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E-Learning in Higher Education during the COVID-19 Pandemic: A Bibliometric Analysis

Adina-Liliana PRIOTEASA*
Bucharest University of Economic Studies, Bucharest, Romania
**Corresponding author, prioteasadina@gmail.com*

Carmen Nadia CIOCOIU
Bucharest University of Economic Studies, Bucharest, Romania
nadia.ciocoiu@man.ase.ro

Laurențiu LAZĂR
Bucharest University of Economic Studies, Bucharest, Romania
laurentiu.dan_lazar@yahoo.com

Mihaela MINCIU
Bucharest University of Economic Studies, Bucharest, Romania
mihaela_minciu@yahoo.com

Abstract. *It is undeniable that the COVID-19 pandemic has caused serious problems to education on a global scale, as well as to health systems and national economies. As a result, governments around the world have had to make extraordinary efforts to solve the various problems encountered not only in the area of health and the economy, but also in education. In terms of education, the changes include, but are not limited to, curriculum revisions, the provision of technology resources and infrastructure, changes in the academic calendar, and policies regarding instructional delivery and assessment. To limit the spread of the pandemic, universities, institutes and academic schools had to switch to online education using available educational platforms. This has been reflected in the emergence of numerous publications dealing with the subject. The study aims at the quantitative evaluation of the research carried out and published in the field of e-lerning in the university environment in the context of the pandemic crisis, starting from a comprehensive bibliometric analysis based on Scopus publications. The distribution of published papers in terms of years, authors, institutions, countries, journals, the network of co-authors, co-citations, and the co-occurrence of keywords is discussed. The main conclusions regarding the research trends in the field are drawn. The study represents a useful resource for those interested in the field of e-lerning in the academic environment in the context of COVID-19 that captures the main changes produced in the field and the potential research directions.*

Keywords: e-learning, higher education, COVID-19 pandemic, bibliometric analysis

Introduction

The last 50 years have seen huge worldwide growth in the provision of educational services at all levels. The COVID-19 pandemic has forced the closure of many activities, especially educational activities (Ionescu, et al., 2020), representing the biggest challenge that educational systems have ever faced (Daniel, 2020). This closure has stimulated the growth of distance learning activities in various forms as an alternative to face-to-face education. As a result, many universities have shared the best ways to provide course materials remotely, involve students and conduct assessments (Brika, Chergui, Algamdi, Musa, & Zouag, 2022).

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In recent years, there has been an increasing interest in research in areas related to e-learning (Brika, Chergui, Algamdi, Musa, & Zouag, 2022), however, there is still a lack of bibliometric information related to e-learning globally in the educational environment (Raman, Thannimalai, Don, & Rathakrishnan, 2021).

In 2018, Tibaná-Herrera, Fernández-Bajón, & De Moya Anegón extracted bibliometric indicators from 39,244 documents indexed in Scopus and SCImago Institutions Rankings, from2003 to 2016, and generated maps of production and collaboration networks and graphs about the impact of e-learning research by countries and institutions.

The exploratory bibliometric analysis carried out by Oliviera, Fontes, Collus, & Cerisier, in 2019, focused on the analysis of scientific publications written in English, in Open Access, in the field of Education, from 2007 to 2017, taking into account the following topics: video, higher education, online education, distance learning. For this, three search strings were used, in total 96 publications were identified, mainly journal articles, mostly published by institutions in European countries.

Fatima & Abu (2019), following the objective of identifying significant contributions in the field of e-learning, applied the bibliometric method to analyze 9826 studies from the Web of Science database, from 1989 to 2018. The results revealed that the United States of America and the United Kingdom contributed more than half of the published research on e-learning, with Computers & Education and the Journal of Chemical Education publishing the most articles on the topic. A recent study by author Sonia Sobral (2021) highlights that the United States of America, over the past 20 years, has been at the forefront of publications on online education, and Kent State University, Purdue University, University of California, University of Plymouth and VA Medical Center are the organizations with two of the most cited papers.

A new bibliometric analysis on the field of online education, carried out on 12,272 publications in the Web of Science database, between 2015 and 2020 revealed that the collaboration between authors, universities and countries researching the field of e-learning is low (Djeki, Dégila, & Bondiombouy, 2022).

Regarding the situation of e-learning in higher education, Gao, Wong, Khambari, & Noordin (2022) concludes that the number of scientific documents continues to grow exponentially, and researchers from different fields have made a great contribution to the field.

A series of researches have been published on online education within the academic environment during COVID-19. However, there is very little research focused entirely on the relationship between e-learning, higher education and COVID-19, using scientometric or bibliometric analyses (Fauzi, 2022). In general, they use different periods and strings of words in searches, dealing with critical areas of e-learning research and the most influential authors, organizations, and countries (Brika, Chergui, Algamdi, Musa, & Zouag, 2022; Fauzi, 2022; Zhang, et al., 2022).

