

Gamification as a Resource in Education. A Bibliometric Analysis in Times of Pandemic

Dennis Arias-Chávez¹, Carlos Augusto Luy-Montejo², Zoila Mercedes Collantes Inga³, Yrene Cecilia Uribe-Hernández⁴

¹Universidad Continental, Arequipa, Perú. E-mail: darias@continental.edu.pe, ORCID <https://orcid.org/0000-0003-1500-8366>

²Universidad Privada Del Norte, Lima, Perú. E-mail: fracarlitos@gmail.com, ORCID <https://orcid.org/0000-0003-0824-7959>

³Universidad Tecnológica Del Perú, Lima, Perú. E-mail: C21574@utp.edu.pe, ORCID <https://orcid.org/0000-0002-8741-9263>

⁴Universidad Nacional De Cañete, Lima, Perú. E-mail: yuribe@undc.edu.pe, ORCID: <https://orcid.org/0000-0001-5893-9262>

Abstract

The objective of the study is to describe the world scientific production on gamification in the Scopus and Web of Science databases between the months of January 2020 and March 2022. We worked with a universe consisting of 754 documents from the database Web of Science and 1443 from Scopus. The results indicate that, in terms of the number of authors, Scopus has 1,336 and Web of Science, 2,223. The rate of collaboration between authors is slightly higher in Web of Science (3.18) compared to 3.05 in Scopus. Regarding the author with the highest production on the subject, Juho Hamari stood out, while the Lecture notes in computer science magazines in Scopus and the Sustainability magazine in WoS stood out as the media with the highest production of articles on gamification; On the other hand, Spain was the main country producing scientific evidence, and the type of scientific production that stood out was the original articles. The growth of scientific production on gamification is corroborated and further growth is forecast for the coming years.

Keywords: Bibliometrics, Scientific Production, Gamification, Educational Games.

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INTRODUCTION

The gamification, which could be translated as 'gamification', is a relatively new concept that has its origins in the business field from which it spread to other areas such as education. Studies have shown that teachers and employers use this concept as an alternative teaching method to see positive results in virtual classrooms. For example, gamification in education has been seen as a way to combat dropout rates in high school and universities globally.

Gamification has been used in various domains, but in education and training it boils down to the use of points and badges to motivate and improve learning processes. Its importance and effectiveness is manifested in the way people apply it. The various definitions of this practice are linked to the use of the game as a learning strategy in non-ludic contexts in order to enhance the motivation of the subjects, their concentration and positive values [1,2]. Its use is supported by a variety of mechanisms to attract and motivate people to develop activities that help solve problems [3].

The game as a learning strategy is a way of taking the subject to a new reality with its own rules and action mechanics, dynamics that will be repeated according to the use and purpose of this activity. Given the role it plays as an activator in attention, the game emerges as an alternative to

complement traditional teaching schemes [4], especially in virtual environments and new technologies, where the student assumes the role of player and develops a dynamic different from the one used in a traditional classroom [5]. This is how the game allows to achieve multiple benefits such as, for example, reaching a high level of group cohesion, reducing conflicts, improving social skills, the ability to solve problems, among others [6]. In order to meet these objectives, the game must have certain particular characteristics: a) educational function, b) simulation, c) interaction with the simulation, d) problems and progression, e) decoration and f) condition of use [7].

However, educational gamification or gamification is related to other phenomena such as motivation [8], given that a student with a high level of motivation will achieve a greater commitment to what he does, a passion that lasts even after the class sessions are over [9]. Achieving the commitment and motivation of students is, without a doubt, one of the biggest problems faced by teachers and educational institutions in general; therefore, gamification is seen as an alternative to solve these difficulties [10]. The advantages of its use are leading developers to design games specifically oriented to support immersive and experiential learning in the classroom [11,12,13,14,15].

The fundamentals of educational gamification are the

dynamics (implicit structure of the game), the mechanics (processes that cause the development of the game) and the components (specific implementations of the dynamics and mechanics) [16]. The interaction of these three foundations generates gamified activity. Likewise, its use is directly related to the contextualized didactic project; that is, with the objectives set to achieve the teaching-learning process, which is also achieved by controlling the challenges that are shown to the students and their ability to solve them, since a game that is too simple will make the student lose the interest in the activity while an unattainable challenge will lead to frustration [17,18].

