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Gamification in the University Context: Bibliometric Review in Scopus (2012-2022)

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Abstract. Gamification is a learning approach that transfers the power of games to the education context, with the purpose of improving the performance of students in the classroom. The present study aimed to analyze scientific activity related to gamification in the context of higher education by using a bibliometric and bibliographic approach and the Scopus database. A bibliometric study was applied with the help of VOSviewer and RStudio software, and the authors managed to identify 287 documents published between 2012 and 2022. The results were classified according to the most influential published documents, keyword co-occurrence network, trend topics, collaboration maps between countries and authors, scientific production by countries, and geographical scientific gaps. The findings show a large geographical scientific gap for the African continent, in particular. This research provides an overview of publications on the topic of gamification in the university environment.

Keywords: gamification; education; university; learning; play

1. Introduction

In recent years, the use of gamification by university professors as an innovative trend aimed at improving the teaching-learning process has increased. The rapid advancement of information and communication technologies has led to the implementation of a variety of techno-pedagogical tools in university education, thereby incorporating multimedia education and active learning applications into the curricula. Educational games (Socrative, Brainscape, Kahoot!, etc.), mobile applications, and even simulations with patients around health, are

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considered gamified training platforms (Bencsik et al., 2021; McCoy et al., 2016; Panagiotarou et al., 2020; Rojas et al., 2021).

Gamification is defined as the application of the features and benefits that a game can provide to real-world processes and problems (Gentry et al., 2019). This tool differs from serious games by the intention of the design, which provides an educational utility beyond simple entertainment. In other words, gamification involves the use of game components outside the game environment (Espina-Romero & Guerrero-Alcedo, 2022; Rodrigues et al., 2019; Romero Parra et al., 2022), which may also involve a reward for completing a learning module. It also allows greater participation by users in setting their own learning goals and objectives, personalizing the intervention and improving academic performance (Gentry et al., 2019).

In the university environment, gamification offers opportunities for students to participate in active and collaborative learning, solve real problems, develop analytical, strategic thinking, knowledge, decision-making, communication, and motor skills, and acquire experience in a risk-free environment, without the need to involve users as applied in professional practice. In addition, games have motivational properties that can be used for educational purposes (Dichev & Dicheva, 2017; Gentry et al., 2019; Smiderle et al., 2020). Gamification encourages frequent interaction between students, frees up time for teachers and involves better use of class sessions. However, opportunities to ask questions and hold open discussions in lessons are limited by the use of games, and unless games are properly evaluated, they can become distractors instead of learning facilitators (Espina-Romero et al., 2021).

To date, we know that using gamification has the potential for benefit in the educational field, because the student can contribute with their knowledge and ideas, collaborate to improve the process, and pass on lessons learned to other students. Several review studies have explored the potential effects of gamification on the teaching-learning process (Díaz-Ramírez, 2020; Dreimane, 2018; Gentry et al., 2019; Nah et al., 2014). Bibliometrics is a tool that enables the identification of quantitative variables, to determine trends in scientific publications on the use of gamification in the university environment, where authors, institutions, countries, and more productive journals stand out, as well as types of documents and collaboration between authors. It also enables the implementation of mapping techniques that organize and analyze scientific information on a given topic (Aria & Cuccurullo, 2017; Idris et al., 2020; Resmayani & Putra, 2020). Starting with the question, what is the global trend of scientific publications indexed in Scopus on gamification in the university context? this review was initiated to identify the main bibliometric indicators of production and collaboration of the scientific literature related to the use of gamification in the university environment, to determine relevant topics and trends in publications that allow identification of new areas of interest for future studies.

2. Methodology

This study undertook a bibliometric review that followed the steps proposed by Zupic and Čater (2015), which include the identification of the study design, and the collection, analysis, visualization, and interpretation of the data. It should be noted that the authors of this research had access to the Scopus database because of the subscription agreements that their institutions had with the company Elsevier.

The search for information was carried out in the Scopus database, using a search strategy through the title or title/abstract, with some restrictions to minimize false positive results. The keywords were obtained from already published literature on educational gamification and university, using search strings with Boolean operators AND/OR. It should be noted that no restrictions were used by type of document, year, or language, however, the title, abstract and keywords had to have, at least, an English language translation.