This study aims to examine descriptively and evaluatively, based on the articles indexed in the reputed Scopus international database, the evolution of concerns regarding online education in the university environment in the context of the COVID-19 pandemic. The paper is organized as follows: the first part includes the review of the literature, the next section includes the presentation of the research methodology; the third section presents the results with subsections according to the methodology and the three types of findings: descriptive information on the scientific production analyzed, evaluative information on the research published on the topic of interest (network of co-authors, co-citations, and co-occurrence keywords), trends in the field, and finally a section presenting the conclusions.

Literature review

The systematic counting of publications has its origins in the field of psychology, in the early 1900s (Godin, 2006). The first systematic data collection efforts were made by Alfred Lotka and Samuel Bradford, who subsequently established the basic laws of bibliometrics (Thompson & Walker, 2015).

In 1926, Alfred J. Lotka published the pioneering study of the frequency distribution of scientific productivity (Lotka, 1926). Eight years after the publication of Lotka's article, Bradford (1934) published the study on the frequency distribution of papers in journals. He established a relationship regarding the frequency distribution of papers in a particular field across journals. For any problem or domain, the top third (Zone 1 or the core) represents the journals that are most frequently cited in the literature of that topic and are therefore likely to be of greatest interest to researchers in the field. The middle third (Zone 2) includes the journals that had an average amount of citations, and the lower third (Zone 3 or the tail) which includes the multitude of journals that are rarely cited and considered of marginal importance for the subject (Nash-Stewart, Kruesi, & Del Mar, 2012; Sudhier, 2010).

With the publication of Eugene Garfield's work in 1955, the foundations of modern bibliometrics are laid (Garfield, 1955). He developed the Science Citation Index (SCI), which took a new approach to finding and tracking the literature and systematizing the process of counting and examining citations for individual articles (Thompson & Walker, 2015).

The situation changed markedly with the publication of Derek John de Solla Price's works entitled "Science since Babylon" (Price, 1961) and "Little Science - Big Science" (Price, 1963). In addition to significantly contributing to the spread of the use of the Science Citation Index (SCI) database of the Institute for Scientific Information, as a tool for quantitative analysis of science, he has the greatest contribution to increasing the interest of scientists and research managers related to the aspects quantitative bibliometric research (Braun, Glänzel, & Schubert, 1985).

The terms bibliometrics and scientometrics were almost simultaneously introduced by Pritchard, Nalimov and Mulchenko in 1969. While Pritchard (1969) explained the term bibliometrics as "the application of mathematical and statistical methods to books and other means of communication", Nalimov & Mulchenko (1969) defined scientometrics as "the application of those quantitative methods which deal with the analysis of science regarded as an information process". According to these interpretations, the specialty of scientometrics is limited to the measurement of scientific communication, while bibliometrics is designed to deal with more general information processes (Glanzel, 2003).

Bibliometrics consists in the collection, manipulation and analysis of quantitative bibliographic data from scientific publications (Verbeek, Debackere, Luwel, & Zimmermann, 2002).

Bibliometrics is the discipline where quantitative approaches have been used to apply mainly to scientific fields and it is mainly based on various aspects of written articles such as subject, author, citations, title, etc. (Hussain, Fatima, & Kumar, 2011)

E-learning, which is defined as a virtual training mode, allows the use of content management systems to carry out training activities in a digital environment (Moreno-Guerrero, Aznar-Díaz, Cáceres-Reche, & Alonso-García, 2020). Two basic types of e-learning are usually compared, asynchronous and synchronous (Hrastinski, 2008).

Asynchronous learning is an unsynchronised method of learning that requires the presence of the teacher and students to be distinct. Examples include online videos, self-study modules, and

articles or papers posted. The synchronous method is reversed,the presence of the teacher and students should be simultaneous, they should meet online on any platform on which they decide to work and cooperate as in a class. There are several methods that allow synchronous learning, such as video conferencing, live chat or live streaming (Palupi, 2022; Amiti, 2020).

In recent years, increased attention has been paid to e-learning in educational institutions due to the many benefits that have been discovered through study. The main advantages of e-learning include the accessibility of teaching materials, the participation of many students regardless of space and time limits, low financial costs (Gautam, 2020; Gao, Wong, Khambari, & Noordin, 2022).