Currently, production in the educational field is such that there are multiple bibliometric studies on the use of gamification at different levels of education and social sciences in general. In this line, the works of Parra-González and Segura-Robles (2019) stood out, Swacha (2021), Schöbel *et al.* (2021), Garrigós *et al.* (2020), Chen *et al.* (2021), Hallinger *et al.* (2020), Bride *et al.* (2021), Metwally *et al.* (2021) and Behl *et al.* (2022) and their studies on the use of gamification in face-to-face and online education; Bagher *et al.* (2021) and their studies on gamification in higher education; Luo (2021) and his work on gamification in the last 25 years.

MATERIAL AND METHODS

The present study was bibliometric and retrospective descriptive in scope. The unit of study is the global scientific production generated on gamification in the period between 2020 and 2022. Bibliometric indicators have become one of the most frequent tools of the usual practice in the management of evaluative research [19]. This type of study helps the statistical evaluation of published scientific articles, books or book chapters, and is an effective way of measuring the influence of the publication in the scientific community [20].

Designs in bibliometric research are aimed at quantitatively evaluating scientific production on certain areas of knowledge. These studies allow knowing the characteristic features of scientific material published in academic-scientific media, such as authorship, use of references, flow of publications, among others. Therefore, the bibliometric indicators used in this study were based on general information about the data, authors, sources, and collaboration between countries and researchers.

The study analyzed the scientific production on gamification in two of the most important scientific databases: Scopus and Web of Science (hereinafter WoS). The bibliometric data obtained from the application of the R bibliometrix software and from the managers of these databases were taken into account. As a search strategy, the formula was used: TITLE (gamification) AND LIMIT-TO PUBYEAR (2020-2022). These criteria were adapted for each database. Once the results were obtained, each of these were analyzed individually in order to minimize the possibility of bias and

thus validate the veracity of the information. After this process, a final sample of 754 documents in WoS and 1443 in Scopus was achieved. All the data selected for the study was exported in RIS and CSV formats for later processing and analysis, using the Bibliometrix R and Vos Viewer software.

Once the sample was formed and validated, the documents were analyzed. First, the initial reading of all the material was carried out in order to record general information. Second, an in-depth reading was carried out to identify, among other things, methodological trends. Thirdly, the information was filled in, codified and systematized, this was done by each researcher and then a single database was created. Finally, the statistical analysis of the information was carried out. The results are presented in tables and figures.

RESULTS

Table 1 presents information on the main bibliometric indicators obtained from the Bibliometrix software. A total of 754 documents were obtained from the WoS database and 1443 from Scopus, extracted from 433 and 686 sources, respectively. The average number of citations is very similar in both databases (3.07 for WoS and 2.61 for Scopus), while the average number of citations per year per document was also similar: 1.183 for WoS and 0.978 for Scopus.

Regarding the number of authors, Scopus presented 1336 and WoS 2223. Documents with a single author totaled 165 in Scopus and 79 in WoS; the rest of the documents presented multiple authors (on average three). The collaboration index between authors was slightly higher in WoS (3.18) compared to Scopus (3.05). Regarding keywords, WoS presented 961 and Scopus, 4460.

Table 1: Bibliometric information on gamification in Scopus and WoS (2020-2022)

Description	WoS	Scopus
Main information about the data		
Sources	433	686
documents	754	1443
Average years since publication	1.46	1.39
Average number of citations per document	3.07	2.61
Average number of citations per year per document	1.183	0.978
References	1	1
Authors		
Authors	2223	1336
Author appearances	2524	1722
Single Author Document Authors	75	294
Authors of multi-author documents	2148	1042
Author Collaboration		
Single Author Documents	79	165
Documents by author	0.339	0.357
Authors per document	2.95	2.80
Co-authors per document	3.35	3.35
Collaboration Index	3.18	3.05
document content		
Keywords (IDs)	961	4460
Author keywords (DE)	2104	3373

Graph 1 evidenced, by years, the results of the world scientific production on gamification. It was noted that Scopus presented a higher production, with growth observed from 2020 to 2021. As of February 2022, a production of 91 articles was observed in Scopus and 44 in WoS. This trend

made it possible to show greater growth than in 2021, considering the validity of the topic due to the greater use of gamification resources due to the virtuality that arose due to the pandemic.

