Online classroom – Bibliometric analysis (2004-2021)

Educação à distância: Uma análise bibliométrica (2004-2021)

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ABSTRACT
Advances in information and communication technology (ICT) have profoundly transformed organizational processes, educational institutions have not been left out of these changes either. Moreover in the beginning of 2020 the Covid-19 pandemic came to extend the use of ICT tools in education through the educational design of emergency remote teaching (ERE). It was sought to understand the evolution of teaching in academic production, for this a bibliometric study was carried out between 2004 and 2021 on the subject "online teaching" comparing the Scopus base and Web of Science (WoS) that according to Marín-Velásquez and Arrojas-Tocuyo (2021) are worldwide recognized and accepted bases of academic search. In this way, the evolution of publications, the areas, the authors, the most cited documents, as well as the key words that appear the most, are highlighted in this work. We noticed as main findings the dominance of the number of Scopus publications and while Scopus is dominated by the area of computing and WoS is led by the area of education.

Keywords: Distance education, Online learning, Bibliometric.

RESUMO
Os avanços da tecnologia de informação e de comunicação (TIC) transformaram profundamente os processos organizacionais, as instituições de ensino também não ficaram fora dessas mudanças. Além disso no iniciou de 2020 a pandemia do Covid-19 chegou a ampliar o uso das ferramentas de TIC na educação através do desenho educativo do ensino remota emergencial (ERE). Foi buscar entender a evolução do ensino na produção acadêmica, para isso foi realizado um estudo bibliométrica entre 2004 e 2021 sobre o tema "ensino online" comparando a base Scopus e Web of Science (WoS) que segundo Marín-Velásquez e Arrojas-Tocuyo (2021) são bases de busca acadêmica mundialmente reconhecidas e aceitas. Deste modo destacando nesse trabalho a evolução de publicações, as áreas, os autores, os documentos mais citados assim que as palavras chaves que mais aparecem. Notamos como principais achados o domino do número de publicação da base Scopus e enquanto a base Scopus e dominado pela área de computação e WoS é liderado pela área da educação.

Palavras-chave: Educação à distância, Ensino online, Bibliométrica.

1 INTRODUCTION

Being a social being, the human being has always integrated in his daily routine the act of teaching and learning, because to survive in the wild nature with its unimposing physical characteristic, he had as his only way out to group. In this way, the sharing of lived experiences was organized in a natural way, such as the domain of fire, whose knowledge was passed from generation to generation, marking the essence of teaching. According to Piaget (1964), this is exactly the starting point of the construction of new knowledge, which begins by overcoming the cognitive conflict between the existing internal structure, the experiences

lived and the unknown external reality. This led Mizukami (1986) to see teaching or rather education as the essence of man, who calls educated human beings the finished man "ready" and the "student a miniature adult".

In the contemporary world, most countries have implemented specific places to obtain diverse knowledge, which have been called schools, colleges, universities, among others that for many authors is the reflection of society. As Tanus (2020) points out, universities through teaching, research and extension have activities that are not only aimed at the academic, but also have the mission of transferring knowledge and services to the whole society. This means that education is feasible beyond the educational environment, influencing politics and reflecting on the society in which such establishments are inserted (ALMEIDA, 2021). Today thanks to the advances of information technology teaching has modernized and brought the concept of Distance Education (EaD), which consists of a non-face-to-face teaching modality. In Brazil, distance education is made feasible and regulated through Decree - Law No. 2,494, of February 10, 1998, seen in Art. 80 of the Law of Guidelines and Bases of National Education.

With the Covid-19 health crisis that affected the world in early 2020, the social distancing strategy was implemented as the main option to contain the spread of the virus, educational institutions began to operate with fully online classes to continue their activities. This form of teaching was called emergency remote teaching (ERE), like EaD, ERE is also a form of online teaching.

The ERE has received several definitions, with the term "online class" being the most used nomenclature in society, as Saldanha (2020, p. 127) highlights. In addition to this definition, other terms have emerged to try to define this type of activity such as Saldanha (2020): "emergency remote teaching", "remote education", "remote activities", "remote learning", "remote learning", "remote learning strategies" and "remote classroom", "online teaching", "online learning", "online education", "online classes", "online classroom", "classes in digital media" and "teleclasses". Or even "remote classes" Lunardi et al., (2021), "virtual classroom" Guimarães (2012), "distance learning" Regina; Yamauchi, (2022), among others.