Moreover, the application of online education in the university environment during the pandemic period has led to the potentiation of the advantages offered by it. Thus, university institutions have reported that online learning has proven to be manageable, with students having convenient access to both teachers and teaching materials. Online learning modalities have also reduced the use of travel resources and other expenses, eased administrative tasks such as recording lectures and marking attendance, and encouraged student-centeredness during lockdown (Mukhtar, Javed, Arooj, & Sethi, 2020). However, this process is not devoid of challenges, among the most significant, are the lack of direct contact with colleagues, difficulties in teaching practical subjects, lack of direct contact with the teacher and too much time spent in front of a computer / phone or other mobile device (Stecuła & Wolniak, 2022).

Research methodology

This study aims to examine descriptively and evaluatively, based on the articles indexed in the reputed Scopus international database, the evolution of concerns regarding online education in the university environment in the context of the COVID-19 pandemic.

The research looks for answers to the following questions:

(1) What is the distribution of descriptive information (years, authors, institutions, countries and journals) of published works on online education in the university environment in the pandemic context in the scientific database Scopus?

(2) What is the distribution of evaluative information (network of co-authors, co-citations, co-occurrence of keywords) of published research on online education in the university environment in the pandemic context in the scientific database Scopus?

(3) What are the main research trends regarding online education in the university environment in the context of the COVID-19 pandemic that emerge from the published works?

The method used by this research is bibliometric analysis. Both the scientific database Scopus and the VOSviewer software were used to examine the content of the articles. The VOSviewer software was developed by Van-Eck & Waltman (2010), and is based on an algorithm called "visualization of similarities" between elements. Examples of such elements include countries, keywords, journals, authors and other bibliometric information extracted from scientific databases (Wong, et al., 2020). So, in this research, VOSviewer software was used to view the descriptive and evaluative results.

The data source plays an important role in conducting a bibliometric study. First, in this study, the data from the specialized literature were collected from Scopus, which, in January 2020, included approximately 77.8 million articles from approximately 23400 journals, 290 trade journals, and 850 book series, including over 9.8 million conference papers and 44 million patents (Elsevier, 2020).

During the literature review process, the keywords were searched in the "Title" section of the Scopus database. A search string of three main keywords and related sub-keywords that can be synonymous or alternatively used in terms of the main keywords has been developed: 1) e-learning, 2) COVID-19, 3) higher education.

The search string for the keyword "E-LEARNING" was composed of "online learning" OR "online teaching" OR "online education" OR "virtual learning" OR "virtual teaching" OR "virtual education". For the keyword „COVID-19", the search string included coronavirus OR covid-19 OR covid19 OR covid 19, while for "HIGHER EDUCATION", it included student or university. Also, a period was set during the literature review process for accessing articles, namely January 1, 2020 - November 1, 2022. In the first stage, a total of 1060 documents were obtained. Subsequent processes, according to the inclusion and exclusion criteria, are presented in Table 1.

Table 1. Stages of the literature review process regarding inclusion and exclusion criteria

Stage	Content	Description
Stage 1	Scientific database	Scopus
	Indexation	Toate
	Date	1.11.2022
	Period	1 January 2020 - 1 November 2022
	Searched keywords	(TITLE ("e-learning") OR TITLE ("online learning") OR TITLE ("online teaching") OR TITLE ("online education") OR TITLE ("virtual learning") OR TITLE ("virtual teaching") OR TITLE ("virtual education") AND TITLE (coronavirus*) OR TITLE (covid19) OR TITLE (covid-19) OR TITLE (covid 19) AND TITLE ("higher education") OR TITLE (student*) OR TITLE (universit*)) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020))
	Initial result	1060 documents
Refining stages		
Stage 2	Language	English ⇨ 1035 documents
Stage 3	Document type	Article ⇨ 780 documents

Source: Authors' own research.

In the second stage, the documents written in English were selected. Thus, the number of documents decreased to 1035. In the next step, the type of document sought was established, namely the article, since it is the most common and popular type of document and provides more objective data. At the end of this step, the number of articles was reduced to 780.

Data analysis and discussion

In this section, the descriptive and evaluative findings of 780 articles obtained as a result of the analysis of the specialized literature are presented.

Descriptive results on years, authors, institutions, countries, and journals

The evolution over time of the 780 selected articles on the topic of online education in the university environment in the context of the COVID-19 pandemic, published between 2020 and 2022, is presented in Figure 1. Examining the data provided by Figure 1, it can be seen that the year 2021 and the year 2022 have an equal number of publications and hold the largest shares (44.61%), followed by the year 2020 (10.78%).