The search and retrieval of the information was carried out on August 28, 2021. A total of 1,727 studies met the referral criteria for educational gamification. After applying the filters, 287 studies referring to gamification in the university environment were identified, which were exported in BibTex format for analysis in the Biblioshiny Software, synchronized with the RStudio statistical package and in RIS format for VOSviewer 1.6.8 software. The software generated figures and data that was used to create tables that were visualized, and which will be interpreted in the discussion of this research.

Table 1 presents a synthesis of the information collected from the database, where conference articles on the selected theme ($n = 139$) are the documents with the greatest presence in the period between 2012 and 2022, followed by original articles ($n = 115$), conference reviews ($n = 23$), literature reviews ($n = 8$) and book chapters ($n = 2$). The number of authors of the papers was 827, with an average citation per document of 5.93, an average of paper citations since publication of 2.52, and an author collaboration index of 3.47.

Table 1: Synthesis of the Information Collected in the Scopus Database1

Description of the data collected	Results
Time	2012:2022
Sources (magazines, books, etc.)	170
Documents	287
Average years since publication	2.52
Average citations per document	5.934
Average citations per year for documents	1.499
References	8,472
Keywords (ID)	1,201
Author keywords (DE)	736
Types of documents	
Article	115
Book chapter	2
Conference article	139

Conference review	23
Revision	8
Authors	
Authors	827
Authors' appearances	914
Single-author document authors	35
Authors of multi-author documents	792
Collaboration by authors	
Single-author documents	59
Documents by author	0.347
Authors by documents	2.88
Co-authors by documents	3.18
Collaboration index	3.47

Data analysis was performed by considering the following categories of analysis: type of document, annual scientific output, most productive countries, institutions, journals and authors, author keywords, article citations, collaboration map by country and the collaboration network by country and authors. A threshold of 10 authors, countries, journals, and institutions with the greatest scientific production was taken as a reference, as well as the 10 most cited documents. This selection was made arbitrarily with reference to already published bibliometric studies.

3. Results

A total of 287 papers exploring the use of gamification in the university context and published between 2012 and 2022 were identified. The scientific production per year was as follows: 2012 (1; 0.34%), 2013 (3; 1.4%), 2014 (12; 4.18%), 2015 (16; 5.57%), 2016 (22; 7.66%), 2017 (26; 9.05%), among them the manuscript titled "Visual and Computational Modelling of Minority Games" (Damaševičius & Ašeriškis, 2017), 2018 (33; 11.49%), among which is research entitled "Towards Better Understanding of Ancient Civilizations by Storytelling and Gaming" (Dimova et al., 2018), and 2019 (61; 21.25%), among them "The Effect of the STEAM-GAAR Field Learning Model to Enhance Grit" (Chujitarom & Piriyasurawong, 2019) and "Is There a Link Between Creativity and Multiculturalism in Education?" (Ogrutan et al., 2019). 2020 (75; 26.13%) is the year with the greatest number of publications, among which the following three investigations: "The Use of Innovative Learning Methods in the System of Modern Economic Education in the Russian Federation" (Pashkov et al., 2020), "Digital Storytelling through Teamwork Gamification Model to Encourage Innovative Computer Art" (Chujitarom, 2020) and "Evaluation of Gamification in e-Learning Systems for Elementary School Students" (Alshammari, 2020). The publications of 2021 were fewer by almost half compared to 2020 (37; 12.89%) and, finally, 2022 (1; 0.34%) at the time of this review. The countries and institutions with the highest production on the subject are shown in Table 2.

Table 2: The Ten Most Prolific Countries and Institutions for Publications on Gamification in the University Context

Ranking	Countries	TD	Institutions	Country	TD
1	Spain	78	Technische Universität Dresden	Germany	7
2	United States	29	Vyatka State University	Russia	7
3	United Kingdom	26	Russian State Social University	Russia	6
4	Canada	21	Nosov Magnitogorsk State Technical University	Russia	5
5	Germany	17	Peter The Great St. Petersburg Polytechnic University	Russia	5
6	Ukraine	15	Universidad de Granada	Spain	5
7	Portugal	14	Universiti Putra Malaysia	Malaysia	5
8	Indonesia	13	McMaster University	Canada	4
9	Mexico	12	Universidad Internacional de la Rioja	Spain	4
10	China	11	University of Alicante	Spain	4

Note: TD: Total documents

Table 3 presents the ten most productive journals/conferences on the subject, detailing the total documents (TD), the total citations received (TC) and the H index.