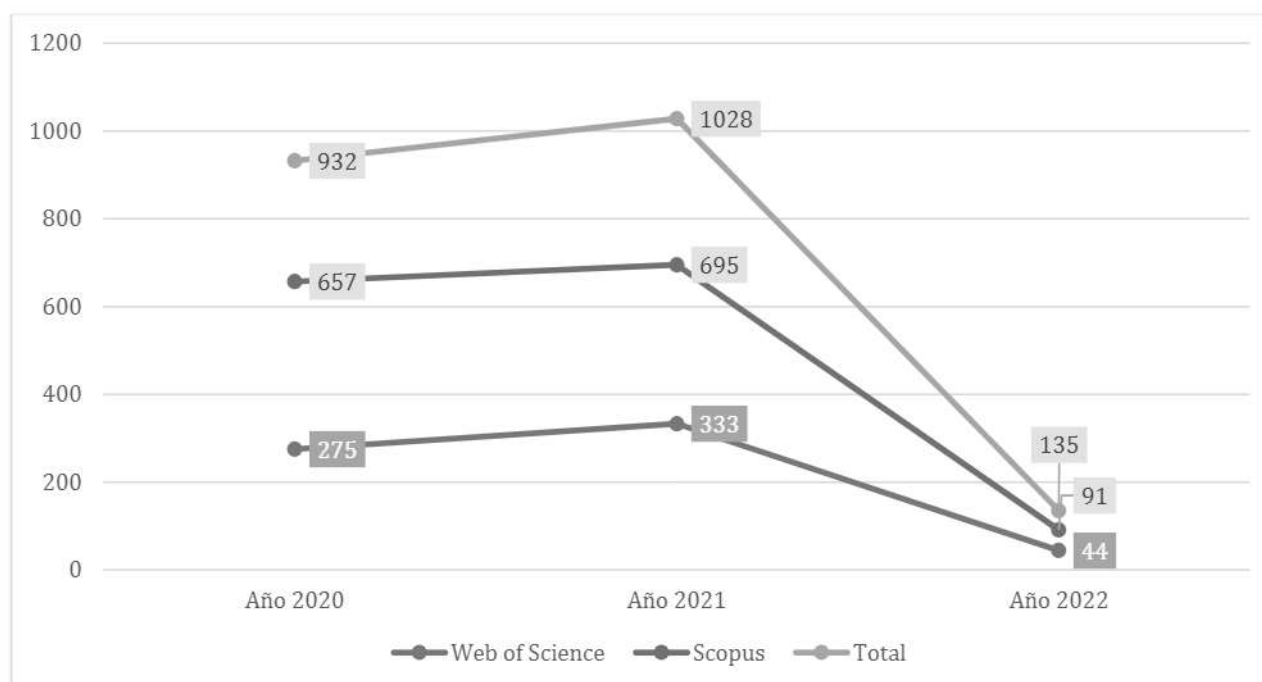


Figure 1: Annual production of scientific documents on gamification in WoS and Scopus

Table 2 shows the list of the five (5) most cited articles in the WoS and Scopus databases. The study by Michael Sailer and Lisa Homner stands out from the list, which aims to systematically synthesize the results of research on the effects of gamification on cognitive, motivational and behavioral learning outcomes. This article has received 101 citations in Scopus and 92 in WoS since its publication in March 2020 in the *Educational magazine Psychology Review* (Q1), published by the publisher Springer Nature.

Second, Zamzami's article Zainuddin, Samuel Kai Wah Chu, Muhammad Shujahat, and Corinne Jacqueline Perera, published in *Educational magazine Research Review* of the Elsevier editorial in June 2000. The article aimed to evaluate, synthesize and present the most recent literature on gamification in educational domains. This publication presents 61 citations in WoS and 93 in Scopus.

Thirdly, the article by Shurui Bai, Khe Foon Hew and Biyun Huang, whose objective was to conduct a meta-analysis in order to examine the effects of gamification on students' learning achievements. The article published in 2020 by *Educational magazine Psychology Review*, from the publisher Elsevier, has received 70 citations in Scopus and 48 in WoS.