Comments Martins (2020), in a post-pandemic scenario, the difference between the face-to-face class and the online class will disappear, the use of both will mark the new "normal" in the academic world. In this context, we sought to map the academic production on this theme in the Scopus and Web of Science (WoS) databases. In the academic sphere, between 2004 and 2021, the number of scientific studies on "online classes" in these databases were respectively 880 and 337 publications, a theme well dispersed in several areas of knowledge, something that may indicate that the subject is multidisciplinary. Even smaller is the number of bibliometric studies on the subject, which is why the present study seeks to fill such deficiencies by analyzing and comparing the data obtained in two highly regarded databases (Scopus and WoS) in order to better understand the current state of academic research on the subject.

The article has been structured into five sections, including the current one concerning the introduction; The next topic will cover the literature review. The third will be dedicated to the methodological procedure; The fourth portrays the analysis of the results and finally the fifth is dedicated to the conclusions and final considerations.

2 LITERATURE REVIEW

This article deals with "online classes" in general, which as we have already seen, contains a very close meaning between "distance learning" and "emergency remote class", but the didactic-pedagogical approaches are different between them (PALMEIRA; DA SILVA; RIBEIRO, 2020).

The "Distance Class" refers to teaching whose teachers and students are not in the same place physically, however, teaching occurs mediated by information technology tools (such as cell phone, computer) Karinne; Hail; Macedo (2021), this form of learning can be both synchronous and asynchronous (PINHEIRO, 2011). While the emergency remote class, differs from distance education in the sense that, normally, students in the remote class are unable to attend classrooms and laboratory spaces (SIMÃO; CARVALHO; ROCHADEL, 2013). In the scenario of the pandemic students and teachers who again had as their only experience the Distance Education in the face-to-face modality, perhaps this is where part of the conceptual confusion that we are witnessing today between Distance Education and remote teaching (Rodrigues, 2020).

Each year there is an exponential growth worldwide of Distance Education in Higher Education (NASCIMENTO; SANTOS, 2021). In Brazil, distance education courses receive more enrollment than face-to-face courses since the following 2018 (OLIVEIRA, 2019). Most of the courses offered (80%) in 2020 were face-to-face and hybrid distance education (CENSO EAD.BR, 2020). Being EBC (2022) more than 3.7 million freshmen of 2020 (public and private institutions), more than 2 million (53.4%) opted for distance courses and 1.7 million (46.6%), for face-to-face courses. It was noted by Figueiredo et al. (2017) based on Enade data, the undergraduate courses offered in the distance modality present little difference, in their majority, the EaDs come to be better or equal than the courses offered in the face-to-face modality.

The EAD is provided for since the Law of Guidelines and Bases (LDB) of education Law No. 9,394, of December 20, 1996. According to Decree No. 9,057, of May 25, 2017, it is a teaching modality that enables didactic-pedagogical mediation through information and communication technologies, being able to make use of education professionals and students in different places and times (BRASIL, 2017). The expansion and intensification of distance education in Brazil was also favored by Ordinance No. 2,117 of December 6, 2019, which authorizes that up to 40% of the total workload of face-to-face undergraduate courses in IFES be offered in this modality.

Data from the United Nations Educational, Scientific and Cultural Organization (UNESCO) indicate that 1.37 billion children and adolescents were left without face-to-face classes with the onset of the pandemic, that is, 80% of students in the world (UNESCO, 2020). this caused the World Health Organization to encourage the adoption of remote classes as a requirement to establish social distancing as a way to contain the advance of the disease and not interrupt activities related to teaching (BAUTISTA et al., 2021). However, the number of institutions that were prepared to carry out 100% distance learning was relatively small (Ontong; Waghid, 2020). In this sense, the ERE is understood as a modality that is not definitive, but temporary to the epidemic scenario.

Silva (2022) "predicted a minimum of 60% of synchronous activities (that is, corresponding to classes, in which teacher and students must be logged in real time and work together) and up to 40% of asynchronous activities (in which the teacher leaves readings, tests, various activities and the student can log in and watch them / perform them whenever he wants, provided that within the predetermined period by the teacher)". Liguori and Winkler (2020) report that innovative solutions implemented by educational institutions through emergency remote classes could cope with the effects of the pandemic. Also Mazlan et al. (2021) state that during the Covid-19 pandemic the remote class strategy ensured that students could learn effectively, supporting the conventional classes we know.

