

World Scientific Production on Education and COVID 19: A Bibliometric Analysis

Julio E. Postigo-Zumarán

Universidad Tecnológica del Perú, Lima, Perú.

E-mail: c21164@utp.edu.pe; <https://orcid.org/0000-0002-7954-0127>

Christian Esteban Gómez Carrión

Universidad Privada Norbert Wiener, Lima, Perú.

E-mail: christian.wiener@uwiener.edu.pe; <https://orcid.org/0000-0001-9698-3176>

Ruth Asela Saravia Alviar

Universidad Nacional San Luis Gonzaga de Ica, Ica, Perú.

E-mail: asela.saravia@unica.edu.pe; <https://orcid.org/0000-0001-5065-5863>

Milagro Baldemar Quiroz Calderón

Universidad Católica Los Ángeles de Chimbote, Chimbote, Perú.

E-mail: mquirozc@uladech.edu.pe; <https://orcid.org/0000-0002-2286-4606>

Dennis Arias-Chávez

Universidad Continental, Arequipa, Perú.

E-mail: darias@continental.edu.pe; <https://orcid.org/0000-0003-1500-8366>

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Abstract

The objective of this study is to characterize the world scientific production on education and COVID-19 between the months of January 2020 to September 2021. A bibliometric study was carried out in five databases (Scopus, Web of Science, Google Academic, Microsoft Academic and Crossref) from which a universe of 5005 articles was extracted. The bibliometric indicators were analyzed with the help of the Publish or Perish v. 7.19 and the same analytical software of the chosen databases. Regarding the most cited article published in the analyzed databases, the one entitled "Medical Student Education in the Time of COVID-19" stands out, which received 419 citations in the Scopus database, 368 in Web of Science, 442 in Crossref, 870 in Google Scholar and 702 in Microsoft Academic. Regarding the authors with the highest scientific production on the subject, Maria Assuncao Flores stands out with 5 publications on the Web of Science and Francisco José García-Peñalvo with 5 articles indexed in the Scopus database. Regarding the journals with the highest number of articles on education and COVID-19, Sustainability stands out. These results show that the

scientific production referring to education and Covid-19 confirms the radical change generated in education at all levels by the pandemic and the increase in scientific production to try to explore and describe the changing situation resulting from the pandemic in education. Regarding the journals with the highest number of articles on education and COVID-19, Sustainability stands out. These results show that the scientific production referring to education and COVID-19 confirms the radical change generated in education at all levels by the pandemic and the increase in scientific production to try to explore and describe the changing situation resulting from the pandemic in education. Regarding the journals with the highest number of articles on education and COVID-19, Sustainability stands out. These results show that the scientific production referring to education and Covid-19 confirms the radical change generated in education at all levels by the pandemic and the increase in scientific production to try to explore and describe the changing situation resulting from the pandemic in education.

Keywords

Bibliometrics, Scientific Production, Education, COVID-19.

Introduction

The health emergency generated by the worldwide spread of Covid-19 forced countries to take preventive measures to prevent its advance. The decisions taken had repercussions (and still have repercussions) in the social, health, political, economic and technological spheres. The pandemic has shown how invaluable technology is for continuing business operations and meeting job responsibilities. To resist the changes introduced by Covid-19, organizations had to break with standard procedures and adopt new ones in their work system (Szopinski & Bachnik, 2022). An example of this is the need to stay connected for socio-economic development and crisis management. Mobile communication and the internet provide digital solutions and support productive and social activity, thus reducing the digital divide.

In the case of the education sector, institutions had to implement tools such as Zoom, Google Meet, Microsoft Teams, LMS platforms or Web 2.0 tools, as well as methodologies such as cooperative work, multiple intelligences, critical thinking (TBL), project-based learning, Competency-based learning, gamification, etc., which, before the confinement, were seen as complementary resources to traditional classes, and not as fundamental tools and resources of the training processes. This sudden step into the 2.0 technological classroom made the presence of ICT in the process of digitization of education definitive. From this moment on, the challenge of adapting begins, given that

geographical mobilization was restricted internationally and within the countries themselves in order to avoid contact. The threat of contagion forced people to isolate themselves and it is in this confinement that technological tools become necessary to create the new normal. Gómez (2021) states that:

New technologies become the base tool of the teaching-learning process, whether the teacher likes it or not, adapts or not, performs better or worse. There is no other solution. And for this, sharing good practices will be fundamental in the holistic paradigm. (p. 206)

All face-to-face activity was suddenly suspended for fear that the virus would spread uncontrollably. Thus, the education sector at all levels was forced to suspend its activities indefinitely and begin to migrate to new forms of teaching, mostly novel and even unknown to teachers and students. These sudden changes have put unprecedented pressure on the Internet infrastructure, forcing developers to create new applications and systems that meet the needs of on-site presence. In a short time, virtual education took center stage and today we can say that it has come to stay (García Aretio, 2021; Pérez-López et al., 2021). Given this:

In times of pandemic, teachers have found themselves in an educational dilemma: adjusting to digital didactic strategies temporarily, which houses improvisation options that adapt to the state of emergency, admitting a posteriori the return to face-to-face teaching; or on the contrary, accept that it is a new reality, formalizing the incorporation of Information and Communication Technologies (ICT) in the teaching-learning process, formalizing the pedagogical bases for an education where the inclusion of the virtual component will prevail. (Torres-Toukoumidis et al., 2021).

This paradigm shift changed the way educators provide quality education. Online learning, distance education, the use of platforms such as Moodle and Zoom are now commonplace in the new educational normal that is gradually consolidating. And although these uses are already a reality, in many cases their relative dominance "does not guarantee an adequate use of technology for a satisfactory level of learning, which directly affects the perception of its quality" (López et al., 2021). The transition from traditional face-to-face learning to online learning can be a completely different experience for learners and educators, to which they must adjust with little or no other available alternatives (Pokhrel & Chhetri, 2021).

In addition to the loss and lack of commitment to learning caused by the interruption of face-to-face instruction and by the variable effectiveness of alternative forms of

education, there are other direct and indirect impacts of the pandemic, for example, the decrease in the capacity to students' families to support them in their education. For students, as well as for teachers and school staff, the economic crises experienced by families led, in some cases, to food insecurity and in many more affected mental health (Reimers, 2021), in addition to economic conditions, unemployment and coexistence at home. This situation has led the social actors that interact with universities, colleges and institutes to reorganize their activities with haste and creativity to maintain the teaching activity, as well as to contemplate new ways of being, of living together and thinking about reality, and to investigate how these elements reconfigure and determine well-being and quality of life in terms of social justice (Rivero & Bahena, 2021). In this context, as Ordorika (2020) mentions:

It will be necessary to carefully analyze the problems and scope that distance education has evidenced during the current crisis, in order to overcome pedagogical deficiencies and the exacerbation of social and gender exclusion and inequality. There is already talk of the establishment of new virtual teaching models and hybrid systems (face-to-face and distance) for teaching.

Thus, the Covid-19 pandemic has revealed the need for drastic changes in the organizational structures, curricula and educational policies of all schools and universities. For Morin (2020) it is necessary that any decision made in the field of education from now on is projected to the needs of the post-pandemic world by preparing to face uncertainties. This change also involves determining what the impact of the pandemic will be on certain innate aspects of the human being, such as physical interaction, dialogue and coexistence, aspects that are the center of the construction of society. For this reason, articles on Covid-19 and its impact on education at all levels have appeared in prestigious international scientific publications since March 2020. This situation has provided important evidence on the enormous impact of the disease in scientific studies educational activities carried out worldwide (Pericàs et al., 2020).