In fourth place, the article of Zamzami Zainuddin, Muhammad Shujahat, Hussein Haruna, and Samuel Kai

WahChu. The article was published in the journal *Computers & Education*, from the Elsevier publishing house in 2020. The authors' objective was to determine the differences in student performance and perceived engagement between three intervention groups in a science class, using two types of pedagogical intervention: traditional instruction with paper questionnaires and gamified instruction with gamified electronic questionnaires as formative evaluations. The article has received 64 citations in Scopus and 59 in WoS.

Fifth is the study by Jiyoung Hwang and Laee Choi, whose objective was to investigate whether gamification in gamified loyalty programs affects consumer loyalty to loyalty programs and consumer behavioral intentions. The article, published in 2020 by the journal *Journal of Business Research*, from the Elsevier publishing house, has received 58 citations in Scopus and 59 in WoS.

These results evidenced the tendency to carry out studies on gamification in two specific contexts: educational and business. Similarly, systematic review studies were presented as the most cited, which highlights the large amount of scientific literature that exists on the phenomenon of gamification. Finally, the Elsevier publishing house brought together the articles with the highest number of citations, which confirms the importance of this publishing company in the world scientific context.

Table 2: Five most cited articles of scientific production on gamification in Scopus and Web of Science

No. or	Authors	Qualification	Quotes		Ano	Sources
			Scopus	WoS		
1	Sailer, M., Homner, L.	The Gamification of Learning : a Meta-analysis	101	72	2020	EDUCATION Psychology Review
2	Zainuddin, Z., Chu, SKW, Shujahat, M., Perera, CJ	The impact of gamification on learning and instruction: A systematic review of empirical evidence	93	61	2020	Educational Research Review
3	Bai, S., Hew, K.F., Huang, B.	Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts	70	48	2020	Educational Psychology Review
4	Zainuddin, Z., Shujahat, M., Haruna, H., Chu, S.K.	The role of gamified e-quizzes on student learning and engagement: An interactive gamification solution for a formative assessment system	64	59	2020	Computers and Education
5	Hwang, J., Choi, L.	Having fun while receiving rewards?: Exploration of gamification in loyalty programs for consumer loyalty	58	59	2020	Journal of Business Research

Table 3 shows the authors with the highest number of publications. In the case of WoS and Scopus, Juho highlighted Hamari as the author with the most publications on gamification. The author presented a total of 193 publications in Scopus (h - index 50), of which 21 published between 2020 and 2022 address the phenomenon of gamification. In WoS (h - index 36), the author presented 94 publications, of which 12 of them deal with the topic of gamification. He highlighted his article on gamification in WoS with the highest number of citations (344) is entitled “Demographic differences in perceived benefits desde gamification”, published in 2014; while, in Scopus, he highlighted his study published in 2019 “The rise of motivational information systems : A review of gamification research”, which has received 467 citations.

Table 3: Authors with the highest number of publications in WoS and Scopus

WoS		Scopus	
Hamari J.	12	Hamari, J.	twenty-one
Segura-robles A	9	Isotani, S.	10
Parra-Gonzalez ME	8	Parra-Gonzalez ME	8
Patel MS.	6	Segura-Robles A	8
Behl A.	5	Palmquist, A.	7

Regarding the journals in which the articles that address the phenomenon of gamification were published (see table 4), *Lecture notes in computer* presented 63 publications in Scopus. This magazine edited by the Springer company was characterized as a medium for the publication of new developments in computer science and research in information technology, teaching and education. For its part, the magazine *Sustainability* He stood out in WoS with 18

posts. This magazine edited by the Multidisciplinary Digital Publishing Institute (MDPI) is known for publishing articles on the environmental, cultural, economic and social line of human beings.

