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Review

Gamification in Online Education: A Visual Bibliometric Network Analysis

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Abstract: This study applies bibliometric and network analysis methods to map the literature-based landscape of gamification in online distance learning. Two thousand four hundred and nineteen publications between 2000 and 2023 from the Scopus database were analyzed. Leading journals, influential articles, and the most critical topics on gamification in online training were identified. The co-authors' analysis demonstrates a considerable rise in the number of nations evaluating research subjects, indicating increasing international cooperation. The main contributors are the United States, the United Kingdom, China, Spain, and Canada. The co-occurrence network analysis of keywords revealed six distinct research clusters: (i) the implementation of gamification in various learning contexts, (ii) investigating the application of gamification in student education to promote the use of electronic learning, (iii) utilizing artificial intelligence tools in online learning, (iv) exploring educational technologies, (v) developing strategies for creating a playful learning environment, and (vi) understanding children's learning processes. Finally, an analysis of the most cited articles identified three research themes: (a) gamification-based learning platforms, (b) measurement of users' appreciation and satisfaction, and (c) 3D virtual immersive learning environments. This study contributes to the subject discipline by informing researchers about the latest research trends in online education gamification and identifying promising research directions.

Keywords: gamification; online learning; e-learning; scientometrics; thematic map; bibliometric analysis

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1. Introduction

Gamification is the application of gaming principles for behavioral change in non-game situations [1]. Studying this object [2–4] shows that gamification, a concept focusing on playfulness, is designed for self-purposeful activities, often aiming for hedonistic use. Its ultimate goals are utilitarian, supporting extrinsic outcomes outside the system. Gamified services often include robust social features, as demonstrated in applications such as Foursquare and Fitocracy [5]. The process of applying gaming concepts to non-game contexts, such as activities, systems, and services, to create experiences comparable to those found in games is known as gamification [6–8].

Moreover, gamification offers several educational advantages [9,10]. For example, increased engagement and interest have been documented across all levels of education [11]. However, not all those advantages have been realized [12,13]. For instance, the games have several drawbacks, mainly because of their less engaging interfaces and dearth of content specifically tied to learning objectives [14], confirmed by one study [15]. Even in a causal investigation [16], it has been discovered that there are four obstacles preventing instructors from using games in the classroom: difficulties efficiently integrating games, difficulties utilizing technology, difficulties with the present educational system, and difficulties purchasing games.

In new cases, online education research focuses on its effectiveness [17], student engagement [18], and technology integration [19]. Key areas include comparing learning outcomes with traditional face-to-face instruction, enhancing student engagement through interactive activities, integrating emerging technologies like virtual reality, and examining the role of online instructors [20]. Research also explores the impact of online education on access and equity, particularly for underserved populations [21], and fostering social interaction among online learners through virtual communities and communication tools [22]. Nowadays, gamification in online education is completely clear to anyone [23,24]. Gamification has been applied in a wide range of scientific fields, such as neurosurgery education [25], management education [26], engineering education [27], teaching in sports values [28], architecture education [29], accounting education [30], vocational technical education [31], pharmacy education [32], medical education [33], computer science education [34] historical education [35], historical heritage education [28], language learning [36,37], culture, and art [38]. As a result, the size and scope of the research, as well as the quantity of publications published in this area, have all grown.

According to one study [39], Google Scholar offers 19,000 papers as of the time of writing. With such a wealth of information, it becomes harder for researchers to stay current on gamification research, especially in their specific fields of expertise, like education. Therefore, several forms of literature surveys are needed to overview each area comprehensively. The primary areas of previous studies on game-based learning have been theoretical frameworks and experimental studies.

Online learning, electronic learning, or e-learning is a cutting-edge and practical instrument for boosting university competitiveness, satisfying the many needs and interests of learners, and putting the idea of continuous education into practice [40]; it offers educational benefits that make it possible to see it as a supplement to traditional (in-person) education methods [41]. It yields advantageous results for educators, learners, and administration when considered in light of its capacity to offer creative teaching and learning [42]. Additionally, it is being used by more and more public and private non-profit organizations [43].

This study provides a thorough literature assessment using bibliometric techniques. It enables scholars to monitor the development of research on gamification in online education. Bibliometric research is a crucial instrument for comprehending and assessing the effects of online learning. It supports decision making by tracking advancements, identifying essential contributors, and evaluating the influence of research. Researchers can facilitate cooperation and information sharing by identifying significant authors, institutions, and research groups by analyzing citation patterns and publication records. It also assists in monitoring the development of online learning, spotting new subjects and technical breakthroughs. This information helps with the adaptation of instructional tactics and online learning environments. Therefore, bibliometric research is crucial to improving and perfecting online learning to satisfy the demands of learners throughout the world.

2. Literature Review

2.1. Previous Studies and Research Gap

Numerous bibliometric analysis-based research studies on gamification in education have been published. To better understand the variety of gamification approaches and how different academics, nations, institutions, or universities responded to the study of gamification in higher education through research and scientific publications, a thorough evaluation of the field and its challenges is necessary [44]. A substantial amount of literature has been published since 2015. As illustrated in Table 1, several reviews have performed scientometric analyses in different fields: medical education, higher education, adolescents, university students, and education in general. However, no bibliometric or scientometric review has focused on online education and e-learning.

Table 1. Previous scientometric reviews on gamification and education.

Reference	Software	Area of Focus	Duration	Articles	Databases
[45]	Excel	Education	2010–2014	139	WOS
[46]	VOSviewer	Higher Education	2010–2020	432	WOS
[39]	VOSviewer	Education	(unrestricted)	2517	Scopus
[47]	HistCite	Education	1995–2020	4059	WOS
[48]	VOSviewer	Education	2016–2021	344	WoS, Scopus, PubMed
[49]	VOSviewer	Higher Education (University Students)	2012–2022	287	Scopus
[44]	VOSviewer	Higher Education	(unrestricted)	1029	WOS
[50]	Bibliometrix	Education	1969–2020	429	Scopus
[51]	VOSviewer	Adolescents	2015–2020	222	Not specified
[52]	Bibliometrix + VOSviewer	Education	January 2020–March 2022	1443 + 754	WOS, Scopus
[53]	HistCite	Education	(unrestricted)	44	WOS
[54]	VOSviewer	Higher Education	2013–2022	819	Scopus
[55]	CiteSpace + Gephi	Medical Education	1990–2020	466	WOS

Most of the previous reviews used the Scopus citation database or the WOS citation database, which were also very different regarding the time covered. Additionally, VOSviewer software (VOS) is usually used and is the dominant aspect of this research. By analyzing and examining the findings of these researchers, various points can be realized. The study by Martí-Parreño et al. [45] focuses on four main themes: effectiveness, acceptance, engagement, and social interactions. The amount of research conducted in the field has increased steadily for at least seven years, thanks to broad interest from many nations and scientific fields and excellent communication via citations and co-citations [46]. Luo [47] highlights the need to differentiate gamification from game-based learning, the lack of consensus on its effectiveness, and the importance of engagement in assessing its efficacy. It suggests focusing on its reasons for energy, using gamification plugins in educational websites, and redefining the concept of gamified learning tools. The necessity of a more thorough knowledge of the success of gamification has been highlighted by Nadi-Ravandi and Batoolis' [48] consideration of many gamification-related aspects in publications in the field of education. Another review by Grosseck et al. [49] recognized significant studies that have shaped the discipline, prior contributions, current trends, and possibly game-changing concepts. The subjects that appear most frequently in this dataset include gamification, exercise, health, game design, and game-based learning. The literature emphasizes theory instead of actual application [50]. It assists those involved in creating educational policies and gamification-based software firms and organizations in determining the gamification strategies that work best for online learning [51]. According to [52], Juho Hamari from Finland is the most prolific author on gamification, with Lecture Notes and Sustainability articles dominating the Scopus and WoS journals [56]. Spain is the leading nation in creating original content; an increase is anticipated in the following years. With a focus on people's psychological requirements, Luo's study [47] redefines game features and gamification processes and offers a framework for engaging gamification that includes aim, visualization, feedback, adaptability, challenge, competition, reward, and enjoyable failure. Moreover, another study [54] indicates that Dominguez et al., de-Marcos et al., Buckley and Doyle, and de-Marcos, Boyle, and Pérez-López are essential writers. Top journals include the Journal of Chemical Education, Sustainability, and the International Journal of Emerging Technologies in Learning.

As demonstrated and experienced during the COVID-19 pandemic, distance online learning is an essential field and mode of education that should be prioritized in practice and research [57]. On the other hand, COVID-19 had a positive effect on the production process and the use of gamification in online education [58]. Research on gamification applications in online learning is needed to understand its long-term effects on student

motivation, skill development, and retention, critical challenges of open education [59,60]. It is crucial to adapt and align gamification components to various learning methods, ensure fairness and data privacy, and consider teachers' opinions. By filling these gaps, researchers can develop innovative strategies for successful and engaging learning experiences.

This paper differs primarily in its focus on the use of gamification in online distance education. The fact that most scientific studies have not examined the connection between gamification and online learning demonstrates the novelty of this research.