Regarding the literature on the subject, the study by Rodrigues et al. (2020), who carried out bibliometric research on Covid-19 and its interruption in academic management and education. The aim of the authors was to map the scientific literature in these areas in the context of the pandemic and analyze its content through bibliometrics. The study concludes by stating that there is a shortage of research on the subject, that is, empirical studies on the effects of this pandemic on science. For their part, Mustapha et al. (2021) worked with a sample of 82 articles from 2020 to 2021 from the Scopus and Web of Science databases. The results of the study indicate that the reviews found are classified

into four main groups, These are 1) Rapid change of online digital education and teaching and learning during the Covid-19 pandemic; 2) Digital education during the pandemic and rethinking for a sustainable community; 3) Digital education for medical education and healthcare in the hospital; and 4) Digital education and digital innovation during the pandemic. On the other hand, among the studies focused solely on the processes and characteristics of education worldwide, the works of Comarú et al. (2021), who evaluated the publications on education indexed in the Web of Science Core Collection (WoS). The authors selected a total of 119 articles published between 2009 and July 2019 that have addressed the issue of inclusive education. Their findings show an increase in the number of articles that associate science teaching (TS) and Integrated Education (IE). Also noteworthy is the study by Barrot (2021), who examined a total of 13,527 documents related to education from the Scopus database between the years 1996 to 2019. His findings revealed that despite the progress of the Southeast Asia region in the educational research, its contribution to global scientific knowledge remains modest compared to other leading countries.

This panorama shows us the gaps and inequalities that have been taking place in the educational field and that are aggravated by the current state of health. Education faces a complex challenge, which is to ensure the continuity and quality of student learning through the necessary adaptations that contribute to the effectiveness of education. In this framework, a descriptive bibliometric study of scientific production in education during the Covid-19 pandemic was carried out. This type of study helps to determine the scientific production of researchers, research groups or fields through the analysis of prestigious databases from which selected indicators are classified that help to specify the frequency and distribution of knowledge for the case of a discipline or scientific area. This study will show an overview of the work that researchers, journals and countries have been doing in terms of educational findings and proposals during the pandemic.

Materials and Methods

A descriptive-retrospective bibliometric study of the world scientific production on education and Covid-19 was carried out. For this, information was collected from five databases: Scopus, Web of Science, Google Academic, Microsoft Academic and Crossref. Once the documents were obtained, the bibliometric indicators were calculated through the Publish or Perish v. 7.19 given its usefulness in the production of integrated results. The data capture was carried out between January 2020 and September 2021.

Data Collection

For the searches, the terms TITLE (education AND covid 19) AND PUBYEAR> 2019) and (TI = (education)) AND TI = (covid 19) were used, the same terms that should appear in the title of the research, in the abstract and keywords.

The results were reviewed individually in order to carry out an information cleaning process to avoid mixed results and duplicate records. Said cleaning process made it possible to select documents related to education and the current state of the pandemic, which are indexed in the chosen databases and which have the structure of a document communicating the results of an investigation.

After this process, a final universe of 5005 results was formed that are related to the subject of the study. After the individual review of the documents, they were exported to a database (MS Excel from Microsoft Corp) in order to process and analyze them. The figures prepared in the present study were made with the help of the Vos Viewer software.

Results

Table 1 shows the bibliometric indices obtained from the analysis of the 5005 documents. An average of 15071 citations was obtained, 8612 citations per year, 21 citations per article and 9996 citations per author. The publications found have on average an h index of 51, a g index of 101 and an e index of 74. Finally, the AW index was 120 and the AWCR was 9966.

Table 1 Scientometric indicators on Covid-19

Source	Scopus	Microsoft Academic	Google Scholar	Crossref	Web of science
Articles	200	1000	1000	999	1806
Quotes	7517	24006	2074	37707	4050
Years	1	1	1	1	1
Appointments per year	7517	24006	2074	37707	4050
Citations per article	37.59	24.01	2.07	37.74	4.66
Citations by author	7517	11201.22	1545.18	19602.1	
Articles by author	200	406.72	615.65	452.76	
Authors by article	1	3.96	1.6	3.04	
h index	41	74	17	87	38
index g	71	134	39	161	
hc index	95	120	40	176	
hi index	41	19.35	9.03	30.4	
normal h-index	41	44	13	60	
AWCR	7517	24006	2074	37707	
AW index	86.7	154.94	45.54	194.18	
AWCRpA	7517	11201.22	1545.18	19602.1	
index e	48.04	99.01	31.32	117.83	
Hm index	41	44.76	13.5	62.27	
Citations per author per year	7517	11201.22	1545.18	19602.1	
hI_Annual	41	44	13	60	
Amplitude h	53.1	63.6	61.2	56.9	
Amplitude g	67.2	74.9	74.8	69.1	
he has	41	74	17	87	