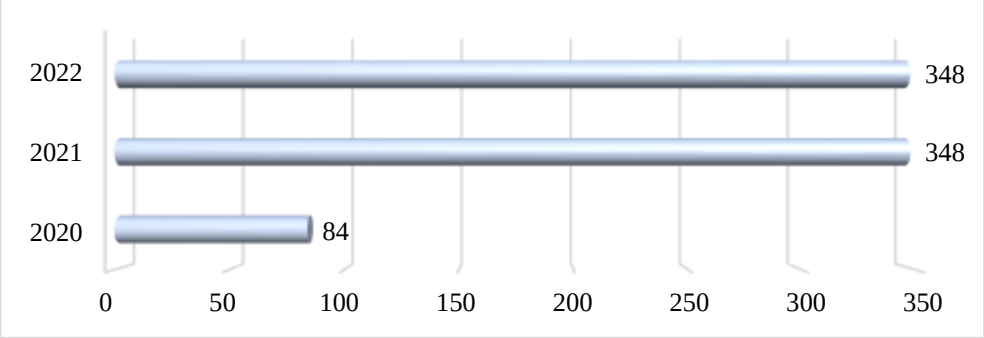


Figure 1. Number of articles published by year

Source: Authors after Scopus (2022).

Table 2 contains a double ranking on authors and institutions that have contributed with scientific research to the subject of online education in the university environment in the context of the pandemic. 2781 authors contributed to the preparation of the 780 articles. For example, the first two positions are occupied by Akram, H. and Su, Y. S. who have 4 personal contributions and are affiliated with Northeast Normal University and National Taiwan Ocean University, respectively. They are closely followed by authors who have 3 researches each. As for the institutions, the first position is held by King Abdulaziz University, with 11 documents. The next two positions are held by The University of Jordan and the University of Utara Malaysia, with 10 and 9 publications respectively in the Scopus scientific database. Moreover, examining the top 10 institutions that make significant contributions to online education in the university environment in the context of the pandemic, 100% of them are from Asia, including countries such as Saudi Arabia, Jordan, Indonesia, Malaysia and Hong Kong.

Table 2. Top 10 authors and institutions with significant contributions in the studied field

Authors			Position	Institution		
Author name	**Contribution (Documents)**	**Percent**		**Institution name**	**Contribuție (Documente)**	**Percent**
Akram, H.	4	0.512%	**1**	King Abdulaziz University	11	1.410%
Su, Y. S.	4	0.512%	**2**	The University of Jordan	10	1.282%
Aslam, S.	3	0.384%	**3**	Universiti Utara Malaysia	9	1.153%
Lin, C. L.	3	0.384%	**4**	King Saud University	8	1.025%
Prasetyo, Y.T.	3	0.384%	**5**	Universiti Malaya	8	1.025%
Saleem, A.	3	0.384%	**6**	Bina Nusantara University	8	1.025%
Sobaih, A. E. E.	3	0.384%	**7**	Chinese University of Hong Kong	7	0.897%
Yau, A. H. Y.	3	0.384%	**8**	The University of Hong Kong	7	0.897%
Yeung, M. W. L.	3	0.384%	**9**	Hong Kong Polytechnic University	7	0.897%
Abuhammad, S.	2	0.256	**10**	Al Qassim University	7	0.897%

Source: Authors after Scopus (2022)

Figure 2 shows the top 10 most productive countries in publications on online education in academia in the context of the COVID-19 pandemic out of the 107 countries to which the selected publications belong. The findings show that the People's Republic of China, in which 88 articles were published, is the country at the top of this ranking. Further, 34 articles were published in the second-ranked country, Saudi Arabia, followed by Indonesia with 67 articles. Significant contributions also hold the next positions in the ranking, so Malaysia holds 57 researches, India 55, and the United States of America 54. These six positions provide more than half (51.15%) of the total number of articles distributed by country. Moreover, 7 countries out of the 10 are from Asia, offering 424 items (54.35%) of the 780 selected documents.

