in green, includes three authors. Hamari, with 373 citations, has collaborated with several authors from Cluster 1. Fernandez and Legaki are also part of Cluster 2, though they exhibit minimal collaboration, each having only two connections, positioning them at the far right of the cluster.

## CONCLUSION

The present study embarks on a comprehensive analysis of the academic structure of gamification-based learning, without limiting its focus to specific subject areas or knowledge domains. It offers a contemporary perspective on the development of this research field by utilizing a larger, up-to-date dataset ( $n = 2818$ ; 2011–2023) and concentrates on peer-reviewed journal articles, which are generally regarded as reliable sources of knowledge. The study makes a significant contribution through its novel use of bibliometric visualization to bring together a fragmented body of literature and highlight growing trends, key influencers and collaborative patterns in gamification-based learning. These findings offer a solid framework for researchers, practitioners and policymakers to guide future endeavors. The findings reveal that gamification-based learning has followed a linear growth trend, as evidenced by the increasing number of publications and citations over time. This linear trend further enables the projection of future publication patterns over the next five years. The growing interest in the field is particularly notable, with the most highly cited article—published in 2015—receiving 1,559 citations. Country-specific analyses indicate that the United States leads in the number of documents produced, followed by Spain.

The incorporation of bibliometric maps introduces a captivating and visually illustrative perspective for examining the prominence and evolution of this research domain. Analysing keyword occurrence highlights key topics and their relative significance within the intellectual structure of gamification-based learning. Central clusters identified through this analysis include ‘gamification’, ‘education’, and ‘human’, with ‘gamification’ being the primary keyword, closely interlinked with other components of the field’s intellectual structure. In the author co-citation analysis, Hamari was identified as the most frequently cited author. The study identified 206 authors representing the intellectual landscape, providing insight into prevailing lines of thought, patterns of collaboration, and influential contributors within the field. The results of this bibliometric analysis demonstrate the growing relevance and significance of gamification-based learning in the digital era.

However, certain limitations should be acknowledged. First, it relied solely on Scopus, excluding other prominent repositories such as Web of Science and Dimensions. This may result in partial perspective of the literature, especially in interdisciplinary or emergent topics. Second, it considered only peer-reviewed journal articles, leaving out other important scholarly outputs including books and conference proceedings, and thesis works. These sources usually feature novel or early-stage discoveries that may not yet be recorded in academic articles. Third, it focused exclusively on English-language publications, potentially overlooking significant scholarship in other languages. This linguistic bias may result in an underrepresentation of regional patterns, particularly in Asia, Latin America and Europe, where gamification in education is actively studied. Despite these limitations, the study adopts a meticulous and robust methodological framework, offering an invaluable reference for future research in gamification and pedagogy. By strategically selecting keywords, temporal coverage, and a substantial dataset, the study provides an authoritative foundation for advancing understanding in this emerging field. Future research could expand upon this approach by including works in other languages—such as Chinese and Spanish—to develop a more comprehensive, global perspective on the literature. Additionally, incorporating other types of documents could further enrich the understanding of this evolving field.

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