The opinion article written by Suzanne Rose, a researcher at the Perelman School of Medicine of the University of Pennsylvania (Philadelphia), entitled: "Education of medical students in the time of COVID-19" and that analyzes the effect of COVID-19 in the teaching process in medical education, it has received 419 citations in Scopus, 368 in Web of Science, 442 in Crossref, 870 in Google Scholar and 702 in Microsoft Academic since its publication on March 31, 2020 in JAMA (Journal of American Medical Association), a peer-reviewed medical journal endorsed by the American Medical Association.

Also noteworthy is the article "COVID-19 and online teaching in higher education: A case study of Peking University" written by Wei Bao, a researcher affiliated with the Graduate School of Education of the Institute of Economics of Education, Peking University, Beijing, China. The article explains the case of online education developed by Peking University and the strategies applied by this superior house to carry out this teaching modality. This article was published in Wiley's journal Human Behavior and Emerging Technologies. Its publication date was April 7, 2020. This publication features 307 citations in Web of Science, 999 in Google Scholar, and 643 in Microsoft Academics.

Another prominent article was that of Sir John Daniel, entitled "Education and the COVID-19 Pandemic", which has 198 citations in Scopus, 131 in Web of Science, 848 in Google Scholar and 227 in Crossref. The article was published in Prospects magazine

Table 2 shows the results by authors, journals and countries with the highest number of publications, as well as the types of publications. In this case, the two most important databases are considered: Scopus and Web of Science. Regarding the authors with the largest scientific production on the subject, Maria Assuncao Flores stands out, affiliated with the Universidade do Minho, in Braga, Portugal, with 5 publications on the Web of Science. In the Scopus database, Francisco José García-Peñalvo, from the University of Salamanca, in Spain, also stands out with 5 articles. Regarding the journals with the highest number of articles on education and COVID-19, Sustainability, from the Multidisciplinary Digital Publishing Institute (MDPI), stands out. This journal features 50 publications on the Web of Science and 52 on Scopus. With regard to production on the subject by country, the United States stands out with 516 documents indexed in the Web of Science and 544 in Scopus. It is followed by the United Kingdom with 183 on the Web of Science and 225 on Scopus. Finally, regarding the type of publications, the original scientific articles predominate, these being 1166 in Web of Science and 1418 in Scopus. The latter highlights the importance of the publication of original results for the scientific community, since these documents allow us to know the assessment and contribution of

knowledge supported by the scientific community to explain and respond to the problems of the moment (Postigo-Zumarán et al., 2021; Arias-Chávez et al., 2021). It is followed by the United Kingdom with 183 on the Web of Science and 225 on Scopus. Finally, regarding the type of publications, the original scientific articles predominate, these being 1166 in Web of Science and 1418 in Scopus. The latter highlights the importance of the publication of original results for the scientific community, since these documents allow us to know the assessment and contribution of knowledge supported by the scientific community to explain and respond to the problems of the moment (Postigo-Zumarán et al., 2021; Arias-Chávez et al., 2021). It is followed by the United Kingdom with 183 on the Web of Science and 225 on Scopus. Finally, regarding the type of publications, the original scientific articles predominate, these being 1166 in Web of Science and 1418 in Scopus. The latter highlights the importance of the publication of original results for the scientific community, since these documents allow us to know the assessment and contribution of knowledge supported by the scientific community to explain and respond to the problems of the moment (Postigo-Zumarán et al., 2021; Arias-Chávez et al., 2021).