2.2. Theoretical Foundations

Scientometrics is a valuable method for identifying necessary research, evaluating the effect of research, and spotting new trends [61]. It helps with decision making for funding, promotions, and academic assessments by offering metrics like citation counts and h-index to assess specific scholars, institutions, or research fields. In addition, scientometrics may highlight new directions in research and technology developments, which helps researchers and decision makers make smarter resource allocation decisions. Monitoring co-authorship networks or citation trends across several domains may also assess multidisciplinary cooperation, encouraging creativity and teamwork. Scientific information may be visually represented through scientometric mapping, which tracks research output over time and offers evidence-based insights into areas needing funding and assistance. Finally, scientometrics illustrations support the scientific community's openness, cooperation, and creativity by revealing hidden patterns, evaluating effects, and directing decision making.

Scientometrics is one of the branches of bibliometrics. According to [62], a scientometrics overview, like a systematic review of a thousand articles, may be helpful information when performing systematic reviews, especially when finding recent and pertinent systematic reviews is difficult [63,64]. Evaluating scientific items using scientific techniques has become crucial because of the ever-growing proliferation of knowledge and rising competition between countries and universities. In scientific research, scientometrics enables the researcher to synthesize significant scientific data, explain the current level of expertise, and identify probable future trends in a topic or field of study across time. In scientific research, scientometrics enables the researcher to synthesize significant scientific data, explain the current level of expertise, and identify probable future trends in a topic or field of study across time. The growth in systematic surveys using scientific mapping technologies is a fast-expanding trend [61,65,66].

As a result of the dramatic rise in scientific research and papers, scientometrics has become a very intriguing research method. Research on scientometrics variables can substantially impact public and organizational knowledge of the state of science and worldwide trends. Resorting to scientometrics is imperative because of the rise in scientific publications and the understanding of new areas in digital education. The gamification of education in the modern world has seen so many changes and transformations that only with scientometric tools can one keep up with these developments and not lag behind in worldwide trends uncovering emerging, exciting, and lesser-known themes. In this study, we created a thematic map of the papers published in this field. The guiding research questions of this research were as follows:

RQ1. What are the most frequently used keywords?
RQ2. What are the most influential publication sources?
RQ3. What are the most cited articles on gamification in online education, and what topics did they cover?
RQ4. How are the authors' keywords co-occurrence networks constructed?
RQ5. Which countries have contributed the most publications on gamification in online education over the last few years?

3. Methodology

3.1. Search Strategy

Data were collected from the Scopus database. The reason for choosing Scopus instead of other databases such as Web of Science (WOS) was the fact that the citation database under study offered more articles, and the relevance of these articles was higher and more closely related to this research topic. The information from the Scopus database [67] was gathered to create a thorough and interdisciplinary citation profile using the Excel spreadsheet program and the network diagramming tool in the VOSviewer (version 1.6.18.0), R (version 2022.02.2) (Bibliometrix package), and Publish and Perish software (version 8.2.394408118).

The following inclusion criteria were applied:

1. Studies should be published between 2000 and 2023;
2. Studies should be research journal articles;
3. Articles should be written in the English language.

A starting date of 2000 was chosen considering the adoption of online digital software tools and platforms in distance learning. Articles published in Scopus-indexed journals are generally characterized by higher scientific rigor. The extraction of data from the Scopus database took place in September 2023. The search strategy included the following keywords:

TITLE-ABS-KEY (“online learning” OR “virtual learning” OR “distance education” OR “digital education” OR “remote learning” OR “mobile learning” OR “Electronic training” OR “electronic learning” OR “E-learning” AND “gamify” OR “game” OR “gamification”) AND PUBYEAR > 2000 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “j”)). Based on this, the entry criteria for articles (keywords) and the exit criteria for articles (year, type of article, and language) are provided.

As illustrated in Figure 1, 2419 papers were selected for inclusion after normalization. Additionally, between them, 1444 were open-access. Finally, data were extracted in three Plain Text, RIS, and CSV files and inserted into the software. It should be clarified that the years under review (2000–2023) were chosen because not only were not many articles published before 2000, they could also be of lesser quality and relevance to the subject of the present article.

The first aspect considered in scientometric research is the distribution of articles across time.

After the initial review and according to Figure 2, which shows a spectrogram with the data range of cited sources from 2000 to 2023, the highest peak was recorded in 2022, with 435 published works. This statistic means that the references used in the literature dataset are older than ten years. It can be concluded that the collected documents use current publications, and research based on the collected papers can be viewed as a recent trend.

Additionally, annual search results are used to determine the status or progress of articles on Gamification in Online Education. The result of scientific yearly production is required to support spectroscopy from the reference year of publication. The significant increase in articles shows that researchers can continue researching Gamification in Online Education.

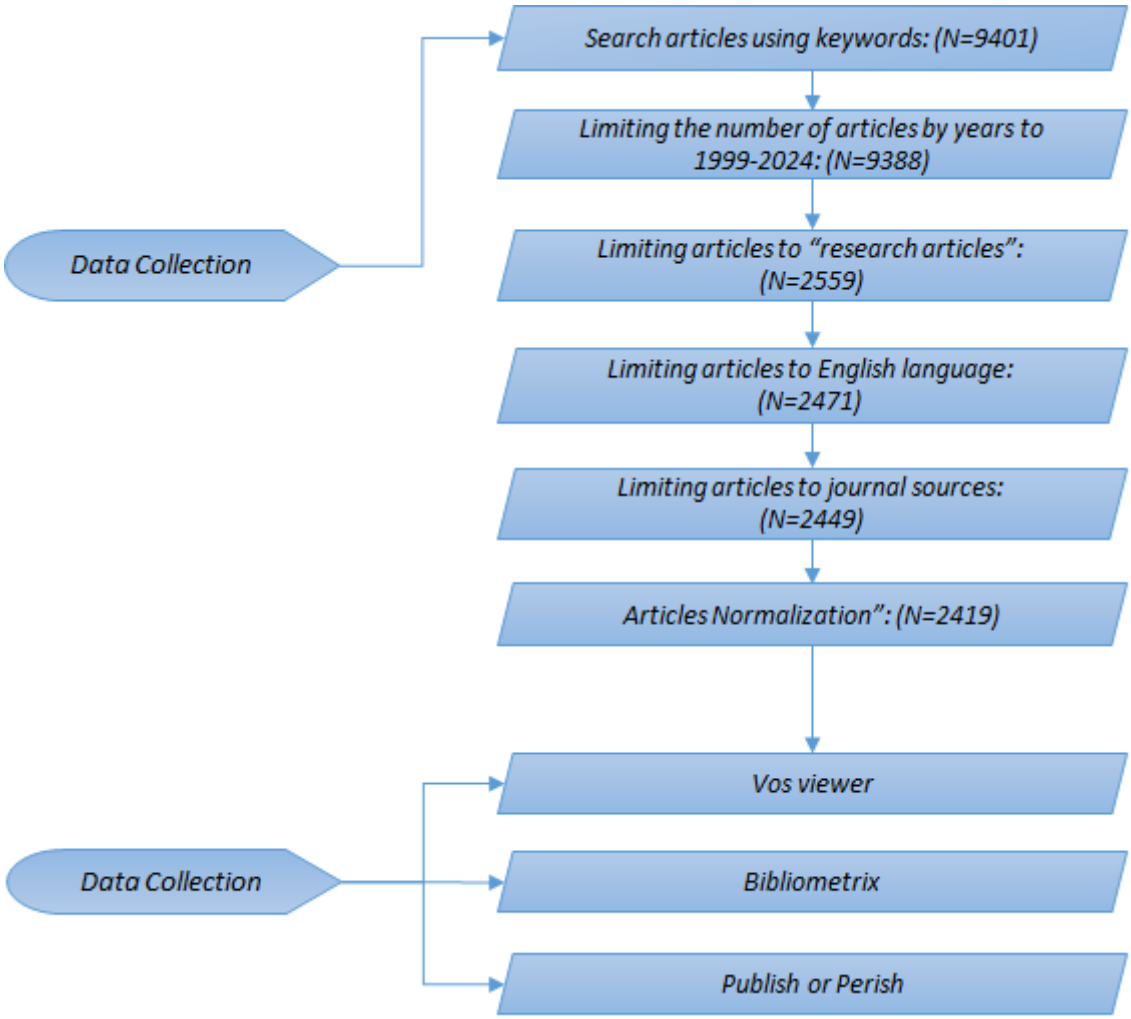

Figure 1. The methodological data collection and analysis strategy.