Both EaD and ERE, are part of online teaching, both use virtual platforms as a study room. Distance Learning generally makes use of a Virtual Learning Environment (VLE), such as Moodle or Google Classroom, among others, while ERE often uses platforms such as Zoom, Google Meet, Discord and Microsoft Teams (BAUTISTA et al., 2021). Both modalities were necessary to maintain student bond with teaching during the pandemic (CARVALHO et al, 2020). Hack (2011), points out that the internet provided this exchange of information that again used more television and radio as resources to pass educational content.

3 METHODOLOGICAL PROCEDURE

We sought to analyze the impacts on academic production on online teaching, a theme that was heard more often in society with the arrival of the Covid-19 pandemic. Bibliometrics was used as a research method in this study. According to Wallin (2005), bibliometrics emerged in the early 1950s, gaining strength and academic recognition over time. Bornmann; Marewski (2019) highlights that the bibliometric analysis is made possible through the method of Systematic Review of the Literature (RSL), which helps to generalize the trend of development of the field being researched, with emphasis on capturing the number of publications (Zupic; Cater, 2015). Bibliometrics also helps to map the evolution and offer a predictive scenario on a given subject, facilitating researchers, professionals and managers in their performance. According to Gunashekar, Wooding and Guthrie (2017), understanding bibliometric panels better supports

decision making. More specifically, this study delimits as the period of analysis the productions published between 2004 and 2021. In its project "Open University" created by the Forum of State Enterprises and instituted on September 21, 2004 marks the starting point in the arrival of distance education in Brazilian education, we will try to highlight the Brazilian academic production on the subject. It wasn't including 2022, because we want to have a year counting the full 12 months where you can expect lower indexing that made the overall result unfeasible. On the other hand, we want to seek in this study: The evolution of the number of publications over the years; the areas, researchers and institutions of greater publication; the most cited articles and the keywords that stand out.

The data collection was done in two different databases: Scopus and WoS, these platforms are notable references in the academic world as confirmed by the study by Marín-Velásquez and Arrojas-Tocuyo (2021), Scopus and WoS are two international databases of high impact. In both platforms, the following keywords were used as a string in the search of the document: "online teaching" OR "online" OR "distance learning" OR "distance learning" OR "remote classes" OR "remote education" OR "remote classes" OR "remote learning" OR "remote classroom". Since it is a theme focused on teaching, no area has been delimited, since it is believed that all areas are involved from near or far with teaching. We arrived at a total in Scopus of 880 documents and in WoS of 337 documents.

4 DATA ANALYSIS

The analysis of the data is the fundamental point of a bibliometric research whose without it the research could not happen, the bibliometric analysis can and aims to facilitate the mapping of large volumes of scientific literature (GONZÁLEZ et.al, 2020). In this context we will present a succession of tables, graphs, and comments about it.

4.1 EVOLUTION OF RESEARCH IN BRAZIL

We start with Figure 1, number of publications per year, which illustrates the evolution of publications in the Scopus and WoS databases, adding respectively, a total of 880 and 337 publications between 2004 and 2021.

Figure 1 Total number of documents published in the two databases (2004-2021)
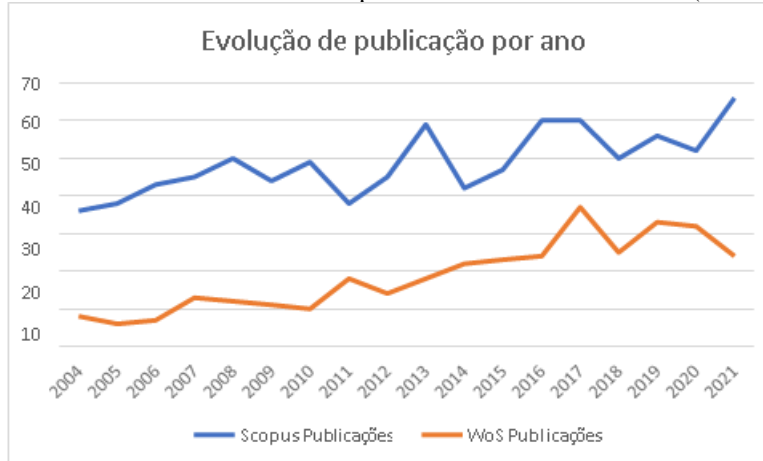
Source: The author.