Table 2 Production by authors, journals, countries and type of publication

	Web of science		Scopus	
Authors	Flores, MA	5	García-Peñalvo, FJ	5
	Park, S.	5	Karakose, T.	5
	Sharma, A.	5	Tlili, A.	5
	Ahmed, S.	5	Burgos, D.	4
	Cho, MJ	4	Crick, T.	4
Journals	Sustainability	fifty	Sustainability	52
	Education sciences	28	Education sciences	28
	Education and information technologies	twenty	International Journal Of Environmental Research And Public Health	twenty-one
	International Journal Of Environmental Research And Public Health	19	World Neurosurgery	twenty-one
	World neurosurgery	19	ACM International Conference Proceeding Series	19
Countries	USA	516	USA	544
	United Kingdom	183	United Kingdom	225
	Canada	105	India	129
	China	103	Spain	108
	India	96	Australia	106
Post types	Articles	1166	Article	1418
	Editorial materials	285	Letter	193
	Letters	179	Conference paper	168
	Early access	171	Editorial	140
	Meeting abstracts	93	Review	134

Regarding the network analysis of the titles and abstracts of the Scopus database, the creation of 8 clusters, 638 items, 42516 links and a total link strength of 170016 is observed. The most important clusters are: cluster 1 red that it is born from covid 19 and has 198 items; cluster 2 green with coronavirus disease 2019 and 118 items; cluster 3 blue with Sars Cov 2 with 105 items; and cluster 4 yellow with medical education and 69 items. Cluster 5 purple with 53 items and human as the base word, cluster 6 light blue with female and 51 items, cluster 7 orange with social media and 20 items, and cluster 8 brown with 4 items and the word professional development (see Figure 1).

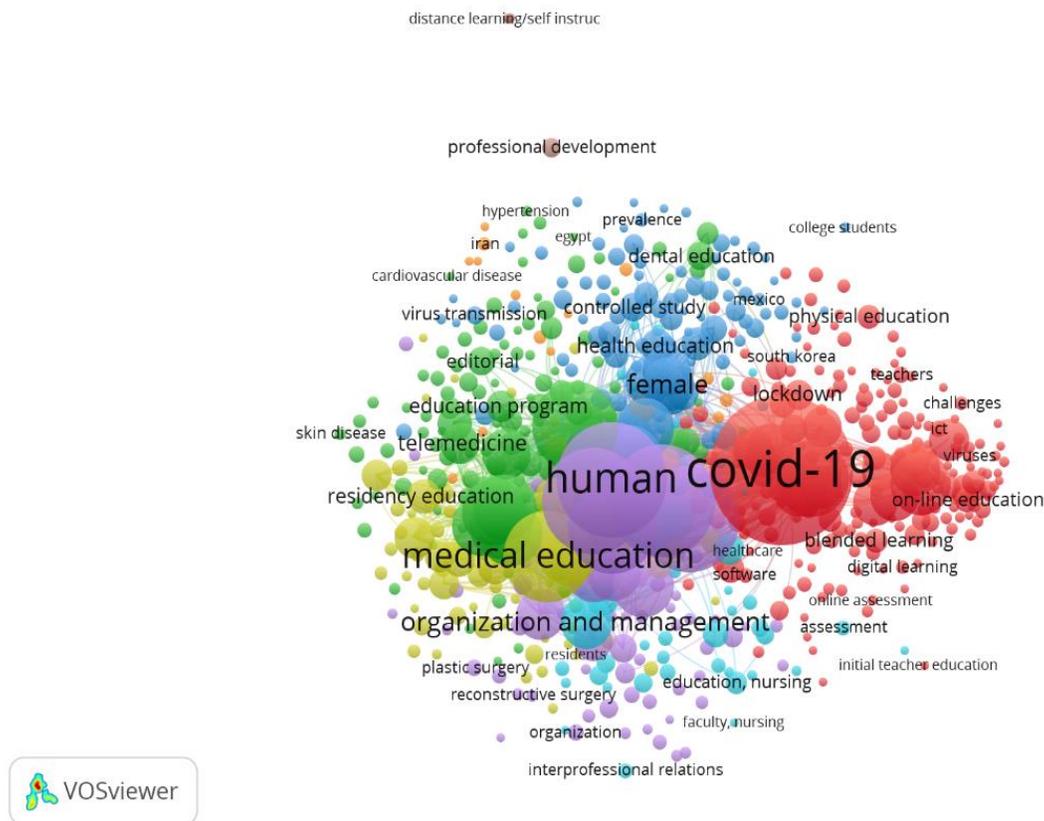


Figure 1 Analysis of the network visualization in Scopus

Analyzing the network of titles and abstracts from the Web of Science database, the creation of 27 clusters, 331 items, 2460 links and a total link strength of 2575 is observed. The first 5 clusters were analyzed as they had the largest amount of items: cluster 1 red, which was born from Sustainability, presents 20 items; cluster 2 green with COVID 19 and 18 items; cluster 3 blue with patterns and 18 items, cluster 4 yellow, with pandemic and 17 items, and cluster 5 purple with school closure and 16 items. The 15 celestial cluster with higher education and 13 items also stands out (see figure 2).