Table 3: The Ten Journals/Conferences with the Most Publications

Ranking	Journals/Conferences	TD	TC	H index
1	Proceedings of the European Conference on Games-Based Learning	15	27	3
2	Ceur Workshop Proceedings	11	35	2
3	ACM International Conference Proceeding Series	10	56	3
4	Lecture Notes in Computer Scienc"	10	4	1
5	Advances In Intelligent Systems and Computing	8	10	2
6	Communications in Computer and Information Science	8	1	1
7	IEEE Global Engineering Education Conference Educon	7	6	1
8	Perspektivy Nauki I Obrazovania	7	6	1
9	E-learning And Software for Education Conference	5	2	1
10	Proceedings of the European Conference On E-Learning ECEL	5	1	1

Note: TD: Total documents. TC: Total citations.

The published documents, in total, were cited 1,703 times in the Scopus database; 159 articles received at least one citation. The average citation per year of the top ten articles ranged from 3.55 to 34.25. Table 4 shows the ten most influential publications detailing their authors, DOI, total citations, and average citations per year.

Table 4: The Ten Most Influential Publications

Publications	Authors	DOI	TC	TC/year
"Gamified learning in higher education: A systematic review of the literature"	(Subhash & Cudney, 2018)	10.1016/j.chb.2018.05.028	137	34.25
"Gamification as a tool for enhancing graduate medical education"	(Nevin et al., 2014)	10.1136/postgradmedj-2013-132486	98	12.25
"The effects of gamification-based teaching practices on student achievement and student's attitudes toward lessons"	(Yildirim, 2017)	10.1016/j.iheduc.2017.02.002	96	19.2
"Gamification: a systematic review of design frameworks"	(Mora et al., 2017)	10.1007/s12528-017-9150-4	89	17.8
"Students' perception of Kahoot's influence on teaching and learning"	(Licorish et al., 2018)	10.1186/s41039-018-0078-8	67	16.75
"Game-based learning and gamification in initial teacher training in the social sciences: an experiment with MinecraftEdu"	(Cózar-Gutiérrez & Sáez-López, 2016)	10.1186/s41239-016-0003-4	54	9
"New challenges for the motivation and learning in engineering education using gamification in MOOC"	(Borrás Gené et al., 2016)	None	50	8.333
"Gamification: An innovative teaching-learning strategy for the digital nursing students in a community health nursing course"	(Day-Black et al., 2015)	None	40	5.714
"The role of serious games, gamification and industry 4.0 tools in the education 4.0 paradigm"	(Almeida & Simoes, 2019)	10.30935/cet.554469	34	11.333
"GradeCraft: what can we learn from a game-inspired learning management system?"	(Holman et al., 2013)	10.1145/2460296.2460350	32	3.556

Figure 1 shows the authors' keyword co-occurrence network, which is organized into five clusters (red, blue, green, yellow, and purple) that evidences the use of gamification in the context of higher education and its relationship with techno-educational variables and processes. The red cluster is lead by the keyword "gamification" with close relationships to the words "university students",

“education”, “motivation”, and “serious games”. The blue cluster is headed by the keyword “learning”, closely related to the words “university student”, “university sector”, “adults”, and “universities”. In the green cluster, the word that dominates is “e-learning”, with strong links to the words “learning systems”, “programming”, and “university course”. The yellow cluster encompasses words such as “engineering education”, “educational technology”, and “personnel training”. Finally, the purple color cluster is composed of the words “educational innovation”, “educational environment”, and “blended learning”. Figure 2 shows trending topics, considering documents published before and during the COVID-19 pandemic. Among the trend topics for the period 2012 and 2019, active learning, collaborative learning, educational technology, educational gamification, higher education, training, and commitment stand out. In turn, the trend topics during the pandemic were e-learning, augmented reality, blended learning, serious games, game-based learning, educational software, and evaluation. In addition, the topics of gamification and active learning remained in force.