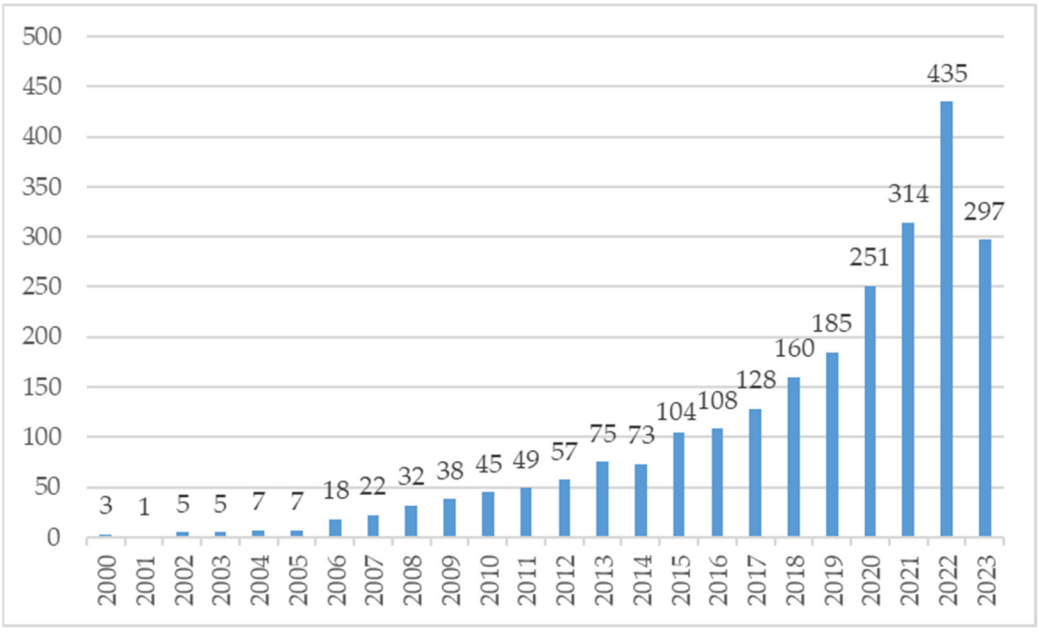

Figure 2. Annual publication output on gamification in online education.

3.2. Data Analysis

The present study is a scientometrics-focused descriptive-applied article. It was developed using a co-occurrence network as an example and can produce, present, and assess bibliometrics based on a network between the documents of various scientific publications. In this article, we will use three of the most practical pieces of software in bibliometric science: VOScvewer (version 1.6.18.0), R (version 2022.02.2) (Bibliometrix package), and Publish and Perish (version 8.2.394408118).

VOS is famous for bibliographic research and bibliometric studies [68,69]. It creates easy-to-understand bibliometric maps, compiles literature, and helps identify themes among publications, aiding data mining and clustering. VOS uses the VOS mapping technique to create structured co-occurrence network maps for scientometrics. It displays visual collaboration diagrams between countries, institutions, and authors in three dimensions: network visualization [70], overlay visualization [71], and density visualization [72]. VOS is beneficial for researchers clustering data related to word co-occurrence, co-authorship, or country of origin [73,74].

After that, checking the information extracted from our database requires using Bibliometrix software. One open-source scientific mapping analytic tool for measuring production in a research topic is called Bibliometrix [75,76]. Descriptive bibliometric analyses were produced using R software (version 3.6.3) and the Bibliometrix package (version 3.1.4). According to [77], typically, the calculation and mapping of metadata that included sources, authors, and citations came after the initial load of raw data in Biblio Tex format. A more thorough investigation of clustering and the structures of concepts, intellect, and society was then conducted [78–81]. This study used the developed bibliographic program interface to generate critical scientific information, author descriptions, and citation analysis.

The software Publish or Perish (version 8.2.394408118) was also used to analyze the citations. Publish or Perish is a software program that analyzes academic citations using various data sources. It provides metrics like paper count, total citations, and h-index and offers on-screen results, copying options, and a help file with search tips [82,83].

4. Results

This section will analyze the data extracted from the Scopus reference database using scientometric software, and tables, images, and maps are presented.

4.1. Data Overview

Table 2 provides detailed information about the collected documents analyzed using the Biblioshiny package in the R Studio (version 2022.02.2) tool. The package contained a detailed description of the papers organized. The collected documents came from 934 different publication sources, and the average number of citations per document was 18.48. This finding means that published work demonstrates the impact of the research. The document's content was analyzed using Keywords Plus and authors' keywords. Keywords Plus allows advanced keywords and phrases to be generated by the search engine system. This analysis uses the authors' keywords for a more detailed analysis. The results are shown below.

Table 2. Primary information about the collected documents.

Description	Results
Timespan	2000:2023
Sources (journals, books, etc.)	934
Documents	2419
Annual growth rate %	22.11
Document average age	4.61
Average citations per doc	18.48
References	97,678

Table 2. *Cont.*

Description	Results
DOCUMENT CONTENTS	
Keywords Plus (ID)	8435
Author's keywords (DE)	6070
AUTHORS	
Authors	7323
Authors of single-authored docs	245
AUTHORS COLLABORATION	
Single-authored docs	256
Co-authors per Doc	3.59
International co-authorships %	19.22
DOCUMENT TYPES	
Article	2419

4.2. WordCloud

Figure 3 depicts a word cloud with the 100 most used authors' keywords in the collected documents. WordCloud displays the most common words in size, varying based on frequency. Visualizing words on WordCloud can serve as a first step and help determine the relationship between a specific text and the requested information. After "gamification", which holds the most prominent font size and center position, "e-learning", "game-based learning", "mobile learning", and "online learning" are also commonly used. Articles on the topics of "virtual reality", "education", "serious games", and "motivation" also appear somewhat less frequently.

Figure 3. WordCloud using authors' keywords.

4.3. Most Relevant Sources

Figure 4 presents the primary research sources on using gamification in online training. The number of articles from each source is also indicated. The journal "Computers and Education" is at the top of the list, with 119 contributions. This point highlights its central role in shaping the academic discourse around gamification in online education and provides a comprehensive insight into these complex phenomena. The "International Journal of Emerging Technologies in Learning" and "IEEE Access" follow closely with 82 and 52 articles, respectively, underscoring their crucial role in promoting research and academic knowledge in these areas. The contribution of the British Journal of Educational

Technology, with 41 articles, is also significant. Computers in Human Behavior and Education and Information Technologies, consisting of 35 and 33 articles, are also primary publication outlets. Also worth mentioning are "Sustainability (Switzerland)", "IEEE Transactions on Learning Technologies", "Computer Applications in Engineering Education", the "International Journal of Advanced Computer Science and Applications", "Interactive Learning Environments", the "International Journal of Interactive Mobile Technologies", and "Frontiers in Education", which contribute to this review more than 15 items each. These sources highlight the multidisciplinary nature of research on gamification in online training by combining different perspectives on gamification and education.

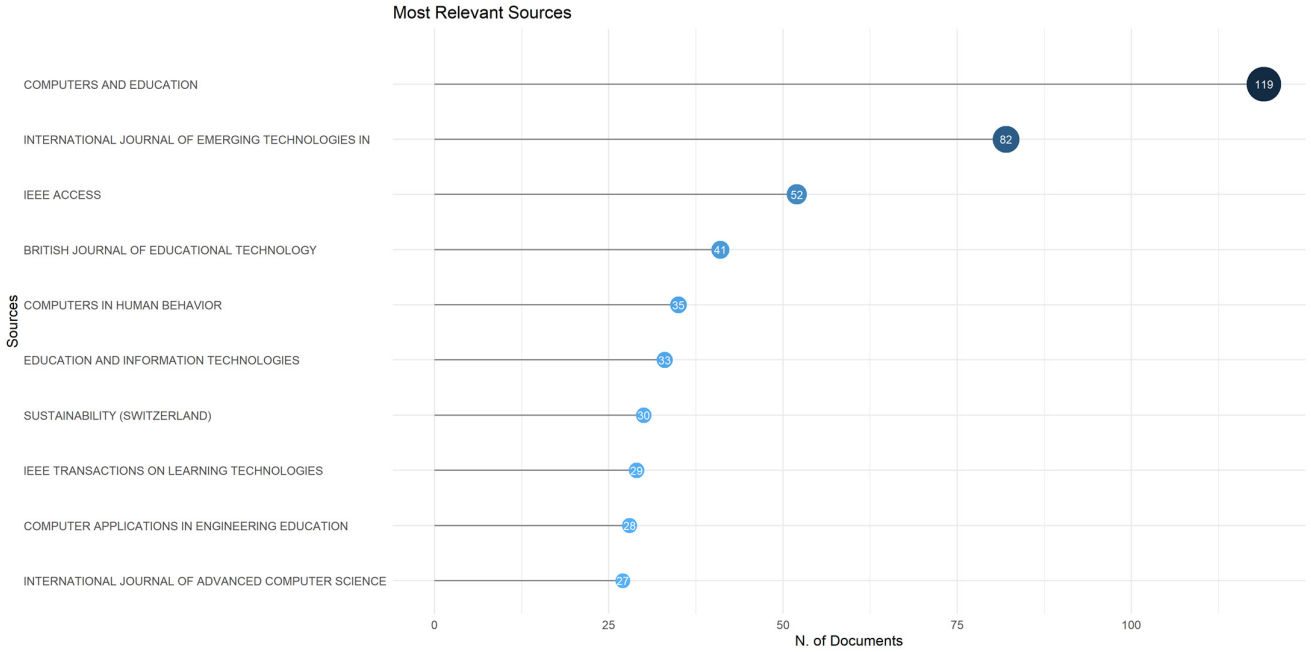

Figure 4. Most relevant sources in using gamification in online education.