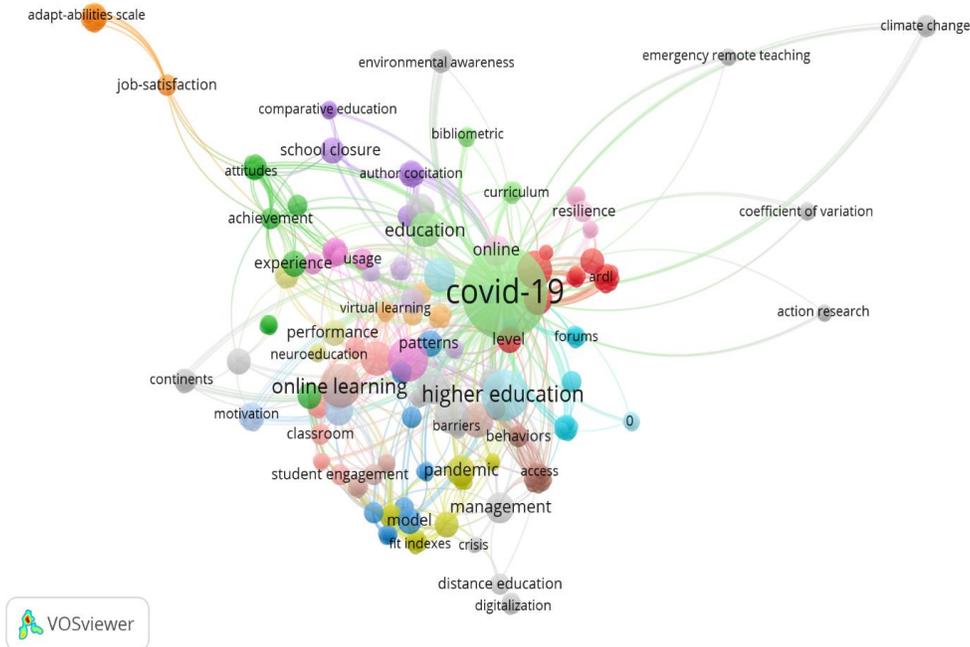


Figure 2 Analysis of the network visualization in the Web of Science

For the visualization of the items, a color-based element density graph was generated. By default, the colors range from blue to green to yellow. The greater the number of elements in a point and the greater the weight of neighboring elements, the closer the color of the point is to yellow. The smaller the number of elements in the neighborhood of a point and the weight of neighboring elements is low, the color of the point will be closer to blue. In the case of the present investigation, the COVID 19 central point is the one that shows the highest accumulation of elements (see figure 3).