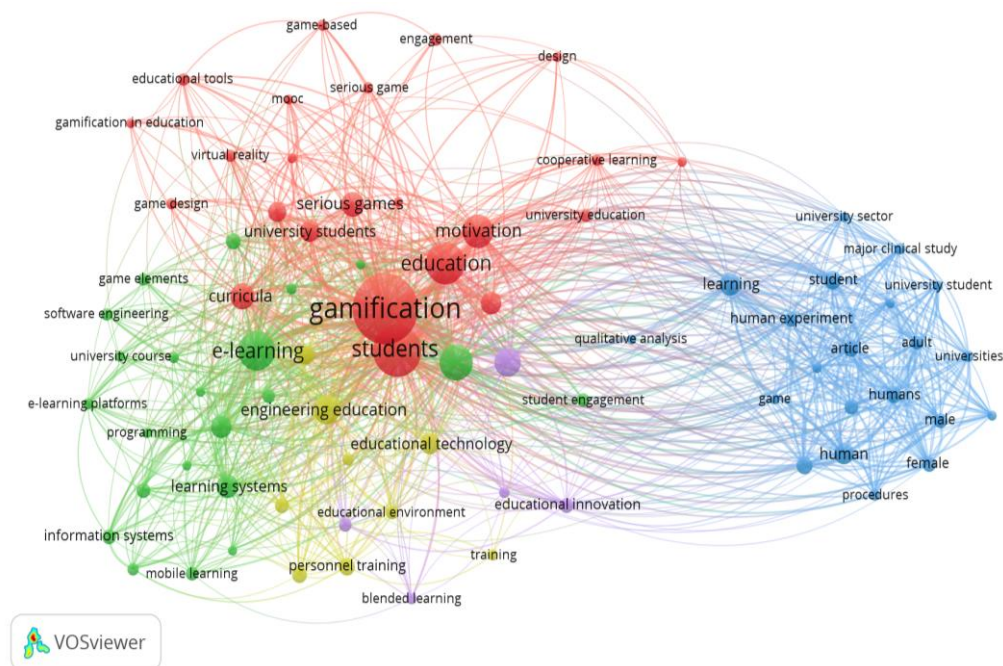


Figure 1. Network of Co-Occurrence of Keywords

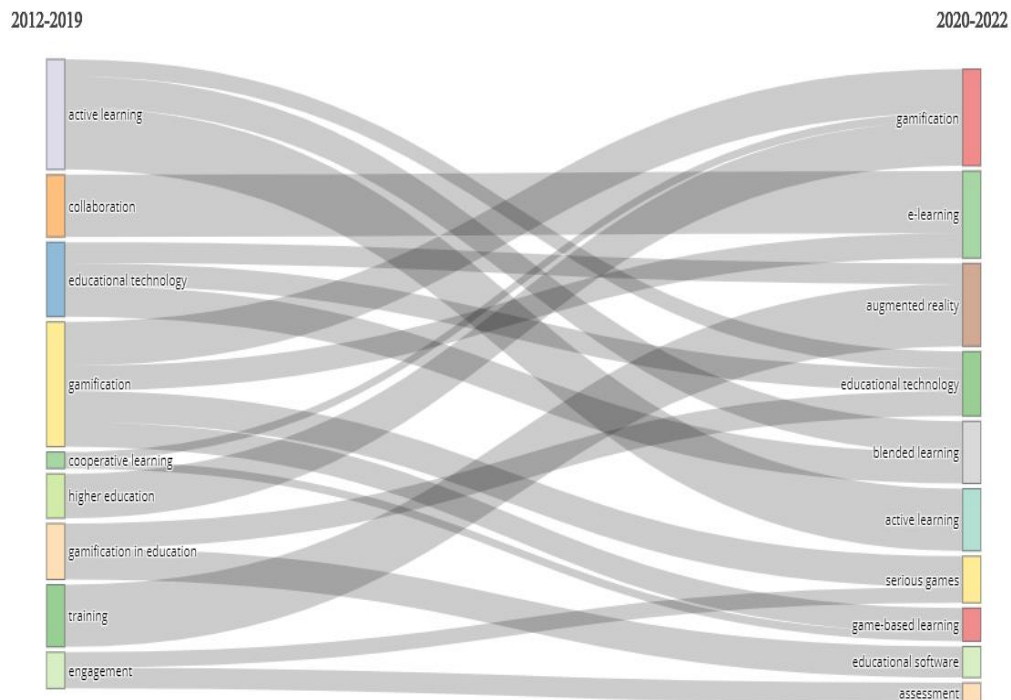


Figure 2. Trend Keywords 2012–2019 and 2020–2022

Figure 3 reports on an analysis of international collaboration between countries. It shows that, of the 287 publications, only 28 (32.18%) involved international collaboration. Of the ten most active countries, Spain had the highest number of documents with international collaboration (N = 8), followed by the United Kingdom (N = 6), the United States (N = 3), China (N = 2), Turkey (N = 2), Brazil, Finland, Greece, Jamaica, and Poland (N = 1).