4.4. 10 Most Cited Documents

A list of the most cited publications on e-learning and gamification is shown in Table 3.

Table 3. The most cited works on gamification in online education.

Author, Year	Source	TC *	TC/Year	DOI
Domínguez, 2013 [84]	Computers and Education	1079	98.09	10.1016/j.compedu.2012.12.020
Dalgarno, 2010 [85]	British Journal of Educational Technology	1010	72.14	10.1111/j.1467-8535.2009.01038.x
Simões, 2013 [86]	Computers in Human Behavior	513	46.64	10.1016/j.chb.2012.06.007
Ebner, 2007 [87]	Computers and Education	479	28.18	10.1016/j.compedu.2005.11.026
Fu, 2009 [88]	Computers and Education	441	29.40	10.1016/j.compedu.2008.07.004
Albarqouni, 2016 [89]	IEEE Transactions on Medical Imaging	414	51.75	10.1109/TMI.2016.2528120
Martín-Gutiérrez, 2017 [90]	Eurasia Journal of Mathematics, Science and Technology Education	402	57.43	10.12973/eurasia.2017.00626a
De-Marcos, 2014 [91]	Computers and Education	389	38.90	10.1016/j.compedu.2014.01.012
Vamvoudakis, 2012 [92]	Automatica	360	30.00	10.1016/j.automatica.2012.05.074
Subhash, 2018 [93]	Computers in Human Behavior	339	56.50	10.1016/j.chb.2018.05.028

* TC = total citations.

Below are summaries of some of the most globally cited publications on online education gamification.

In "Gamifying learning experiences: Practical implications and outcomes", the researchers developed and built a gamification add-on for a popular e-learning platform. They tested this add-on in a university course and gathered numerical and descriptive information. Their findings demonstrate that students engaged in the gamified learning experience achieved higher scores on practice assignments and overall grades. However, the results also indicate that these students struggled with written assignments and were less involved in various activities, despite having higher levels of initial motivation [84].

In "What are the learning affordances of 3-D virtual environments?", researchers demonstrated a range of learning opportunities in 3D virtual learning environments (VLEs), including task facilitation leading to better representation of spatial knowledge, increased experiential learning opportunities, motivation/increased engagement, improved contextualization of richer/more effective learning, and more collaborative learning than alternative activities and 2D methods previously made possible. The authors argue that further development and investment in 3D games, simulations, and virtual worlds for educational purposes should be viewed as dependent on further research into the precise relationships between the unique properties of 3D VLEs and their potential educational benefits [85].

In "A social gamification framework for a K-6 learning platform", the researchers discuss using social gamification in education, experiment with it, and validate their outcomes. They also offer essential components and recommendations for a social gamification framework that may be used in K–6 social learning environments, which are now in place [86]. Some of the policies include

- Allowing repetition of experiments;
- Including fast rewind loops;
- Aligning assignments with students' proficiency levels;
- Raising the level of difficulty in assignments as students make progress;
- Dividing complex tasks into smaller, more manageable sub-tasks;
- Providing multiple pathways to achieve success;
- Facilitating acknowledgment and rewards from educators, parents, and peers.

In "Successful implementation of user-centered game-based learning in higher education: An example from civil engineering", the authors attempt to increase accessibility to complicated theoretical information through an online learning game. We tested an experimental control group design before and after using independent online questionnaires and assessments. Aside from students using this type of online learning, the minimal effect of game-based education was equivalent to the effect achieved using traditional methods [87].

In "EGameFlow: A scale to measure learners' enjoyment of e-learning games", the study aims to construct a more rigorous scale for measuring user satisfaction with e-learning games based on the Sweetser and Wyeth paradigm. The scale established in this study has eight components: control, attention, feedback, goal clarity, social interaction, challenge, immersion, and knowledge development [88].

In "AggNet: Deep Learning from Crowds for Mitosis Detection in Breast Cancer Histology Images" the development of AggNet, a deep learning model that uses crowdsourcing for training and validation to reliably identify mitosis in breast cancer histology pictures, is discussed. This model's ability to automate the detection process is demonstrated [89].

In "Virtual Technologies Trends in Education", the authors projected that the growing availability of virtual technology will help educational institutions. These technologies will allow teachers to educate in virtual environments not available in actual classrooms, such as virtual laboratories, locations with machinery, industrial facilities, and even medical scenarios. We shall be able to push the frontiers of formal education thanks to the enormous capabilities of modern virtual technology [90].

In "An empirical study comparing gamification and social networking on e-learning", the functionality of a gamification plugin deployed in a learning management system is compared to the influence of a social networking site in the same educational institution. They discovered that both techniques perform better than the traditional e-learning ap-

proach regarding academic outcomes in practical activities, while the traditional online e-learning strategy performs better in knowledge evaluation [91].

In "Multi-agent differential graphical games: Online adaptive learning solution for synchronization with optimality", to synchronize agents in a multi-agent system, the authors provide a differential graphical game-based approach that combines optimum control approaches with online adaptive learning algorithms. The writers show how this strategy meets synchronization goals and maximizes efficiency [92].

In "Gamified learning in higher education: A systematic review of the literature", the writers examine how gamification is used in higher education and examine several studies that show how beneficial it is in different fields. Intending to enhance the learning process and results, they offer insights into the planning, execution, and results of gamification projects [93].

4.5. Co-Occurrence

VOS was used to create a keyword co-occurrence network showing the associations of the authors' 48 most-used keywords. The results are shown in Figure 5.

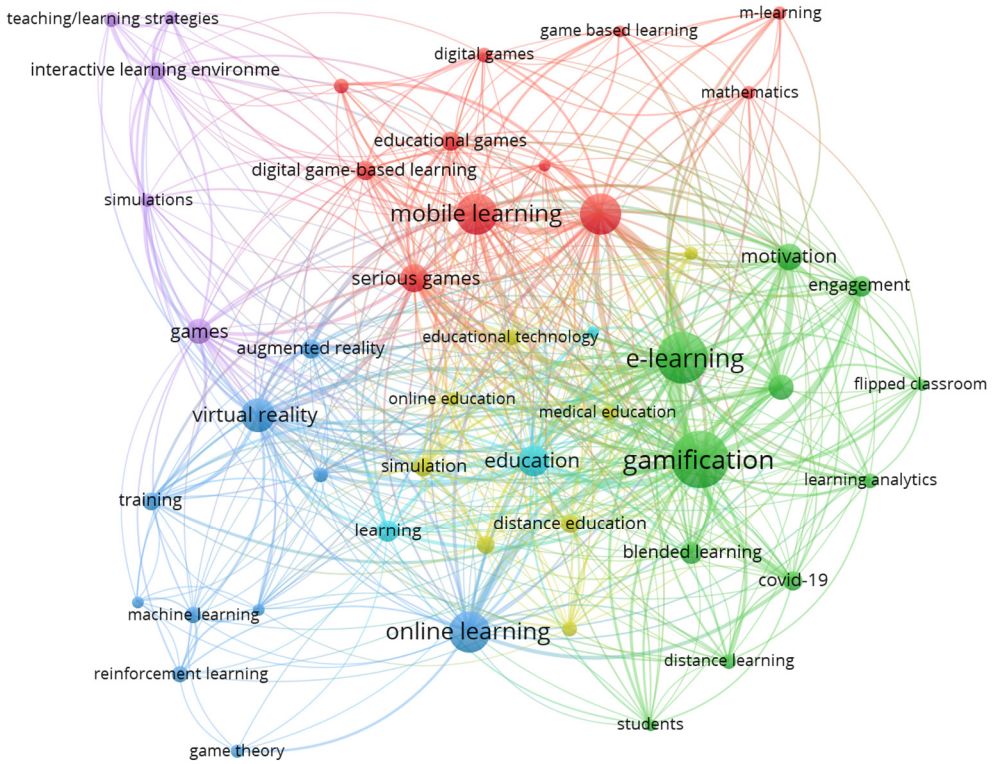

Figure 5. Co-occurrence network (produced with VOS) of the authors' 48 most popular keywords related to gamification in online education in 2000–2023.