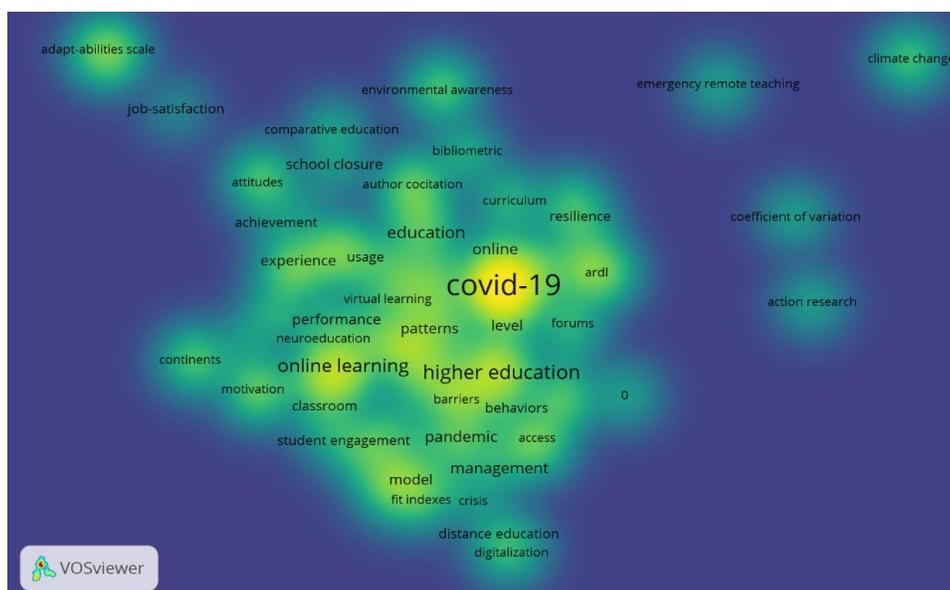


Figure 3 Analysis of the density visualization in the Web of Science

Conclusions

An analysis of reality allows us to observe that education is facing an unforeseen situation that has forced it to adapt to teaching and the knowledge evaluation processes. Online education is not alien to higher education, but for other areas such as school it represents a challenge that at times seems impossible to overcome. This gap requires "careful planning, prior knowledge of the necessary requirements and, in many cases, training or even resources and devices to deal with the work of the different members of a family." (Grande-de-Prado et al., 2021).

Of the 5005 documents selected for the study, an average of 15071 citations were obtained, 8612 citations per year, 21 citations per article and 9996 citations per author. The average publications have an h-index of 51, a g-index of 101, and an e-index of 74. Finally, the AW index was 120 and the AWCR was 9966.

Regarding the authors and the most cited articles published in the analyzed databases, the research by Suzanne Rose stands out, whose article entitled "Medical Student Education in the Time of COVID-19" received 419 citations in the Scopus database, 368 in Web of Science, 442 in Crossref, 870 in Google Scholar, and 702 in Microsoft Academic. In the research by Brika et al. (2021), the most influential authors in the field of higher education quality are presented, which are Lee Harvey, A Parsu Parasuraman and Bjørn Stensaker. For their part, Gonzalez Garcia et al. (2020), in their bibliometric study, determined that the author Cerro Velázquez is the only author with two publications indexed in the Scopus database, obtaining a total of four between both databases.

Regarding the journals with the highest scientific production on education, Sustainability stands out, with 50 publications indexed in the Web of Science database and 52 in Scopus. Mustapha et al., (2021) ranks this journal second to The Journal of Chemical Education journal. However, in the research by Brika et al. (2021), the most prominent journals were Journal of Higher Education, Quality Assurance of Education, Quality in Higher Education Measurement and Evaluation in Higher Education. While in the study by Tsay & Shu (2011), the International Journal of Inclusive Education (465 articles), European Journal of Special Needs Education (97 articles), International Journal of Disability Development and Education (75 articles), Disability & Society (61 articles) and Teaching and Teacher Education (56 articles). Finally, Al Mamun et al. (2021) include the Computer Applications in Engineering Education magazines and the International Journal of Engineering Education.

Regarding the country with the largest scientific production on education, the United States stands out with 516 articles indexed in the Web of Science database and 544 in Scopus. The United Kingdom follows with 183 articles indexed on the Web of Science and 225 on Scopus. Karakose et al. (2021) and Karakose & Demirkol (2021) corroborate the results of this research, since their results show the United States as the most prominent country in scientific production on education, followed by the United Kingdom. While Brika et al. (2021) highlight the United Kingdom and the United States as the countries with the highest scientific production on higher education. Barrot (2021), for its part, also recognizes the US as the leading country in educational research.

Another important result is the one that measures the types of publications. The present investigation determined that the original scientific articles are the most produced (1166 in Web of Science and 1418 in Scopus). This result coincides with the findings of Rodrigues et al., (2020), in their bibliometric study on scientific production in education and business, they affirm that the most common type of document was the original research article (873; 91.03%). While Gonzalez Garcia et al. (2020), in their bibliometric study on quality education, worked mostly with original articles (n = 171), followed by communications (n = 33), encompassing 85% of the analyzed investigations between both formats. Now, the one who disagrees with these results is Swacha (2021).