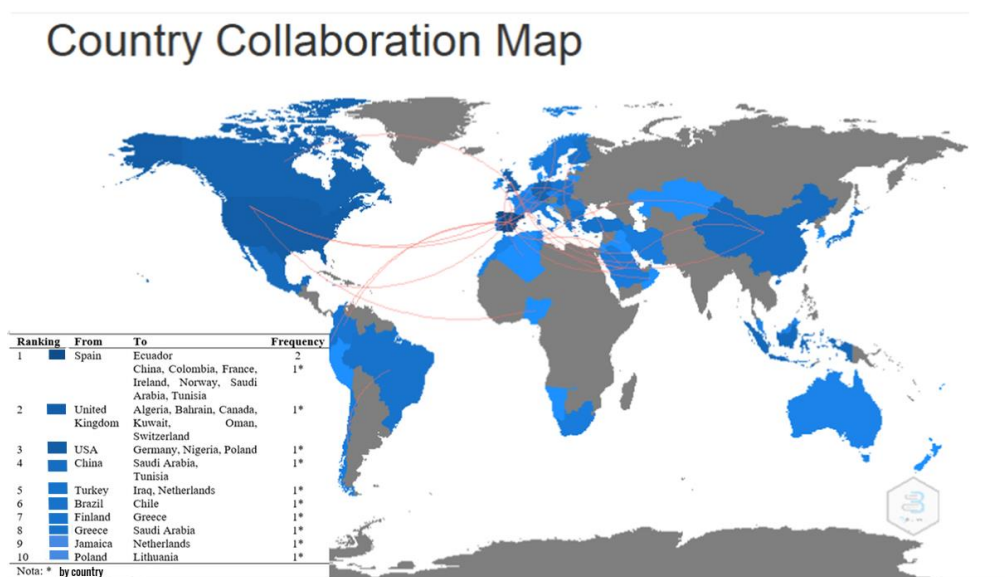


Figure 3. Map Showing Collaboration Between Countries

The different blue colors of the Country Collaboration Map indicate the number of nations involved in each collaboration group: the more intense the blue color, the greater the number of countries that make up that group.

Finally, the analysis of collaboration between authors presented in Figure 4 identifies 17 clusters of collaboration between authors: a cluster composed of five authors (red) and five clusters with four authors (yellow, blue, light blue, green, purple). The rest of the clusters were made up of three authors (four clusters) and two authors (seven clusters).

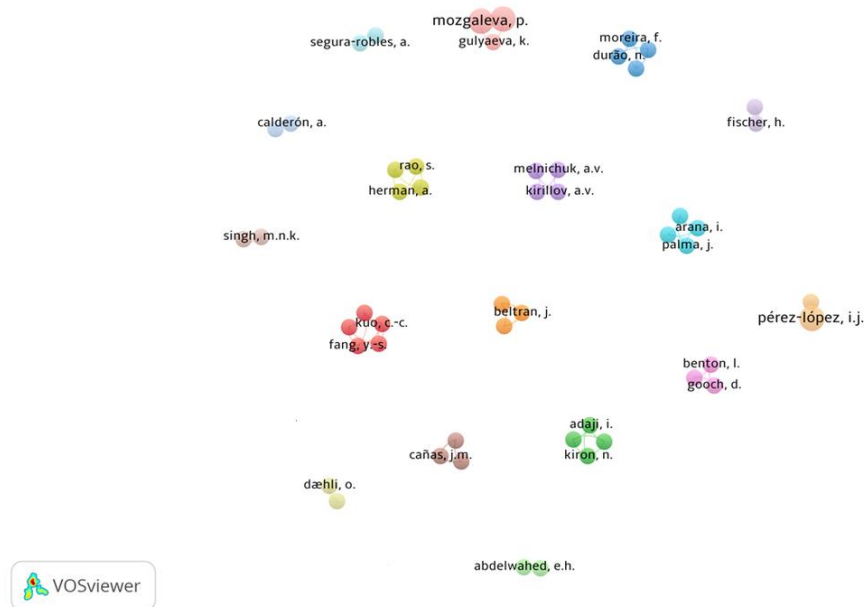


Figure 4. Map Showing Collaboration Between Authors

4. Publications by country and geographical scientific gap

Figure 5 was generated by the RStudio software, and indicates the countries with the highest production of documents, with the variable under study highlighted in blue colors and of different intensities, as well as the countries that do not have production of documents highlighted with the gray color.