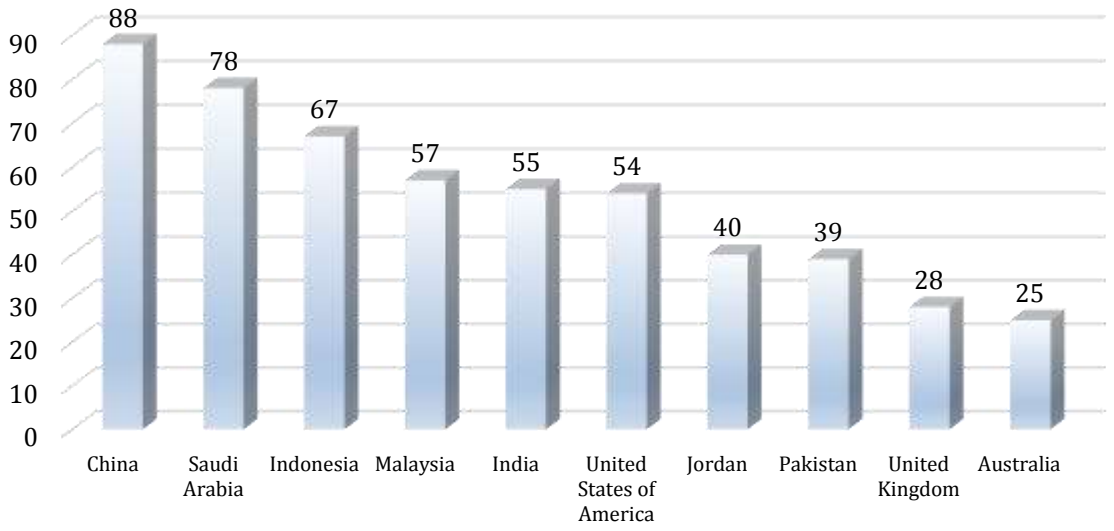


Figure 2. Number of articles published by country

Source: Authors after Scopus (2022)

Table 3 contains only 10 of the 159 journals that published between January 2020 and November 2022 articles on the situation of online education in the university environment in the context of Covid-19. These 10 journals provide 188 papers (24.10%) of the total 780 analyzed. Sustainability has the most significant contribution, with 45 articles and a share of 5.76% in the total of 780 documents studied. Notable contributions also hold the following classified sources, namely Frontiers in Psychology with 35 articles and Education Sciences with 19 documents.

Table 3. Distribution of articles in journals

Position	Journal name	Number of documents
1	Sustainability Switzerland	45
2	Frontiers In Psychology	35
3	Education Sciences	19
4	BMC Medical Education	16
5	Heliyon	13
6	International Journal Of Emerging Technologies In Learning	13
7	Plos One	13

Position	Journal name	Number of documents
8	Education And Information Technologies	12
9	International Journal Of Environmental Research And Public Health	12
10	Frontiers In Education	10

Source: Authors after Scopus (2022).

Evaluative results regarding the network of co-authors, co-citations, and co-occurrence of keywords

In this section, the results of the evaluation of the network of co-authors, co-citations, and co-occurrence of keywords are presented. In a network visualization map, the thickness of the lines indicates the strength of the collaboration, the size of the circle indicates the size of the number of items, and the colors indicate the group of collaborations (Van-Eck & Waltman, 2017).

Figure 3 presents the visualization map of the network of international collaborations of countries that have published research in the field of online education in the university environment in the context of pandemic. The lowest number of articles per country was set at 10 articles, out of the 107 countries, 30 reached the threshold. The results show that the collaborating countries were classified into 5 groups: Cluster 1 contains 10 elements (Bangladesh, India, Iran, Italy, Nigeria, Poland, Romania, South Africa, Turkey, United Arab Emirates), Cluster 2 consists of 8 elements (Australia, Ghana, Hong Kong, Indonesia, Malaysia, Philippines, Thailand, Vietnam), Cluster 3 is made up of 6 elements (Canada, Germany, Pakistan, South Korea, United States of America, United Kingdom), Cluster 4 includes 3 elements (Egipt, Jordan, Saudi Arabia), and Cluster 5 is also composed of 3 elements (China, Spain, Taiwan). Saudi Arabia is the most active country in the field of online education in academia in the context of Covid-19 globally, in terms of collaboration. Saudi Arabia has strong ties with China, the United States of America, India and Malaysia. Also, analyses were made to identify collaboration between authors and institutions, but the results indicated the existence of fragile links between the authors Wang, S. and Liu, Y., and between Chitwan Medical College departments that have researched the field of online education in the university environment during the Covid-19 pandemic.

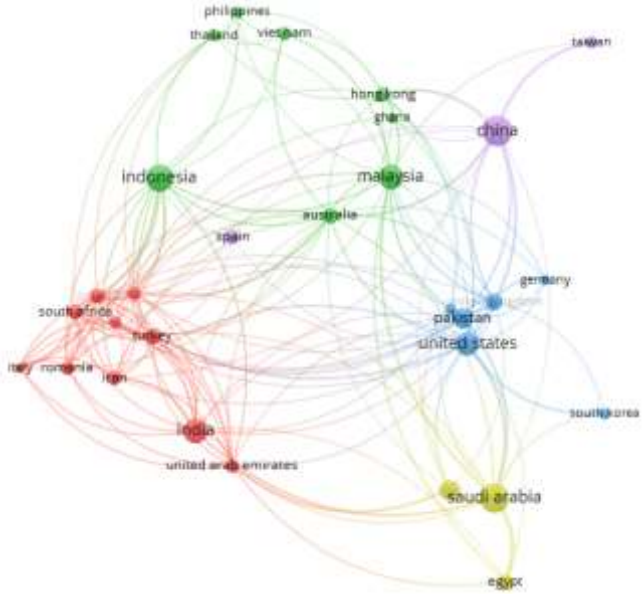


Figure 3. Co-authorship network visualization map for countries

Source: created by authors with VOSviewer (Van-Eck & Waltman, 2019).