We clearly perceive from both bases that the Scopus platform is the base where researchers seek to publish more about the theme.

Scopus published 36 articles in 2004, while WoS published only 8 articles, from 2020 and 2021, while Scopus recorded its highest growth, going from 52 to 66 publications, surpassing by the same time its highest peak so far, of 60 publications, reaching in 2016 and 2017. On the other hand WoS does not show the same behavior, between 2020 and 2021 it indicates a decrease in publications that goes from 32 to 24 on the same dates, we note that it had its peak in 2017 with 37 publications.

4.2 NUMBER OF PUBLICATIONS BY AFFILIATION

Table 1 shows the ten (10) first Brazilian higher education institutions that publish more on the subject in both databases.

Table 1 Institutions that publish the most – Scopus (2004-2021)

	Scopus			Wos	
Position	Filiation	Publications	Position	Filiation	Publications
1	University of São Paulo	177	1	University of São Paulo	52
2	State University of Campinas	127	2	Federal University of Rio Grande do Sul	27
3	Federal University of Rio de Janeiro	72	3	Federal University of Santa Catarina	18
4	Federal University of São Carlos	53	4	State University of Campinas	16
5	Federal University of Santa Catarina	53	5	Federal University of São Carlos	15
6	Universidade Estadual Paulista Júlio de Mesquita Filho	47	6	University of Brasilia	13
7	Federal University of Minas Gerais	47	7	Federal University of Pernambuco	11
8	Federal University of Rio	33	8	Federal University of	10

	Grande do Sul			Uberlândia	
9	State University of Southwest Bahia	32	9	Federal Institute of São Paulo	9
10	State University of Londrina	32	10	Federal University of Maranhão	9

Source: The author.

The University of São Paulo comes to be the first place both in Scopus with 177 publications and in WoS with 52 publications, The State University of Campinas occupies the second position in Scopus with 127 publications followed by the Federal University of Rio de Janeiro with 72 publications in third place. In WoS, the Federal University of Rio Grande do Sul is the second place with 27 and the Federal University of Santa Catarina closes in third place with 18 publications.

4.3 NUMBER OF PUBLICATIONS PER AREA

As for the number of publications per area of knowledge, we attach table 2 that deals with the scopus and WoS databases.

Table 2 Area with most publications (2004-2021)

	Scopus			Wos	
Position	Area	Publications	Position	Area	Publications
1	Chemistry	290	1	Education Educational Research	158
2	Engineering	187	2	Computer Science	152
3	Computer Science	166	3	Engineering	65
4	Social Sciences	109	4	Telecommunications	16
5	Chemical Engineering	100	5	Business Economics	8
6	Biochemistry, Genetics and Molecular Biology	96	6	Public Environmental Occupational Health	8
7	Medicine	90	7	Health Care Sciences Services	7
8	Environmental Science	72	8	Arts Humanities Other Topics	5
9	Agricultural and Biological Sciences	61	9	Science Technology Other Topics	5
10	Mathematics	60	10	Information Science Library Science	4

Source: The author.

We observed that the first three areas that publish more on the subject in Scopus are respectively chemistry with 290 publications, engineering with 187 publications and computer science with 166 publications. On the other hand, in WoS the first three areas with the most publications are, respectively, education, educational research with 158 publications, computer science with 152 publications and engineering, with 65 publications.

4.4 MOST CITED ARTICLE IN SCOPUS

This item refers to the most cited documents in Scopus since they were published, so table 3 presents a list of the ten (10) first placed.