Country Scientific Production

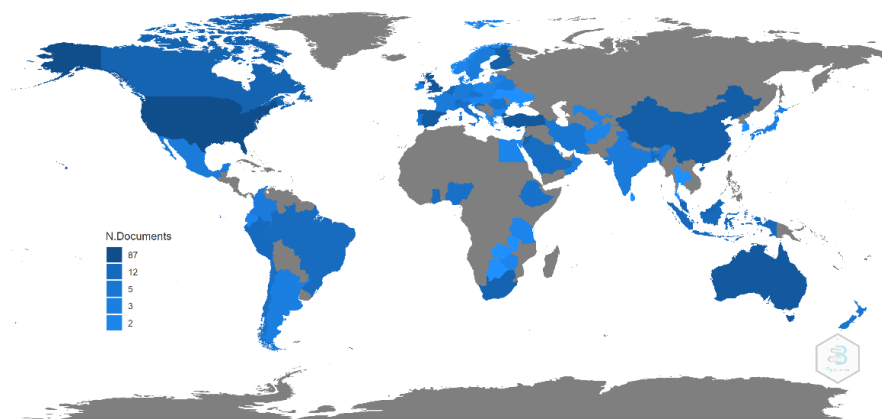


Figure 5. Countries with Production on the Topic of Gamification

The African continent is made up of 54 countries, of which only 9 countries have published research on the subject under study. That means that 83.33% of African countries do not have scientific production related to gamification in the university context. The 9 countries with the greatest number of publications are South Africa (18), Ghana (11), Nigeria (8), Ethiopia (7), Egypt (2), Tanzania (2), Zimbabwe (2), Botswana (1) and Zambia (1).

Table 5: Publications by country in Africa

Country	Documents
South Africa	18
Ghana	11
Nigeria	8
Ethiopia	7
Egypt	2
Tanzania	2
Zimbabwe	2
Botswana	1
Zambia	1

Table 6 reports on countries with scientific production on the topic of gamification in the university context in the Americas. North and South America is made up of 35 countries, though only 9 countries have published research on the variable of this study. Consequently, 74.29 % of American countries have not published studies related to gamification in the university context. The table is headed by the United States (87), followed by Canada (18), Peru (12), Brazil (11), Chile (8), Colombia (4), Mexico (4), Argentina (3) and Ecuador (2).

Table 6: Publications by Country in the Americas

Country	Documents
USA	87
Canada	18
Peru	12
Brazil	11
Chile	8
Colombia	4
Mexico	4
Argentina	3
Ecuador	2

The Asian continent is made up of 47 nations (Table 7), of which 19 countries have published research on this topic. This means that 59.57% of Asian countries have not published on gamification in the university context. The countries with publications are Turkey (43), China (28), Jordan (18), Malaysia (17), Indonesia (13), Bangladesh (11), Saudi Arabia (10), Iran (5), India (4), Oman (4), Japan (3), Lebanon (3), Afghanistan (2), Uzbekistan (2), Bahrain (1), South Korea (1), Kuwait (1), Sri Lanka (1) and Thailand (1).

Table 7: Publications by Country in Asia

Country	Documents
Turkey	43
China	28
Jordan	18
Malaysia	17
Indonesia	13
Bangladesh	11
Saudi Arabia	10
Iran	5
India	4
Oman	4
Japan	3
Lebanon	3
Afghanistan	2
Uzbekistan	2
Bahrain	1
Korea (South)	1
Kuwait	1
Sri Lanka	1
Thailand	1

Table 8 shows the 46 countries that make up the European continent. In this continental group, 30 countries have published scientific work on the variable in question. Consequently, 34.78% of European countries do not have research on gamification in the university context. The 30 countries with publications are the United Kingdom (50), Spain (32), Finland (25), Belgium (13), the Netherlands (12), Switzerland (11), Croatia (10), Italy (7), Czech Republic (7), Romania (6), Portugal (5), Germany (4), Belarus (4), Cyprus (4), France (4), Sweden (4), Denmark (3), Ireland (3), Latvia (3), Austria (2), Bulgaria (2), Slovakia (2), Greece (2), Hungary (2), Lithuania (2), Norway (2), Poland (2), Albania (1), Slovenia (1) and Ukraine (1).