Table 4: Journals with the largest number of publications on gamification in WoS and Scopus

Scopus		WoS	
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	63	Sustainability	18
ACM International Conference Proceeding	52	IEEE Access	13
Advances In Intelligent Systems and Computing	46	International Journal of Emerging Technologies in learning	12
Ceur Workshop Proceedings	28	International Journal of Environmental Research and Public Health	12
Lecture Notes In Networks And Systems	21	JMIR serious games	12

Regarding the types of research (see table 5), in the two databases analyzed, original scientific articles predominated (573 in WoS and 728 in Scopus), followed by bibliographic reviews, present in both databases. This result highlighted the importance of original articles as the standard format for

presenting scientific research results that can be technologies, products, new concepts or hypotheses [21]. Similarly, the publication of original results allowed knowing the assessment and contribution of knowledge supported by the scientific community to explain and respond to current problems [22].

Table 5: Types of publications in WoS and Scopus

WoS		Scopus	
Item	573	Item	728
Bibliographical review	67	Article of presentation	597
Items of prompt access	47	Bibliographical review	60
Proceedings of academic meetings	28	Chapter of book	35
Editorial	16	Editorial	9

Regarding the original countries of the investigations (see table 6), in both databases, Spain stood out in the first place, with 293 articles in WoS and 420 in Scopus. In second place, the United States with 271 publications in WoS and 323 in

Scopus. It should be noted that until 2021, the United States has ranked first among the countries with the highest scientific production in Scopus (14408686 documents) while Spain is ranked 11th worldwide (1731575 documents) [23].

On the other hand, in graph 2, it was observed that Spain stands out as the country of the corresponding author and with the highest intra-country (SCP) and inter-country (MCP) collaboration index (123 to 16 the number of publications in Scopus and 84 to 15 in WoS).

Table 6: Countries of origin of publications in WoS and Scopus

WoS		Scopus	
Spain	293	Spain	420
USA	271	USA	323
Indonesia	194	China	183
Germany	183	Germany	134
China	175	Brazil	118