Table 3 Most cited articles

Position	Title	Authors	Year	Quotes
1	ANN-based soft-sensor for real-time process monitoring and control of an industrial polymerization process	Gonzaga, J.C.B., Meleiro, L.A.C., Kiang, C., Maciel Filho, R.	2009	274
2	Electrospray ionization mass spectrometry: A major tool to investigate reaction mechanisms in both solution and the gas phase	Eberlin, M.N.	2007	164
3	Solid-phase extraction system for Pb (II) ions enrichment based on multiwall carbon nanotubes coupled on-line to flame atomic absorption spectrometry	Barbosa, A.F., Segatelli, M.G., Pereira, A.C., (...), Luccas, P.O., Tarley, C.R.T.	2007	164
4	Amberlite XAD-2 functionalized with 2-aminothiophenol as a new sorbent for on-line. preconcentration of cadmium and copper	Lemos, V.A., Baliza, P.X.	2005	160
5	Use of modified rice husks as a natural solid adsorbent of trace metals: Characterisation and development of an on-line preconcentration system for cadmium and lead determination by FAAS	Teixeira Tarley, C.R., Costa Ferreira, S.L., Zezzi Arruda, M.A.	2004	144
6	Preconcentration system for cadmium and lead determination in environmental samples using polyurethane foam/Me-BTANC	Gama, E.M., da Silva Lima, A., Lemos, V.A.	2006	121
7	Taxi and ride sharing: A dynamic dial-a-ride problem with money as an incentive	Santos, D.O., Xavier, E.C.	2015	116
8	Advanced oxidation of caffeine in water: On- line and real-time monitoring by electrospray ionization mass spectrometry	Dalmázio, I., Santos, L.S., Lopes, R.P., Eberlin, M.N., Augusti, R.	2005	108
9	Synthesis and application of a functionalized resin for flow injection/F AAS copper determination in waters	Cassella, R.J., Magalhães, O.I.B., Couto, M.T., (...), Neves, M.A.F.S., Coutinho, F.M.B.	2005	104
10	SVM practical industrial application for mechanical faults diagnostic	Baccarini, L.M.R., Rocha E Silva, V.V., De Menezes, B.R., Caminhas, W.M.	2011	101

Source: The author.

Firstly, the article "ANN-based soft-sensor for real-time process monitoring and control of an industrial polymerization process" by Gonzaga et al. (2009) with 274 publications, followed by the article "Electrospray ionization mass spectrometry: A major tool to investigate reaction mechanisms in both solution and the gas phase" by

Eberlin (2007) with 164 publications, in third place the article "Solid-phase extraction system for Pb (II) ions enrichment based on multiwall carbon nanotubes coupled on-line to flame atomic absorption spectrometry" by Barbosa et al. (2007) also with 164 publications, among others.

4.5 MOST CITED ARTICLE IN WOS

As the preceding table is the classification of the most cited documents, this time at the base, so table 4 also presents a list of the ten (10) first placed.

Table 4 Most Cited WoS Articles

Position	Article	Authors	Year	quotes
1	Comparing strategies for modeling students learning styles through reinforcement learning in adaptive and intelligent educational systems: An experimental analysis	Dorca, Fabiano A ; Lima, Luciano V; Fernandes, Marcia A; Lopes, CarlosR	2013	50
2	Explaining university students' effective use of e- learning platforms	Moreno, Valter; Cavazotte, Flavia; Alves, Isabela	2017	48
3	A model for learning objects adaptation considering mobile and context-aware computing	Abech, Marcia; da Costa, CristianoAndre; Victoria Barbosa, Jorge Luis; Rigo, Sandro Jose; Righi, Rodrigoda Rosa	2016	30
4	Satisfaction and continuous use intention of e-learning service in Brazilian public organizations	de Melo Pereira, Fernando Antonio; Martins Ramos, Anatalia Saraiva; Gouvea, Maria Aparecida; da Costa, Marconi Freitas	2015	29
5	Revealing the whiteboard to blind students: An inclusive approach to provide mediation in synchronous e-learning activities	Freire, Andre P; Linhalis, Flavia; Bianchini, Sandro L; Fortes, Renata P. M; Pimentel, Maria da GracaC	2010	28
6	Gamification in e-Learning Systems: A Conceptual Model to Engage Students and Its Application in an Adaptive e-Learning System	Tome Klock, Ana Carolina; da Cunha, Lucas Felipe; de Carvalho, Mayco Farias; Rosa, Brayan Eduardo; Anton, Andressa Jaqueline; Gasparini, Isabela	2015	23
7	E-learning: a comparative study for knowledge apprehension among nurses	Padalino, Yara; Ciqueto Peres, Heloisa Helena	2007	22
8	Steps, techniques, and technologies for the development of intelligent applications based on Semantic Web Services: A case study in e-learning systems	Barros, Heitor; Silva, Alan; Costa, Evandro; Bittencourt, Ig Ibert; Holanda, Olavo; Sales, Leandro	2011	20
9	Cognitive Load and Self-Determination Theories Applied to E-Learning: Impact on Students'	Guerra Grangeia, Tiago de Araujo; de Jorge, Bruno; Franci, Daniel; Santos, Thiago Martins; Vellutini Setubal,	2016	19