The causes of the lack of connection between the authors and the institutions in the network can be attributed to the reduced period established in the process of reviewing the specialized literature, respectively January 1, 2020 - November 1, 2022, which at the time of conducting the study (November 2022), may largely coincide with the period of manifestation of the Covid-19 pandemic, but also with the actuality of this context, that has not yet allowed a close collaboration between the authors and the leading institutions in carrying out and publishing research on the subject of online education in the university environment in the pandemic context, a situation that may undergo major changes in the next period.

Regarding the co-citation of the cited authors, the lowest number of citations per author was set at 70, out of the 46109 authors, 19 authors reached the threshold, thus, Figure 4 shows the authors who meet this criterion.

Co-citation refers to the incidence with which two articles are mentioned simultaneously by other articles, while there is bibliographic coupling (Cunill, Salva´, Gonzalez, & Mulet-Forteza, 2019). Based on total link strength, Hair, J. F. (Professor at University of South Alabama, USA) is the most cited author in the Scopus database, followed by Sarstedt, M., Ringle C. M., Davis, F. D. and Venkatesh V.

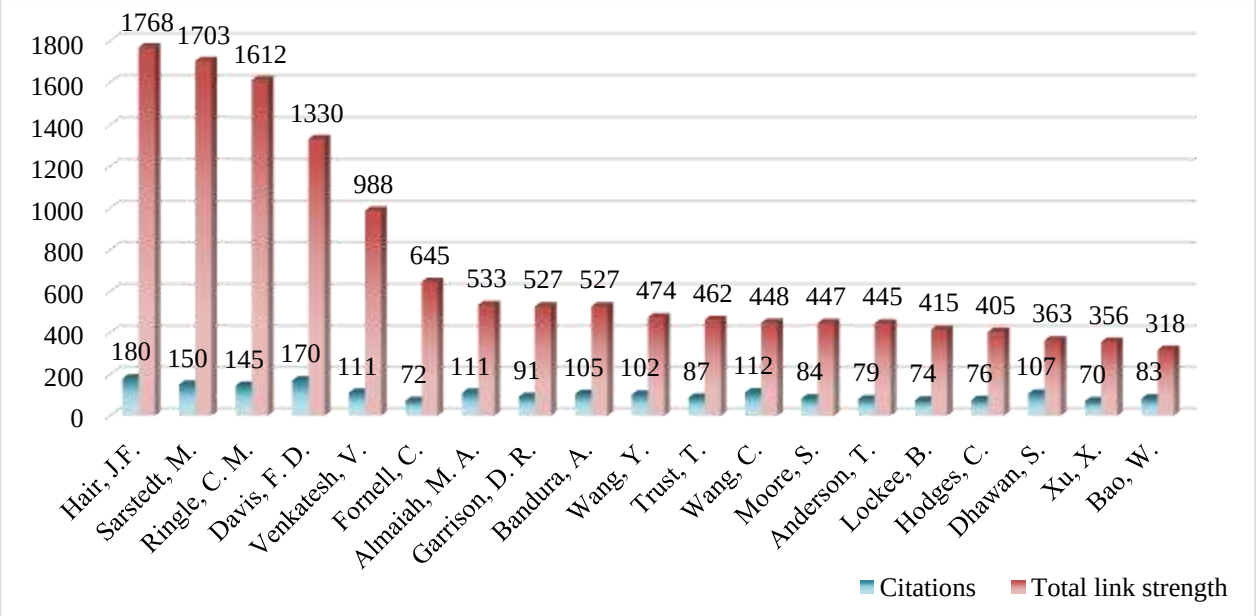


Figure 4. Co-citation of cited authors

Source: created by authors with VOSviewer (Van-Eck & Waltman, 2019).

Related to the co-citation of the references cited by the 780 articles, the lowest number of citations of a cited reference was set at 10 references; of 35770 references, 6 references have reached the threshold and are presented in Table 4. The total link strength attribute indicates the total strength of co-citation links of a given reference with other references. Findings show that the highest co-citation of cited references was held by Fornell, C., Larcker, D. F. (1981), which has 21 citations and total link strength of 15. In this regard, Fornell, C., Larcker, D. F. (1981) had the highest overall link strength in co-citing cited references, followed by Dhawan, S. (2020) and El-Masri, M., Tarhini, A. (2017). In fact, it can be stated that these references are based, in large part, on the subject of e-learning in the university environment during Covid-19, but also on the

importance of information technology and the metodologia of modeling structural equations, which has been used in studies to assess students' perception of different aspects of online education.