According to Figure 5, a close and complex relationship between the words was found. Each circle represents a keyword. The size of the process reflects the frequency of occurrence of the keyword. The link indicates the coexistence relationship between two keywords, and the color represents the keyword group, the search topic. As shown in Figure 4, the keywords were divided into six clusters: Cluster 1, Cluster 2, Cluster 3, Cluster 4, Cluster 5, and Cluster 6, which are represented by red, green, blue, yellow, purple, and light blue. The keywords "game-based learning", "mobile learning", "educational games", "digital game-based learning", "mathematics", and "serious games" indicate that Cluster 1 (red) is focused on the gamification of all forms of training. Based on the keywords "gamification", "E -learning", "engagement", "student", "COVID-19", and "motivation", we can see that Cluster 2 (green) mainly covers investigating the use of gamification among students to

encourage them towards e-learning. Cluster 3 (blue) includes keywords related to the use of AI tools in online education, such as "training", "artificial intelligence", "deep learning", "machine learning", "online learning", "virtual reality", and "augmented reality", which are advanced e-learning technologies. Cluster 4 (yellow) focuses on educational technologies, evidenced by keywords such as "technology", "educational technology", and "simulation". Cluster 5 (purple) includes the keywords "learning environments", "interactive media in education", "games", and "teaching/learning strategies". It refers to the strategy of game-based learning environments. Cluster 6 (light blue) includes "children", "learning", and "education". This cluster focuses on children's learning. These six clusters reflect the majority of the research content of current publications on the use of gamification in online education.

4.6. Co-Authorship Analysis by Countries

The co-authors' analysis examined countries that are leaders in using gamification in online education (with at least five articles per country). Regarding the use of gamification in online training, the national network covers all continents and is represented by 10 clusters (Figure 6).

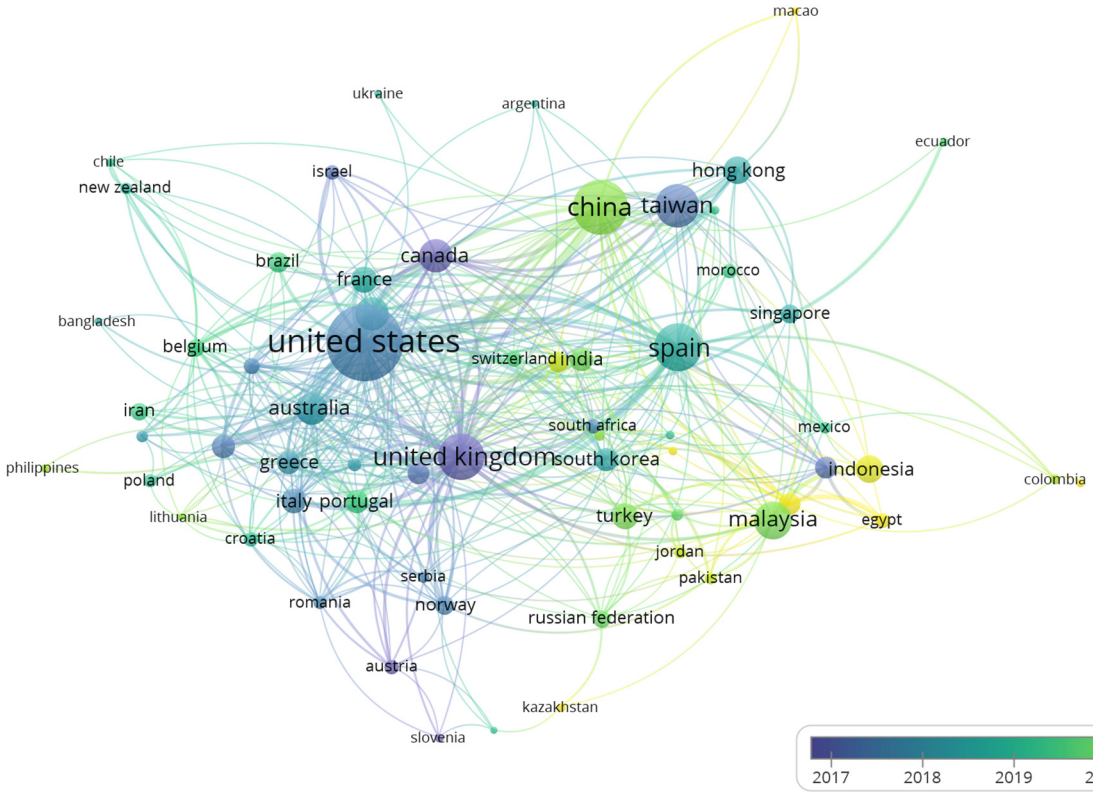

Figure 6. Overlay visualization (produced with VOS) of co-authorship analysis by countries in the field of using gamification in online education.

The most influential countries in this research field are the United States, China, Spain, the United Kingdom, Taiwan, and Malaysia, which have the most significant number of primarily consistent documents. Canada, Australia, Indonesia, Hong Kong, France, Germany, Turkey, Italy, Greece, and India have fewer records but at least 50. The United States, the United Kingdom, China, Spain, and Canada conduct the most collaborative research in this area. The USA, Great Britain, Taiwan, Canada, Finland, the Netherlands, Italy, Japan, Israel, Norway, and Austria have the most extended research history in this area, even considering 2015–2021 (Figure 6). In 2018, New Zealand, France, Bangladesh, Denmark, Spain, Australia, Greece, South Korea, Argentina, Ukraine, Singapore and Ger-

many cooperated the most in this area. Some countries, such as Portugal and Switzerland, Iran, Poland, Chile, India, Switzerland, Belgium, Mexico, Malaysia, Ecuador, the Russian Federation, and Brazil, intensified research on gamification and education in 2019. China, Malaysia, Turkey, Philippines, Indonesia, Cyprus, and Ukraine significantly extended their gamification and online education studies in 2020. Thailand, Egypt, Kazakhstan, Macau, Saudi Arabia, Peru, and Vietnam also progressed in 2021.

5. Discussion

The article examines the origins of research on gamification in online education. It includes 2419 publications on gamification in online training, downloaded from the Scopus database for bibliometric analysis. Based on the results, WordCloud showed that gamification, e-learning, game-based learning, mobile learning, and online learning are the most frequently used author keywords in the collected documents. Other commonly used keywords are e-learning, game-based, mobile, and online learning.

Notably, the most influential journals in the field are Computers and Education, the International Journal of Emerging Technologies in Learning, IEEE Access, the British Journal of Educational Technology, Computers in Human Behavior (which was introduced in Trinidad [94] as the most influential journal), and Education and Information Technologies.

The results of the bibliometric analysis show that ten most cited documents are "Gamifying learning experiences: Practical implications and outcomes" with 1079 total citations, "What are the learning affordances of 3-D virtual environments"? with 1010 total citations, "A social gamification framework for a K-6 learning platform" with 513 total citations, "Successful implementation of user-centered game-based learning in higher education: An example from civil engineering" with 479 total citations, "EGameFlow: A scale to measure learners' enjoyment of e-learning games" with 441 total citations, "AggNet: Deep Learning From Crowds for Mitosis Detection in Breast Cancer Histology Images" with 414 total citations, "Virtual Technologies Trends in Education" with 402 total citations, "An empirical study comparing gamification and social networking on e-learning" with 389 total citations, "Multi-agent differential graphical games: Online adaptive learning solution for synchronization with optimality" with 360 total citations, and "Gamified learning in higher education: A systematic review of the literature" with 339 total citations. The ten most cited articles on gamification applications in virtual education revealed three themes: (a) gamified learning platform testing, (b) user appreciation and satisfaction measurement, and (c) 3D virtual, immersive learning environments.

Notably, a co-occurrence network was created to show the associations and weights of the first 48 keywords. Out of 6078 keywords and 299 connections, the minimum number of keyword matches was 20, so the graph was designed for 48 keywords. The keywords were divided into six groups. Cluster 1 focused on gamification of all types of training. Cluster 2 is mainly concerned with studying the use of gamification in the education of students to encourage them to use e-learning. Cluster 3 contains keywords related to the use of artificial intelligence tools in online learning. Cluster 4 focuses on educational technologies. Cluster 5 refers to strategies for a playful learning environment, while Cluster 6 focuses on children's learning.

This diverse distribution of clusters shows that all topics related to gamification in education are covered. Additionally, the co-authorship analysis by countries presented that publications on gamification in online education have taken place mainly in the following countries: the United States, China, Spain, the United Kingdom, Taiwan, and Malaysia, with the most significant number of primarily consistent documents. In the 2015–2020 time span, the leading players in this area are the United States, the United Kingdom, Taiwan, Canada, Finland, the Netherlands, Italy, Japan, Israel, Norway, and Austria.

These results are consistent with previous literature [54]. However, unlike [94], Germany is not among these countries. Of course, it should be noted that in this study, which focuses on the online platform, China was able to be placed among the three powerful countries of Spain, the United States, and the United Kingdom [54,95], which shows that

China is more focused on online education. Still, the United States has a higher position than Spain compared to previous studies, inferring that research into using online spaces is developing there.