Table 8: Publications by Country in Europe

Country	Documents
United Kingdom	50
Spain	32
Finland	25
Belgium	13
Netherlands	12
Switzerland	11
Croatia	10
Italy	7
Czech Republic	7
Romania	6
Portugal	5
Germany	4
Belarus	4
Chipre	4
France	4
Sweden	4
Denmark	3
Ireland	3
Latvia	3
Austria	2
Bulgaria	2
Slovakia	2
Greece	2
Hungary	2
Lithuania	2
Norway	2
Poland	2
Albania	1
Slovenia	1
Ukraine	1

Table 9 shows the group of countries that make up Oceania. This continent comprises 15 countries only 2 nations have manuscripts linked to gamification in the university context. Therefore, 86.67% of the countries of Oceania do not have publications related to the variable under study. The two countries are Australia (39) and New Zealand (5).

Table 9: Publications by Country in Oceania

Country	Documents
Australia	39
New Zealand	5

5. Discussion

The present study carried out a bibliometric review that identified production indicators by countries, institutions, journals/conferences, and authors, as well as current issues. This information should give researchers an indication of the progress of research into gamification in the context of higher education.

The trend line in scientific production on the subject suggests a considerable increase in publications in recent years, increasing from 1 article in 2012 to 75 in 2020 (Andriushchenko et al., 2020; Koravuna & Surepally, 2020) and 37 at the time of the study in 2021 (Brezolin et al., 2021; Denden et al., 2021; Liu & Lu, 2021; Luo, 2021; Metwally et al., 2021). The most productive countries were Spain, the United States, the United Kingdom, Canada, and Germany, which account for around 59% of the documents published. In addition, four institutions in Russia, three in Spain and one each in Germany, Malaysia and Canada produced 52% of scientific production worldwide. Conference papers and articles were the types of documents chosen by the authors registered in the 287 investigations selected for this bibliometric review. Conference proceedings were also a common medium of publication. Subhash, S. and Cudney, E.A. were the authors with the greatest impact due to the number of citations (TC: 137). In 2018, Subhash and Cudney published the article with the greatest impact, Entitled "Gamified Learning in Higher Education: A Systematic Review of the literature" in the journal, *Computers in Human Behavior*, with an average citation per year of 34.25.

As for the trend themes that stand out for the period 2012-2019, we have active learning, collaborative learning, educational technology, educational gamification, higher education, training, and commitment. For the period 2020-2022 were e-learning, augmented reality, blended learning, serious games, game-based learning, educational software, and evaluation, keeping the themes of gamification and active learning in force.

It should be noted that the term gamification was introduced into the general vocabulary from 2011 (Deterding et al., 2011; Fitz-Walter et al., 2011). From there, it has become a trend in research, possibly based on expectations that it is

associated with motivation, behavioral changes and the promotion of competencies and skills, in addition to enhancing collaboration in different contexts. However, knowledge about gamification and its application in the university educational context is still limited (Chujitarom, 2020). Therefore, it is necessary to continue investigating what benefits gamification could generate in the teaching-learning process. This bibliometric review offers a global overview of the progress that this topic has received in the university environment.

As for the limitations of this research, it should be clarified that bibliometric reviews only provide information on a specific topic in a general way, therefore it cannot replace a thorough reading of the subject. In addition, the data was gathered exclusively in a search of literature available in the Scopus database, therefore, it is possible that the search strategy was not able to identify all the relevant documents. Similarly, the low number of citations of the documents could be associated with the years of publication, since it is expected that publications of longer ago will have been cited more often, compared to more recent publications, therefore, the interpretation of the findings must consider these limitations.

6. Conclusion

Once the assessment of the scientific activity around gamification in the university context had been completed, numerous geographical scientific gaps on the five continents were identified. Africa is home to the most important gap, because only 16.67% of the 54 countries that make up this continent have published research on the variable in question. Another important scientific gap is that located in Oceania, where only 13.33% of the 15 countries have published studies on the subject under study. We suggest that authors conduct research in collaboration with authors on continents with geographical scientific gaps.

This bibliometric review identified trends in publications in the context of university education during the period 2012–2022. Information on current progress in the subject provide researchers with guidelines for future studies. Greater support is needed from university-level institutions, especially in Latin America, to promote research that evaluates the use of gamification tools with educational indicators in the short, medium, and long term. This research is current to February 2022 and was limited to the Scopus database.

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