Table 4. Co-cited references

Position	Authors	Title	C*	T**
1	Fornell, C., Larcker, D. F. (1981)	Evaluating structural equation models with unobservable variables and measurement error	21	15
2	Dhawan, S. (2020)	Online learning: A panacea in the time of COVID-19 crisis	34	13
3	El-Masri, M., Tarhini, A. (2017)	Factors affecting the adoption of e-learning systems in Qatar and USA: Extending the unified theory of acceptance and use of technology	10	8
4	Davis, F. D. (1989)	Perceived usefulness, perceived ease of use, and user acceptance of information technology	13	7
5	Bao, W. (2020)	Covid-19 and online teaching in higher education: A case study of Peking University	11	6
6	Aristovnik, A., Kerzic, D., Ravselj, D., Tomazevic, N., Umek, L. (2020)	Impacts of the Covid-19 pandemic on life of higher education students: A global perspective	10	5

Source: created by authors with VOSviewer (Van-Eck & Waltman, 2019)
*Citations, ** Total link strength

Figure 4 shows the co-occurrence of keywords on the network visualization map. The lowest number of keywords was set at 40, as a result, out of the total 2316 keywords only 30 reached the threshold. The results show that the co-occurrence keywords were classified into 3 groups: Cluster 1 contains 12 elements (Adult, Article, Coronavirus Disease 2019, Cross-Sectional Study, Female, Human, Internet, Male, Medical Education, Medical Student, Perception, Questionnaire), Cluster 2 consists of 11 elements (Covid-19, Covid-19 Pandemic, E-learning, Higher Education, Learning, Online Education, Online Learning, Online Teaching, Student, Students, Teaching), and Cluster 3 is composed of 7 elements (Education, Education Distance, Epidemiology, Humans, Pandemic, Pandemics, Sars-Cov-2). Moreover, the results show that the strongest link of co-occurrence between keywords is formed between the concepts of “covid-19”, “online learning”, “e-learning” and “students' '.

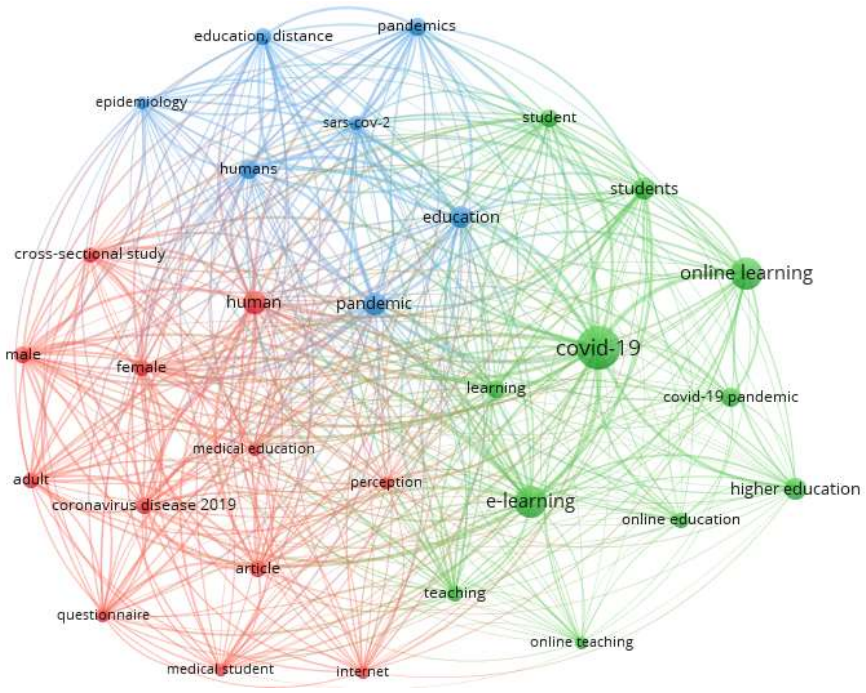


Figure 4. Network visualization map of co-occurrence of keywords

Source: created by authors with VOSviewer (Van-Eck & Waltman, 2019).

Synthesis of concerns regarding online education in the university environment in the context of the Covid-19 pandemic

The new reality, disrupted by the effects of COVID, has involved a radical transformation of education and training, and one of the sectors undergoing digital transformation is global higher education (García-Morales, Garrido-Moreno, & Martín-Rojas, 2021). The precipitation of universities to transfer courses to online has been achieved with varying levels of success, but has ensured continuity in the teaching and learning of students (Seetal, Gunness, & Teeroovengadum, 2021). According to UNESCO, higher education institutions were completely closed in 185 countries in April 2020, affecting more than a billion students worldwide (Marinoni, Van't Land, & Jensen, 2020).

In terms of conducting online teaching and learning, socio-economic factors, such as the study space (noisy and crowded environment) and students' access to equipment (unstable network and device failures), have been identified as key challenges. Students also found it difficult in online learning to consult teachers and receive feedback, as well as the clarity of the course organization (Yeung & Yau, 2022).