6. Conclusions

Even though bibliometric methods have been used to investigate the effects of gamification on all types of education, none have focused exclusively on online education. Therefore, this research aims to cover the existing gap. Swacha [39] concluded that the most preferred dissemination channel for the results of gamification in education research was conferences, such as the ACM International Conference Proceeding Series. Beyond gamification, the most essential keywords among the top 100 authors were e-learning, game-based, mobile, and online learning. These differed from other studies [49], especially on motivation [52,54], which is expected due to the different research fields. It is suggested that these words should be the focus of studies in this field. Although Computers and Education was identified as the most active publication venue [45], other studies pointed to Lecture Notes in Computer Science [52], Sustainability [46], and Proceedings of the European Conference on Games-Based Learning [49]. According to Scopus, most gamification studies in online education have been published in the areas of computer science [39], social sciences, and engineering, respectively. In terms of citations, the works of Domínguez et al. [84], Irwanto et al. [54] and Dalgarno and Lee [85] are the most cited papers in Scopus. A review of the ten most cited papers showed that they fit into three main themes: testing gamification-based learning platforms, measuring user satisfaction, and focusing on virtual and 3D learning environments. Furthermore, the co-occurrence network divided the keywords into six clusters. The analysis also identified 67 influential countries, with the USA, China, Spain, the UK, Taiwan, and Malaysia being the most influential. Therefore, this research categorized the most-used gamification topics in online education. There was no time limit for document collection and document type. The time frame of this research was more prolonged than that of other similar surveys. Moreover, this research showed different results in terms of countries' contributions.

Despite the authors' efforts, this study has several limitations. First, this study collected documents exclusively from the Scopus database. Articles published in languages other than English that could contain valuable insights were also excluded. In addition, it was not possible to review all bibliographic topics related to the use of gamification in online education in this article, because it would render the article too long and hard to read. Some of the most important findings were revealed. However, the results of this study continue to serve as a reference for a deeper understanding of the gamified online education field. Additionally, practical suggestions are offered for researchers in this field. Future studies may focus on the use of gamification in online education in specific educational levels such as K-12, higher education, or vocational education and draw comparisons. Another suggested research direction is the use of emerging technologies for gamified e-learning such as spatial computing, the Metaverse, and artificial intelligence. Specifically, future research could expand the use of gamification in emerging learning platforms such as learning experience platforms, social virtual reality, and the Metaverse, focusing on research topics such as personalized educational gamification and gamified immersive learning.

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References

1. Robson, K.; Plangger, K.; Kietzmann, J.H.; McCarthy, I.; Pitt, L. Is It All a Game? Understanding the Principles of Gamification. *Bus. Horizons* **2015**, *58*, 411–420. [CrossRef]
2. Marache-Francisco, C.; Brangier, E. Redefining gamification. In Proceedings of the IADIS International Conference Interfaces and Human Computer Interaction 2012, IHCI 2012, Proceedings of the IADIS International Conference Game and Entertainment Technologies 2012, Lisbon, Portugal, 17–23 July 2012; pp. 227–231. [CrossRef]
3. Huotari, K.; Hamari, J. A Definition for Gamification: Anchoring Gamification in the Service Marketing Literature. *Electron. Mark.* **2017**, *27*, 21–31. [CrossRef]
4. Hamari, J.; Hassan, L.; Dias, A. Gamification, Quantified-Self or Social Networking? Matching Users' Goals with Motivational Technology. *User Model. User-Adapt. Interact.* **2018**, *28*, 35–74. [CrossRef]
5. Hamari, J.; Koivisto, J. Why Do People Use Gamification Services? *Int. J. Inf. Manag.* **2015**, *35*, 419–431. [CrossRef]
6. Colabi, A.M.; Sharaei, F.; Alipour, S. The Relationship between Gamification and Sustainability of Small and Medium Enterprise: Explaining the Role of Digital Transformation in Open Innovation and Value Co-Creation. *J. Inf. Technol. Manag.* **2022**, *14*, 118–137. [CrossRef]
7. Baowidan, S.A. A survey on application of game design element in edutainment. In *Lecture Notes in Computer Science*; Including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics; Springer: Berlin/Heidelberg, Germany, 2023; Volume 14046, pp. 39–50. [CrossRef]
8. Tan, W.K.; Sunar, M.S.; Goh, E.S. Analysis of the College Underachievers' Transformation via Gamified Learning Experience. *Entertain. Comput.* **2023**, *44*, 100524. [CrossRef]
9. Denden, M.; Abed, M.; Holotescu, V.; Tlili, A.; Holotescu, C.; Grosseck, G. Down to the Rabbit Hole: How Gamification Is Integrated in Blockchain Systems? A Systematic Literature Review. *Int. J. Hum.-Comput. Interact.* **2023**, 1–15. [CrossRef]
10. Gui, Y.; Zhao, F.; Hoyt, E. Gamification in mobile application development education. In *Lecture Notes in Computer Science*; Including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics; Springer: Berlin/Heidelberg, Germany, 2019; Volume 11595, pp. 404–413. [CrossRef]
11. Christopoulos, A.; Mystakidis, S. Gamification in Education. *Encyclopedia* **2023**, *3*, 1223–1243. [CrossRef]
12. Toda, A.M.; Valle, P.H.D.; Isotani, S. The Dark Side of Gamification: An Overview of Negative Effects of Gamification in Education. *Commun. Comput. Inf. Sci.* **2018**, *832*, 143–156. [CrossRef]
13. Almeida, C.; Kalinowski, M.; Uchôa, A.; Feijó, B. Negative Effects of Gamification in Education Software: Systematic Mapping and Practitioner Perceptions. *Inf. Softw. Technol.* **2023**, *156*, 107142. [CrossRef]
14. Rahmadi, I.F.; Lavicza, Z.; Arkün Kocadere, S.; Houghton, T.; Hohenwarter, M. The Strengths and Weaknesses of User-Generated Microgames for Assisting Learning. *Educ. Inf. Technol.* **2022**, *27*, 979–995. [CrossRef]
15. Abbasi, G.A.; Jagaveeran, M.; Goh, Y.N.; Tariq, B. The Impact of Type of Content Use on Smartphone Addiction and Academic Performance: Physical Activity as Moderator. *Technol. Soc.* **2021**, *64*, 101521. [CrossRef]
16. Watson, W.; Yang, S.-C. Games in Schools: Teachers' Perceptions of Barriers to Game-Based Learning. *J. Interact. Learn. Res.* **2016**, *27*, 153–170.
17. Hongsuchon, T.; El Emary, I.M.M.; Hariguna, T.; Qhal, E.M.A. Assessing the Impact of Online-Learning Effectiveness and Benefits in Knowledge Management, the Antecedent of Online-Learning Strategies and Motivations: An Empirical Study. *Sustainability* **2022**, *14*, 2570. [CrossRef]
18. Wilhelm-Chapin, M.K.; Koszalka, T.A. Graduate Students' Use and Perceived Value of Learning Resources in Learning the Content in an Online Course. *TechTrends* **2020**, *64*, 361–372. [CrossRef]
19. Mercader, C. Explanatory Model of Barriers to Integration of Digital Technologies in Higher Education Institutions. *Educ. Inf. Technol.* **2020**, *25*, 5133–5147. [CrossRef]
20. Mystakidis, S.; Lympouridis, V. Immersive Learning. *Encyclopedia* **2023**, *3*, 396–405. [CrossRef]
21. Tate, T.; Warschauer, M. Equity in Online Learning. *Educ. Psychol.* **2022**, *57*, 192–206. [CrossRef]
22. Miao, J.; Ma, L. Students' Online Interaction, Self-Regulation, and Learning Engagement in Higher Education: The Importance of Social Presence to Online Learning. *Front. Psychol.* **2022**, *13*, 815220. [CrossRef]
23. Saleem, A.N.; Noori, N.M.; Ozdamli, F. Gamification Applications in E-Learning: A Literature Review. *Technol. Knowl. Learn.* **2022**, *27*, 139–159. [CrossRef]
24. Khaldi, A.; Bouzidi, R.; Nader, F. Gamification of E-Learning in Higher Education: A Systematic Literature Review. *Smart Learn. Environ.* **2023**, *10*, 10. [CrossRef]
25. Sandrone, S.; Carlson, C. Gamification and Game-Based Education in Neurology and Neuroscience: Applications, Challenges, and Opportunities. *Brain Disord.* **2021**, *1*, 100008. [CrossRef]
26. Silva, R.; Rodrigues, R.; Leal, C. Gamification in Management Education—A Literature Mapping. *Educ. Inf. Technol.* **2020**, *25*, 1803–1835. [CrossRef]