	Participation and Academic Performance	Maria Silvia; Schweller, Marcelo; de Carvalho-Filho, Marco Antonio		
10	Zoom In, Zoom Out: The Impact of the COVID-19 Pandemic in the Classroom	Joia, Luiz Antonio; Lorenzo, Manuela	2021	18

<div align="center">Source: The author.</div>

First, we have the article "Comparing strategies for modeling students learning styles through reinforcement learning in adaptive and intelligent educational systems: An experimental analysis" by Docas et al. (2013) with 50 publications, followed by the article "Explaining university students' effective use of e-learning platforms" by Moreno et al. (2017) with 48 publications, in third place the article "A model for learning objects adaptation in light of mobile and context-aware computing" by Abech et al. (2016) also with 30 publications, among others.

4.6 THE AUTHORS WITH THE HIGHEST NUMBER OF PUBLICATIONS

In the present item it was sought to expose the researchers who publish in the two academic search bases, in this sense was attached to table 5 just below a list of the first ten.

<div align="center">Table 5 Authors with the most publications (2004-2021)</div>

| Sopus			Wos		
Position	Author	Publications	Position	Author	Publications
1	Tarley, C.R.T.	29	1	Barbosa EF	10
2	Lemos, V.A.	28	2	Gasparini I	10
3	Segatelli, M.G.	23	3	De Oliveira JPM	8
4	Carasek, E.	13	4	Zaina LAM	7
5	Cass, Q.B.	12	5	Brandao AAF	5
6	Figueiredo, E.C.	11	6	De Oliveira AEF	5
7	Eberlin, M.N.	10	7	Anacleto JC	4
8	Ho, L.L.	10	8	Barbosa JLV	4
9	Bezerra, M.A.	9	9	Costa E	4
10	Curtius, A.J.	9	10	De Oliveira CD	4

<div align="center">Source: The author.</div>

On the Scopus platform it is Tarley that leads with 29 publications followed by Lemos with 28 publications, that is, only with one publication differentiates between the two first, in third place Segatelli with 23 publications. On the WoS platform, Barbosa and Gasparini are respectively the two first place with 10 publications each and in the third position is Oliveira with 8 publications, that is, with two fewer publications than his predecessors.

4.7 THE KEYWORDS

This last point refers to the keywords, we use the Vosviewer software to count and highlight the sum of these words that each highlighted document highlights. We also limited a minimum of 8 words in both databases as a criterion for inclusion in the figure that costs because of this search. Key words are useful in that they help you find a text or a set of text on the same topic (SCOTT; TRIBBLE, 2006; Bondi, 2010). In this way we will present the first ten (10) key words of Scopus and the next of WoS.

Figure 2 Word Cloud in the Scopus Base
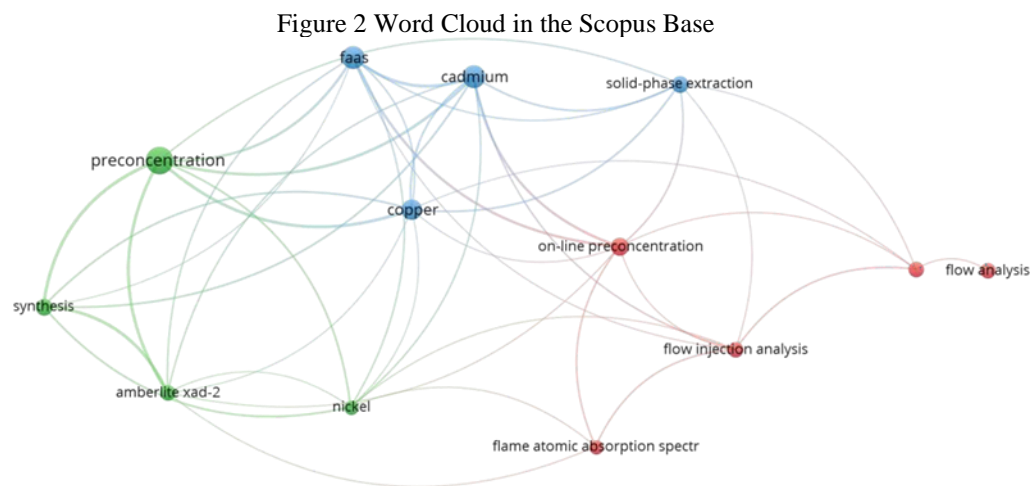
Source: The author.