In the same sense, teachers should take into account the perspective of students to determine the types of activities that are suitable for the use of webcams in online learning, despite the perceptual gaps between teachers and students regarding the use of webcam, teachers being more positive about the impact of its use on learning. Usually, reflective tasks and oral evaluations were considered suitable for the use of webcams by students (Yeung, Yau, & Lee, 2022).

Also, the teaching staff of the universities have faced several challenges that have caused restrictions in achieving competent teaching and learning. In addition, teachers lacked solid experience in conducting online courses and were not provided with adequate technical assistance or ICT (Information and Communications Technology) infrastructure to meet technical challenges (Akram, Aslam, Saleem, & Parveen, 2021). Research indicated that teachers possessed adequate levels of knowledge of pedagogical technological content. The highest competence was obtained by content knowledge, while technological knowledge was reported at the lowest level. In addition,

a significant difference in gender and teaching experience has been observed (Akram, Yingxiu, Al-Adwan, & Alkhalifah, 2021).

Therefore, providing teachers with the right opportunities to develop technical and infrastructure skills becomes a necessity in integrating technology in the post-pandemic period into higher education.

The pandemic crisis has provided the opportunity for social media applications (e.g. WhatsApp, Facebook, Twitter, or Microsoft Teams) to demonstrate their significant contribution for both higher education institutions, by continuing the learning process, and for students, by achieving positive learning outcomes and performance. Despite the significant positive impact of social media apps on students' academic performance, it does not mean that they can replace conventional learning or are better than traditional, face-to-face learning in the classroom. However, it means that social media apps can help both policymakers and teachers to secure their learning during crises such as the COVID-19 pandemic, especially in the absence of digital learning management systems in many universities in developing countries (Sobaih, Hasanein, & Elshaer, 2022).

The current moment represents an opportunity to examine the benefits of social media applications and determine their relative benefits for education. This aspect is relevant in the context in which the distinction between online and real-world communities is becoming increasingly restricted, especially among younger generations, and especially the perception by students of social media applications as useful and easy to use in the educational process (Sobaih, Palla, & Baquee, 2022). In addition, it is very likely that online learning has changed the learning habits of students. Thus, exploring the impact of online learning during the COVID-19 pandemic on students' attitude and behavioral intention, revealed that push effects (perceived security risk, learning convenience and service quality), pull effects (usefulness, ease of use, teacher's teaching method, task-technology match) and mooring effects (switching cost, habit) significantly influence users' switching intentions from physical courses to online learning platforms (Lin, Jin, & Zhao, 2021).

At the end of this study it is useful to address some limitations that can be eliminated in future research. First, this research was limited to 780 articles published in a reduced period (1 January 2020 - 1 November 2022) and accessed according to the criteria mentioned in the section on research methodology. The articles included in this review were limited to journal publications only. The reason for the exclusive inclusion of publications in journals is to ensure that the results are of high quality and standard, despite the fact that there may be relevant studies published in books, book chapters and conferences. In this regard, other types of documents and different time intervals may be taken into account in future studies. In addition, only the Scopus database was used to search for articles in this study, thus, journal articles not enclosed in the Scopus database were not included. Furthermore, this literature review included only articles published in English. In future research, experts could examine the situation on the basis of papers published in local languages and indexed in the national databases of different countries.

Conclusions

In this study, by using bibliometric analysis, the trends of research on online education in the university environment in the context of Covid-19 were examined and highlighted.The 780 papers used in the bibliometric analysis were extracted from the Scopus scientific database, following the application of some inclusion and exclusion criteria. Although this research is not the first bibliometric study conducted on the topic of online education in the university environment in the pandemic context, it is unique by using different periods and strings of words in the bibliometric search, using the Scopus database.

The analysis of the years has resulted, as expected, a high concern on the part of the academic and research environment to study and disseminate information related to various aspects of online education in the academic environment during the pandemic.

In line with the aim pursued, this research is considered to make three important contributions to the literature. First of all, it presents in a holistic way the structure of the current aspects regarding online education within the institutions of university education in the pandemic context. Secondly, the collaboration of researchers on online education in the academic environment in the context of Covid-19 is revealed. Finally, the results of their analysis and the keywords allowed the identification of the most cited articles and revealed the frequently used keywords. In fact, all these contributions will give a general perspective to their researchers working in this field. Thus, researchers will be able to quickly identify authors, organizations, institutions, journals, references, and keywords of relevant publications. From a practical point of view, this study may be useful to researchers and practitioners interested in assessing the incipient situation of studies on online education in higher education institutions in the context of the pandemic and identifying the different research trends in the context of COVID-19.

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