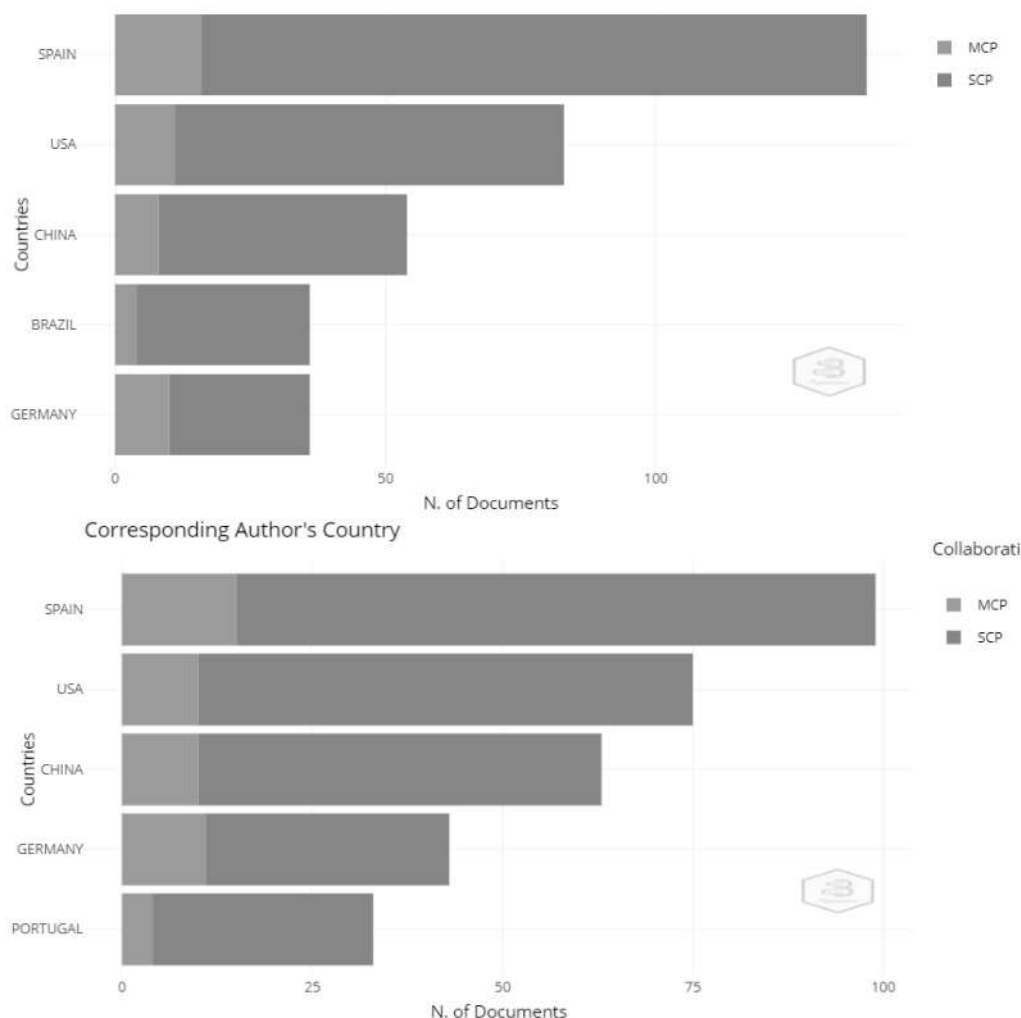


Chart 3: Country of the corresponding author. Intracountry (SCP) and intercountry (MCP) collaboration during 2020-2022

Finally, regarding the network analysis of the co-occurrences of the Scopus database (see graph 4), the creation of 7 clusters, 454 items, 12,504 links and a total link strength of 29,210 was observed. Cluster 1 stood out (red) that is born

from *gamification*, with 5520 occurrences; cluster 6 (light blue) with *motivation* and 258 occurrences; cluster 4, (yellow) with *students* and 239 occurrences; *e-learning*, with 128 occurrences; and cluster 2 (green), with *human* and 115 occurrences.

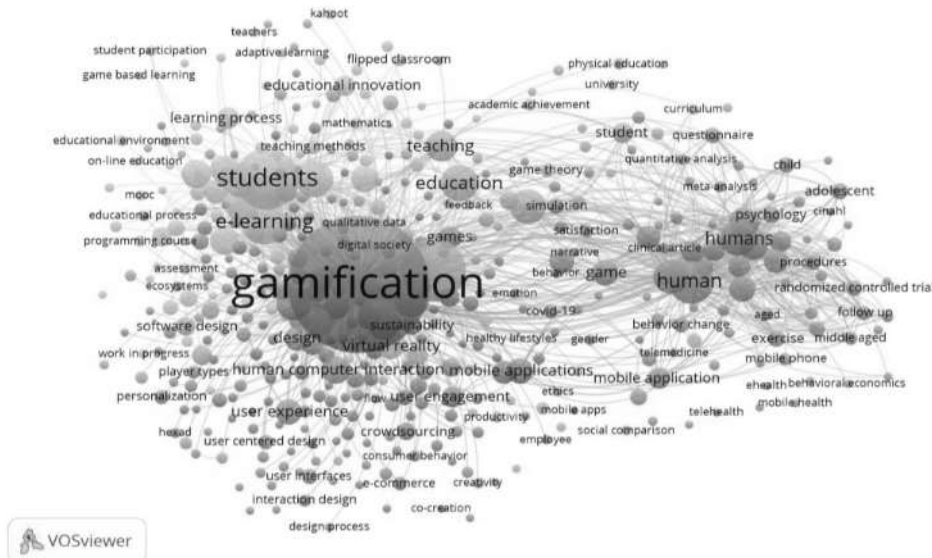


Chart 4: Analysis of network visualization in Scopus

Regarding the network analysis of the co-occurrences of the WoS database (see graph 5), the creation of 8 clusters was observed, highlighting cluster 3 (blue) with *gamification* and 511 occurrences. In this cluster, *motivation also stood out* with 943 occurrences and *education* with 115. Cluster 7

(orange) that stems from *games stood out*, with 97 occurrences. In cluster 4 (yellow), they highlighted *engagement* with 137 occurrences and *design* with 87; cluster 2 (green), with *serious games* and 57 occurrences; cluster 1 (red), with *intrinsic motivation* and 52 occurrences.