27. Anil Yasin, A.; Abbas, A. Role of gamification in engineering education: A systematic literature review. In Proceedings of the 2021 IEEE Global Engineering Education Conference (EDUCON), Vienna, Austria, 21–23 April 2021; pp. 210–213. [CrossRef]
28. Tarrago Mingo, J.; Andia, A.; Dawson, M.; Valdez, R.; Jin, R.; Zou, P.X.; Li, B.; Piroozfar, P.; Painting, N.; Hain, V.; et al. Cross curricular issues in university studies: Teaching and scientific congress. In Proceedings of the 12th International Technology, Education and Development Conference (INTED), Valencia, Spain, 5–7 March 2018; Volume 4, pp. 1279–1286.
29. Fonseca, D.; Villagrasa, S.; Navarro, I.; Redondo, E.; Valls, F.; Sánchez, A. Urban Gamification in Architecture Education. *Adv. Intell. Syst. Comput.* **2017**, *571*, 335–341. [CrossRef]
30. Ramanauskaite, A. Reporting on intellectual capital of a company: Initiatives and new reporting model. In Proceedings of the 4th International Conference on Accounting Studies (ICAS) 2017, Putrajaya, Malaysia, 18–20 September 2017; pp. 72–78.
31. Xiang, O.C.; Ann, T.T.; Hui, C.Y.; Yew, L.T. Effectiveness of Gamification in Vocational Technical Education. *Eur. Conf. Games Based Learn.* **2014**, *2*, 636–644.
32. Hope, D.L.; Grant, G.D.; Rogers, G.D.; King, M.A. Gamification in Pharmacy Education: A Systematic Quantitative Literature Review. *Int. J. Pharm. Pract.* **2023**, *31*, 15–31. [CrossRef] [PubMed]
33. Krishnamurthy, K.; Selvaraj, N.; Gupta, P.; Cyriac, B.; Dhurairaj, P.; Abdullah, A.; Krishnapillai, A.; Lugova, H.; Haque, M.; Xie, S.; et al. Benefits of Gamification in Medical Education. *Clin. Anat.* **2022**, *35*, 795–807. [CrossRef] [PubMed]
34. Spanier, A.; Harms, S.W.; Hastings, J. A Classification scheme for gamification in computer science education: Discovery of foundational gamification genres in data structures courses. In Proceedings of the 2021 IEEE Frontiers in Education Conference (FIE), Lincoln, NE, USA, 13–16 October 2021. [CrossRef]
35. Moseikina, M.; Toktamysov, S.; Danshina, S. Modern Technologies and Gamification in Historical Education. *Simul. Gaming* **2022**, *53*, 135–156. [CrossRef]
36. De La Cruz, K.M.L.; Noa-Copaja, S.J.; Turpo-Gebera, O.; Montesinos-Valencia, C.C.; Bazán-Velasquez, S.M.; Pérez-Postigo, G.S. Use of Gamification in English Learning in Higher Education: A Systematic Review. *J. Technol. Sci. Educ.* **2023**, *13*, 480–497. [CrossRef]
37. Al-Dosakee, K.; Ozdamli, F. Gamification in Teaching and Learning Languages: A Systematic Literature Review. *Rev. Rom. Pentru Educ. Multidimens.* **2021**, *13*, 559–577. [CrossRef]
38. Pishchanska, V.; Altukhova, A.; Prusak, Y.; Kovmir, N.; Honcharov, A. Gamification of Education: Innovative Forms of Teaching and Education in Culture and Art. *Eduweb* **2022**, *16*, 119–133. [CrossRef]
39. Swacha, J. State of Research on Gamification in Education: A Bibliometric Survey. *Educ. Sci.* **2021**, *11*, 69. [CrossRef]
40. Oleksiienko, L.; Sheptytska, L.; Fonariuk, O. Online Education: Challenges and Prospects. *Pedagog. Educ. Manag. Rev.* **2020**, 60–69. [CrossRef]
41. Al-Ahmari, A.N.; Ajlan, A.M.; Bajunaid, K.; Alotaibi, N.M.; Al-Habib, H.; Sabbagh, A.J.; Al-Habib, A.F.; Baeesa, S.S. Perception of Neurosurgery Residents and Attendings on Online Webinars During COVID-19 Pandemic and Implications on Future Education. *World Neurosurg.* **2021**, *146*, e811–e816. [CrossRef] [PubMed]
42. Montelongo, R. Less Than/More Than: Issues Associated with High Impact Online Teaching and Learning. *Adm. Issues J. Educ. Pract. Res.* **2019**, *9*, 67–78. [CrossRef]
43. Paulsen, J.; McCormick, A.C. Reassessing Disparities in Online Learner Student Engagement in Higher Education. *Educ. Res.* **2020**, *49*, 20–29. [CrossRef]
44. Grosseck, G.; Malita, L.; Sacha, G.M. Gamification in Higher Education: A Bibliometric Approach. *eLearn. Softw. Educ.* **2020**, *3*, 20–30.
45. Martí-Parreño, J.; Méndez-Ibáñez, E.; Alonso-Arroyo, A. The Use of Gamification in Education: A Bibliometric and Text Mining Analysis. *J. Comput. Assist. Learn.* **2016**, *32*, 663–676. [CrossRef]
46. Bagher Khatibi, M.; Badeleh, A.; Khodabandelou, R. A Bibliometric Analysis on the Research Trends of Gamification in Higher Education: 2010–2020. *New Educ. Rev.* **2021**, *65*, 17–28. [CrossRef]
47. Luo, Z. Educational gamification from 1995 to 2020: A bibliometric analysis. In Proceedings of the 2021 the 6th International Conference on Distance Education and Learning, Shanghai, China, 21–24 May 2021; ACM International Conference Proceeding Series. pp. 140–145. [CrossRef]
48. Nadi-Ravandi, S.; Batooli, Z. Gamification in Education: A Scientometric, Content and Co-Occurrence Analysis of Systematic Review and Meta-Analysis Articles. *Educ. Inf. Technol.* **2022**, *27*, 10207–10238. [CrossRef]
49. Guerrero-Alcedo, J.M.; Espina-Romero, L.C.; Nava-Chirinos, Á.A. Gamification in the University Context: Bibliometric Review in Scopus (2012–2022). *Int. J. Learn. Teach. Educ. Res.* **2022**, *21*, 309–325. [CrossRef]
50. Tyni, J.; Tarkiainen, A.; López-Pernas, S.; Saqr, M.; Kahila, J.; Bednarik, R.; Tedre, M. Games and Rewards: A Scientometric Study of Rewards in Educational and Serious Games. *IEEE Access* **2022**, *10*, 31578–31585. [CrossRef]
51. Behl, A.; Jayawardena, N.; Pereira, V.; Islam, N.; Del Giudice, M.; Choudrie, J. Gamification and E-Learning for Young Learners: A Systematic Literature Review, Bibliometric Analysis, and Future Research Agenda. *Technol. Forecast. Soc. Chang.* **2022**, *176*, 121445. [CrossRef]
52. Arias-Chávez, D.; Luy-Montejo, C.A.; Collantes Inga, Z.M.; Uribe-Hernández, Y.C. Gamification as a Resource in Education. A Bibliometric Analysis in Times of Pandemic. *J. Pharm. Negat. Results* **2022**, *13*, 268–276. [CrossRef]
53. Luo, Z. Gamification for Educational Purposes: What Are the Factors Contributing to Varied Effectiveness? *Educ. Inf. Technol.* **2022**, *27*, 891–915. [CrossRef]