In figure 2 that concerns the key words of Scopus we have respectively as the first 5 placed: preconcentration (53 appearances), cadmim (41 appearances), faas (32 appearances), synthesis (32 appearances) and copper (31 appearances).

Figure 3 Word Cloud in the WoS Base
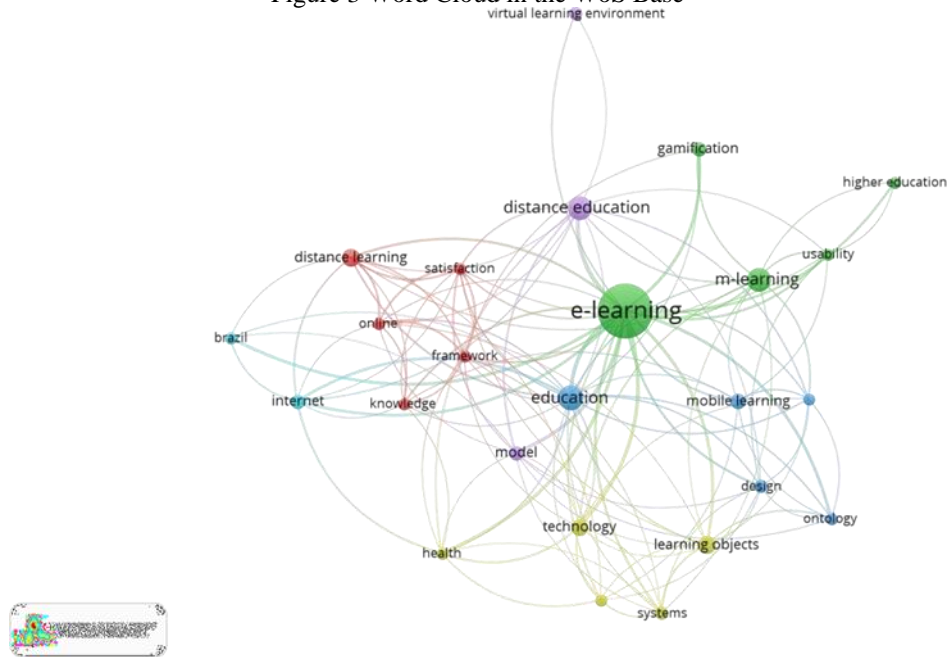
Source: The author.

In Figure 3, referring to the Wos database, the first five (5) key words are, respectively: e-learning (175 appearances); Education (63 appearances), Distance Education (39 appearances), Technology (33 appearances) and Learning Objects (32 appearances).

5 CONCLUSION

In this comparative exercise between the two bases Scopus and WoS we noticed a strong difference in knowledge where in the Scopus base returns more documents from computing and in the WoS base focuses more on the area of teaching, consequently the same phenomenon is observed in the keyword cloud. This indicates that probably the search strings did not efficiently retrieve the documents on distance education, or the computer area in the public Scopus so influenced the result. So that is as a tip for future research to verify the viability of these strings in the Scopus base or exclude in the selection criterion the area of computing if it is not important in the proper research that one wishes to do.

On the other hand, in terms of the number of publications between Scopus and WoS it may indicate to researchers that Scopus is the basis of the two where they would find more documents that could corroborate their research. Bibliometrics is a technique that maps scientific production and helps researchers make decisions about the relevance of the research topic (DONTHU et al., 2021). There is a tendency to continue to observe for some years the publications of the theme in the Scopus database, something that indicates that the academic discussions have not been exhausted and that it is in conceptual construction, that is, in the construction or strengthening of its theory as stated by Liu et al (2013) the publications become

widely recognized after many years, It is a process that takes time for fields with smaller scales and/or that develop more slowly. Thus, bibliometrics has the power to show when the theme can be attractive by the researcher, this study makes available to academic's reliable data that could be used as contributions in the subjects around the theme. As Wallin (2005) informs, bibliometric studies can only offer a short-term prediction of field research. That said, improvements in the academic world bring change and decision-making that will impact society in general mainly in relation to expanding access to education.

One of the weaknesses of this research is seen the large number of documents, it was not opening one by one to make sure that they all fit the theme "online teaching". Also, given the delay in the evaluation as well as the acceptance of the document in the bases, a document referring to 2021 could be added even though it is in 2022, something that will give a small difference in the data if it is to replicate the research. But this small difference will not contradict the general trend observed in this research.

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