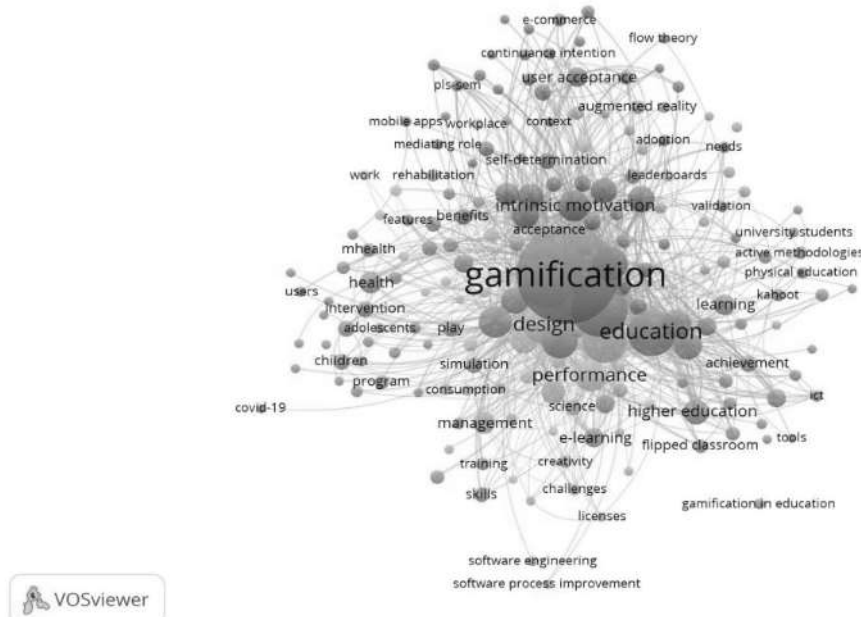


Chart 5: Analysis of network visualization in WoS.

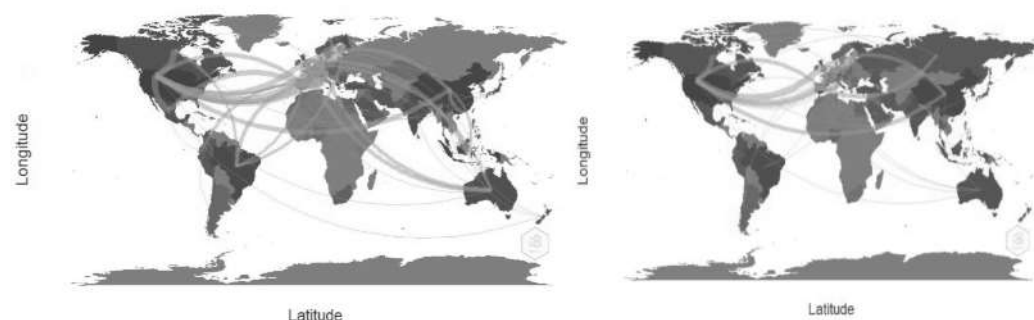
For the visualization of the items, an element density graph based on color was generated. For its interpretation, the variation of the colors that go from blue to green and yellow must be taken into account. The greater the number of elements of a point and the weight of the neighboring elements, the color that will stand out will be yellow. The smaller the number of elements in a point's group and the lower the weight of neighboring elements, the closer the point's color is to blue. In the case of this research, the central

point is *gamification*, which is related, in both databases, to terms *What motivation* and *students*. The union of these terms made it possible to establish a baseline study line that is followed in research on the phenomenon. This is corroborated in the word map (see graph 6). For Scopus, for example, they highlighted the words *students*, *motivation*, *human*, *e-learning* and *learning systems*, while for WoS terms such as *motivation*, *education*, *design*, *game* and *classroom* stand out.



Finally, graph 7 showed the country collaboration maps. The collaborations between Spain and Portugal (9) in Scopus, and

the United States and the United Kingdom (6) in WoS stand out.



CONCLUSIONS

The present investigation works with the two most important databases of the scientific environment. The evaluation period covers from 2020 to 2022, years marked by the covid-19 pandemic. Based on the databases, the main characteristics regarding publications, authors, sources, collaboration between authors and countries, and network analysis have been identified. Data were extracted using bibliometric techniques. The data found highlights the growth of scientific production due to the important attention that gamification has gained in the educational context due to its potential to motivate students during virtual classes, which became widespread during the pandemic.

Regarding the scientific production on gamification, a moderate increase in production is observed, which occurred in the year 2021 compared to the year 2020. This is corroborated by Swacha (2021), who affirms that recent years have brought a rapid growth of the scientific production in

the area of gamification in education [24].