54. Irwanto, I.; Wahyudiati, D.; Saputro, A.D.; Laksana, S.D. Paper-Research Trends and Applications of Gamification in Higher Education: A Bibliometric Analysis. . . Research Trends and Applications of Gamification in Higher Education: A Bibliometric Analysis Spanning 2013–2022. *Int. J. Emerg. Technol. Learn.* **2023**, *18*, 19–41. [CrossRef]
55. Zohari, M.; Karim, N.; Malgard, S.; Aalaa, M.; Asadzandi, S.; Borhani, S. Comparison of Gamification, Game-Based Learning, and Serious Games in Medical Education: A Scientometrics Analysis. *J. Adv. Med. Educ. Prof.* **2023**, *11*, 50–60. [CrossRef] [PubMed]
56. Hamari, J.; Koivisto, J.; Sarsa, H. Does gamification work?—A literature review of empirical studies on gamification. In Proceedings of the 2014 47th Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 6–9 January 2014; IEEE: Piscataway, NJ, USA, 2014; pp. 3025–3034.
57. Sidi, Y.; Shamir-Inbal, T.; Eshet-Alkalai, Y. From Face-to-Face to Online: Teachers' Perceived Experiences in Online Distance Teaching during the COVID-19 Pandemic. *Comput. Educ.* **2023**, *201*, 104831. [CrossRef]
58. Qiu, J.; Shen, B.; Zhao, M.; Wang, Z.; Xie, B.; Xu, Y. A Nationwide Survey of Psychological Distress among Chinese People in the COVID-19 Epidemic: Implications and Policy Recommendations. *Gen. Psychiatr.* **2020**, *33*, e100213. [CrossRef] [PubMed]
59. Schophuizen, M.; Kreijns, K.; Stoyanov, S.; Kalz, M. Eliciting the Challenges and Opportunities Organizations Face When Delivering Open Online Education: A Group-Concept Mapping Study. *Internet High. Educ.* **2018**, *36*, 1–12. [CrossRef]
60. Mystakidis, S. Sustainable Engagement in Open and Distance Learning With Play and Games in Virtual Reality. In *Handbook of Research on Gamification Dynamics and User Experience Design*; Bernardes, O., Amorim, V., Moreira, A.C., Eds.; IGI Global: Hershey, PA, USA, 2022; pp. 409–424.
61. Gurcan, F.; Ayaz, A.; Gokce, G.; Dalveren, M.; Derawi, M. Business Intelligence Strategies, Best Practices, and Latest Trends: Analysis of Scientometric Data from 2003 to 2023 Using Machine Learning. *Sustainability* **2023**, *15*, 9854. [CrossRef]
62. Linnenluecke, M.K.; Marrone, M.; Singh, A.K. Conducting Systematic Literature Reviews and Bibliometric Analyses. *Aust. J. Manag.* **2020**, *45*, 175–194. [CrossRef]
63. Tariq, S.; Hu, Z.; Zayed, T. Micro-Electromechanical Systems-Based Technologies for Leak Detection and Localization in Water Supply Networks: A Bibliometric and Systematic Review. *J Clean Prod.* **2021**, *289*, 125751. [CrossRef]
64. Tang, M.; Liao, H.; Wan, Z.; Herrera-Viedma, E.; Rosen, M. Ten Years of Sustainability (2009 to 2018): A Bibliometric Overview. *Sustainability* **2018**, *10*, 1655. [CrossRef]
65. Sohail, S.S.; Farhat, F.; Himeur, Y.; Nadeem, M.; Madsen, D.Ø.; Singh, Y.; Atalla, S.; Mansoor, W. Decoding ChatGPT: A Taxonomy of Existing Research, Current Challenges, and Possible Future Directions. *J. King Saud Univ.-Comput. Inf. Sci.* **2023**, *35*, 101675. [CrossRef]
66. Azima, M.; Seyis, S. Science Mapping the Knowledge Domain of Energy Performance Research in the AEC Industry: A Scientometric Analysis. *Energy* **2023**, *264*, 125938. [CrossRef]
67. Chen, M.C.; Chen, S.H.; Cheng, C.D.; Chung, C.H.; Mau, L.P.; Sung, C.E.; Weng, P.W.; Cathy Tsai, Y.W.; Shieh, Y.S.; Huang, R.Y.; et al. Mapping out the Bibliometric Characteristics of Classic Articles Published in a Taiwanese Academic Journal in Dentistry: A Scopus-Based Analysis. *J. Dent. Sci.* **2023**, *18*, 1493–1509. [CrossRef]
68. van Eck, N.J.; Waltman, L. Visualizing Bibliometric Networks. *Meas. Sch. Impact* **2014**, 285–320. [CrossRef]
69. van Eck, N.J.; Waltman, L. Software Survey: VOSviewer, a Computer Program for Bibliometric Mapping. *Scientometrics* **2009**, *84*, 523–538. [CrossRef] [PubMed]
70. Nandiyanto, A.B.D.; Al Husaeni, D.F. A Bibliometric Analysis of Materials Research in Indonesian Journal Using VOSviewer. *J. Eng. Res.* **2021**, *9*, 1–16. [CrossRef]
71. Hirawan, D.; Oktafiani, D.; Fauzan, T.A.; Luckyardi, S.; Jamil, N. Research Trends in Farming System Soil Chemical: A Bibliometric Analysis Using VOSviewer. *Moroc. J. Chem.* **2022**, *10*, 10–13. [CrossRef]
72. Finandhita, A.; Mega, R.U.; Jumansyah, R.; Rafdhi, A.A.; Oktafiani, D. VOSviewer Application Analysis: Computational Physical Chemistry Case Study. *Moroc. J. Chem.* **2022**, *10*, 10–11. [CrossRef]
73. Putri, C.R.; Soleh, S.M.; Saregar, A.; Anugrah, A.; Susilowati, N.E. Bibliometric Analysis: Augmented Reality-Based Physics Laboratory with VOSviewer Software. *J. Phys. Conf. Ser.* **2021**, *1796*, 012056. [CrossRef]
74. Guleria, D.; Kaur, G. Bibliometric Analysis of Ecopreneurship Using VOSviewer and RStudio Bibliometrix, 1989–2019. *Libr. Hi Tech* **2021**, *39*, 1001–1024. [CrossRef]
75. Aria, M.; Cuccurullo, C. Bibliometrix: An R-Tool for Comprehensive Science Mapping Analysis. *J. Informetr.* **2017**, *11*, 959–975. [CrossRef]
76. Moral-Muñoz, J.A.; Herrera-Viedma, E.; Santisteban-Espejo, A.; Cobo, M.J. Software Tools for Conducting Bibliometric Analysis in Science: An up-to-Date Review. *Prof. Inf.* **2020**, *29*, 1699–2407. [CrossRef]
77. Liu, B.; Zhou, C.J.; Ma, H.W.; Gong, B. Mapping the Youth Soccer: A Bibliometrix Analysis Using R-Tool. *Digit Health* **2023**, *9*, 20552076231183550. [CrossRef] [PubMed]
78. Abbas, A.F.; Jusoh, A.; Mas'od, A.; Alsharif, A.H.; Ali, J. Bibliometrix Analysis of Information Sharing in Social Media. *Cogent Bus. Manag.* **2022**, *9*, 2016556. [CrossRef]
79. Arruda, H.; Silva, E.R.; Lessa, M.; Proença, D.; Bartholo, R. VOSviewer and Bibliometrix. *J. Med. Libr. Assoc.* **2022**, *110*, 392. [CrossRef]
80. Wani, J.A.; Ganaie, S.A. The Scientific Outcome in the Domain of Grey Literature: Bibliometric Mapping and Visualisation Using the R-Bibliometrix Package and the VOSviewer. *Libr. Hi Tech*, 2022; *ahead-of-print*. [CrossRef]
81. Derviş, H. Bibliometric Analysis Using Bibliometrix an R Package. *J. Scientometr. Res.* **2019**, *8*, 156–160. [CrossRef]

82. Ertaş, M.; Kozak, M. Publish or Perish: The Proportion of Articles versus Additional Sections in Tourism and Hospitality Journals. *J. Hosp. Tour. Manag.* **2020**, *43*, 149–156. [CrossRef]
83. Michael Hall, C. Publish and Perish? Bibliometric Analysis, Journal Ranking and the Assessment of Research Quality in Tourism. *Tour. Manag.* **2011**, *32*, 16–27. [CrossRef]
84. Domínguez, A.; Saenz-de-Navarrete, J.; De-Marcos, L.; Fernández-Sanz, L.; Pagés, C.; Martínez-Herráiz, J.-J. Gamifying Learning Experiences: Practical Implications and Outcomes. *Comput. Educ.* **2013**, *63*, 380–392. [CrossRef]
85. Dalgarno, B.; Lee, M.J.W. What Are the Learning Affordances of 3-D Virtual Environments? *Br. J. Educ. Technol.* **2010**, *41*, 10–32. [CrossRef]
86. Simões, J.; Redondo, R.D.; Vilas, A.F. A Social Gamification Framework for a K-6 Learning Platform. *Comput. Human. Behav.* **2013**, *29*, 345–353. [CrossRef]
87. Ebner, M.; Holzinger, A. Successful Implementation of User-Centered Game Based Learning in Higher Education: An Example from Civil Engineering. *Comput. Educ.* **2007**, *49*, 873–890. [CrossRef]
88. Fu, F.-L.; Su, R.-C.; Yu, S.-C. EGameFlow: A Scale to Measure Learners' Enjoyment of e-Learning Games. *Comput. Educ.* **2009**, *52*, 101–112. [CrossRef]
89. Albarqouni, S.; Baur, C.; Achilles, F.; Belagiannis, V.; Demirci, S.; Navab, N. AggNet: Deep Learning From Crowds for Mitosis Detection in Breast Cancer Histology Images. *IEEE Trans. Med. Imaging* **2016**, *35*, 1313–1321. [CrossRef]
90. Martín-Gutiérrez, J.; Mora, C.E.; Añorbe-Díaz, B.; González-Marrero, A. Virtual Technologies Trends in Education. *EURASIA J. Math. Sci. Technol. Educ.* **2017**, *13*, 469–486. [CrossRef]
91. de-Marcos, L.; Domínguez, A.; Saenz-de-Navarrete, J.; Pagés, C. An Empirical Study Comparing Gamification and Social Networking on E-Learning. *Comput. Educ.* **2014**, *75*, 82–91. [CrossRef]
92. Vamvoudakis, K.G.; Lewis, F.L.; Hudas, G.R. Multi-Agent Differential Graphical Games: Online Adaptive Learning Solution for Synchronization with Optimality. *Automatica* **2012**, *48*, 1598–1611. [CrossRef]
93. Subhash, S.; Cudney, E.A. Gamified Learning in Higher Education: A Systematic Review of the Literature. *Comput. Hum. Behav.* **2018**, *87*, 192–206. [CrossRef]
94. Trinidad, M.; Ruiz, M.; Calderon, A. A Bibliometric Analysis of Gamification Research. *IEEE Access* **2021**, *9*, 46505–46544. [CrossRef]
95. López-Belmonte, J.; Parra-González, M.E.; Segura-Robles, A.; Pozo-Sánchez, S. Scientific Mapping of Gamification in Web of Science. *Eur. J. Investig. Health Psychol. Educ.* **2020**, *10*, 832–847. [CrossRef] [PubMed]