Regarding the network analysis of titles and abstracts, the VosViewer tool was used. The creation of 8 clusters, 638 items, 42516 links and a total link strength of 170016 were obtained from the Scopus database. The most prominent terms are covid 19, coronavirus disease, Sars Cov 2, medical education, human, female, social media and professional development. Brika et al. (2021), in their bibliometric study on higher education found seven clusters based on quality assurance, institutional quality, quality of higher education, quality improvement, quality management, quality indicators and quality culture.

After the analysis carried out, it can be concluded that the scientific production referring to education and Covid-19 confirms the radical change generated in education at all levels by the pandemic and the increase in scientific production to try to explore and describe the changing situation fruit of the pandemic. Reimers (2021; 2022) considers that the pandemic had a negative effect on education systems and that it led this sector to face two serious problems. The first, related to educational inequality and the second with insufficient relevance. A considerable growth of economic inequality, especially between individuals within the same nations, resulted in challenges of social inclusion and legitimacy of society, which go beyond the lost class hours. Thus, the sudden emergence

and expansion of the COVID-19 pandemic is not only causing great controversy about how to manage populations and the effects on society, its scope reaches the most daily and practical processes that we all face in the day to day (Baleriola & Contreras-Villalobos, 2021).

In addition to this, the school not only fulfills an educational mission of acquiring knowledge, but also satisfies the socialization needs of young people. Therefore, online education is justified by the following:

a) territorial dispersion; b) the need to educate very large groups of students; and c) as a way to meet educational needs in exceptional situations (disasters, pandemics, wars and others), in which students and teachers have difficulty traveling or cannot attend schools or universities (Careaga-Butter et al., 2020).

The contribution of this research is to provide the scientific community with updated information on education and COVID 19. It also aims to be a point of reference for teachers of different educational stages, so that they can learn about the latest trends related to the pandemic and the impact in education. Finally, it was also presented to demonstrate the importance of scientific production in unforeseen emergency situations.

The pandemic has brought with it a series of changes in people's lives, as well as opportunities to "blame or blame" on the link between technology and education. It seems clear that education in general is going to undergo changes as a result of the COVID-19 crisis that require changes to face the new scenarios that are approaching.

There is another key sector where COVID-19 is penetrating deeply and where the consequences will undoubtedly transform post-pandemic society: education. For decades, in many countries around the globe an educational agenda focused on the efficiency and quality of education has been implemented. (Baleriola & Contreras-Villalobos, 2021).

Responsible use of technology will complement quality teaching practices. The teachers with the best results in face-to-face education, knowing how to use new technological tools with solvency, will also be the best in online education. And the reason is that their knowledge about how we learn will allow them to select the best pedagogical tools and the most appropriate content to address them either in person or virtually (López et al., 2021).

Scientific production on education and COVID-19, given the public health situation in which we live, is a field in continuous expansion, which leads researchers to focus on

answering questions related to teaching, the digital context and the impact on students. The present investigation has several limitations, including the suitability of the study corpus. Another aspect is the selection of databases (only those that can be evaluated by the Publish or Perish software were considered). Third, only a portion of the scientific production was worked on. For future research, it is suggested to evaluate specific aspects of education in times of a pandemic by delimiting geographical areas, since scientific production decreases dramatically precisely in the countries that saw their educational systems most affected. Finally, the importance of online education is highlighted as a vital resource in which social distancing has been imposed as a new form of normality. Nevertheless:

Neither the technological platforms, nor the students, nor the teachers had foreseen this sudden change. There is a lack of careful planning, prior knowledge of the necessary requirements and, in many cases, training or even resources and devices to deal with the work of the different members of a family. Mainly the tranquility of a normal situation is lacking. Teachers and students have found themselves at home, having to respond in a stressful situation to different demands, with a high probability of negative consequences on their health due to the pressure of telematic teaching. (Grande-de-Pardo et al., 2021).

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