WoS database and 1443 from Scopus, extracted from 433 and 686 sources, respectively. A very similar citation average was generated between WoS (3.07) and Scopus (2.61). The average number of citations per year per document is also similar between both databases (1.183 for WoS and 0.978 for Scopus). The number of documents analyzed is related to what was done by other researchers, for example, they investigated a total of 432 documents from 2010 and 2020 indexed in the WoS database [25] ; analyzed 4059 academic papers published in WoS from 1995 to 2020 [26] and 2517 documents retrieved from Scopus [24].

Regarding authorship, Scopus presented 1,336 and WoS, 2,223. Scopus recorded a greater number of documents by a single author (165) compared to WoS (79). Regarding documents with multiple authors, in both databases, articles with three signing authors stood out. The collaboration index between authors was slightly higher in WoS (3.18 vs. 3.05 in

Scopus).

Regarding the article with the highest number of citations, Michael Sailer and Lisa Homner's study entitled "The gamification of Learning : a Meta- analysis ", the same one that has received 101 citations in Scopus and 92 in WoS since its publication in March 2020. Regarding the authors with the largest number of publications on gamification in WoS and Scopus, Juho highlighted Hamari. This result differed from that found by Schöbel et al. (2021), for whom Papastergiou (2009) heads the list of the most cited authors with his article "Interactive learning environments, multimedia/ hypermedia systems, applications in subject areas, secondary education, gender studies " [27]. On the other hand, the work of Domínguez et al. (2013) as the most cited [28], while the author who has contributed the most to the study of gamification has been Gwo -Jen Hwang [29].

Regarding the most important journals that publish research on gamification, *Lecture Notes in Computer stood out. Science*, which features 63 Scopus publications. In WoS, the *Sustainability* magazine stands out, with 18 publications. They also highlighted the *Bulletin of the technique committee on learning technology*, *Computers & Education* and *Eurasia journal of mathematics science and technology education*, all of them focused more on the technological field than on the purely educational [30].

Regarding the countries with the highest production on gamification, in both databases, Spain stood out with 293 articles in WoS and 420 in Scopus, followed by the United States. In addition, Spain led both in intracountry (SCP) and intercountry (MCP) collaboration.

Regarding the types of research, in the two databases analyzed, original scientific articles predominated (573 in WoS and 728 in Scopus). This is corroborated in a study in which, of the 376 documents analyzed, 205 are original articles (55%), 155 conference articles (41%) and 16 book chapters (4%) [31]. There are six types of documents available, namely article, conference paper, book, review, book chapter, and conference review [32].

Regarding the concurrence analysis of the Scopus database, the words *gamification*, *motivation*, *students*, *e-learning* and *human stood out*. In the WoS database, the creation of 8 clusters is observed: *gamification*, *motivation*, *education*, *games*, *engagement*, *design*, *serious games* and *intrinsically motivation*. It was confirmed that the most mentioned keyword is *motivation*, followed by *performance* and *commitment* [27]. For others, they highlighted *concept* and *theoretical knowledge*, *development*, *impact*, *personalization* and *higher education* as recurring words of analysis [33]. Finally, others considered that the recurring words were *motivation*, *serious games*, *games based learning* and *e-learning* [24].

Previous bibliometric studies have drawn attention to a series of limitations of this approach. It is obvious, for example, that international scientific production in a specific field, such as the case of gamification, is much more extensive (many

journals or contributions made to congresses and scientific meetings are not indexed in the usual databases). The lack of standardization of the name of the authors, or those derived from the incorrect use of methodological filters can also be cited. [34].

However, in the present study not only documents written in English, but also in other languages have been selected, which makes the sample more than representative. By way of conclusion, it can be stated that, despite the limitations of bibliometric studies, and thanks to the design of this study, it has been possible to obtain a representative image of international research on gamification worldwide in times of pandemic, in order to highlight its role as a generator of commitment to the development of innovations in the classroom.

Gamification in education is a resource that helps us boost student motivation, whatever the level of studies they are at. Therefore, future bibliometric research will need to expand the data set by including more databases and other types of publications. Over time, other computer and web tools will emerge that will allow generating more indicators and exploiting the selected databases with greater accuracy and precision.

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