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The Bibliometric Analysis of Studies on Distance Education

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Abstract

This research determines the trends of academic articles on distance education in the COVID-19 epidemic and provides a roadmap for possible future studies on this topic. In this context, bibliometric and content analysis methods were used. Research data were collected through the Web of Science (WOS) database. As a result of the filtering process on WOS, 767 scientific articles were included in the research. In the data analysis process, the articles were reviewed in terms of the year, country, journal, publication language, citation, co-authorship, co-occurrence, and co-citation. Research results indicate that the articles were published between 2020 and 2021 and generally in English. "Journal of Chemical Education" is the journal with the most publications and the most cited and co-cited journals. The USA draws attention as the country that publishes the most, has the most citations, and cooperates the most. The most cited article was conducted by Chick et al. According to the co-occurrence analysis, it is seen that the terms "COVID-19" and "distance learning" are frequently used by the authors. The findings were discussed within the framework of the literature, and other studies and suggestions were made.

Introduction

The novel coronavirus, SARS-Cov2 (COVID-19), which emerged in December 2019 in the Hubei province of Wuhan city of China, is an infectious disease transmitted by droplets and causes symptoms such as fever, cough, and shortness of breath (Guan et al., 2020; Liu et al., 2020). Although COVID-19 first appeared in China, it has taken the whole world under its influence in a short time with the effect of advanced transportation opportunities. As a result of the high number of cases reported by countries quickly, the World Health Organization declared a worldwide pandemic on March 11, 2020 (WHO, 2020). Hence, countries that wanted to control the increasing cases had to take radical measures such as social isolation, quarantine practices, and travel and education restrictions (Bourouiba, 2020; Hellewell et al., 2020; Zhao, 2020). The COVID-19 pandemic has caused major problems not only in the economy, health, and environment but also in education and training services (Marpa, 2021). Many educational institutions worldwide had to suspend face-to-face education due to restrictions (Zhang et al., 2020). Moreover, institutions without technical infrastructure and equipment, especially in countries with economic problems, ultimately suspended their education activities. April 2020 data shows that schools were closed in 195 countries, and approximately 1.6 billion students were affected by this situation (UNESCO, 2020). In the following days, many countries could not permanently switch to face-to-face education and teaching activities (see Figure 1).

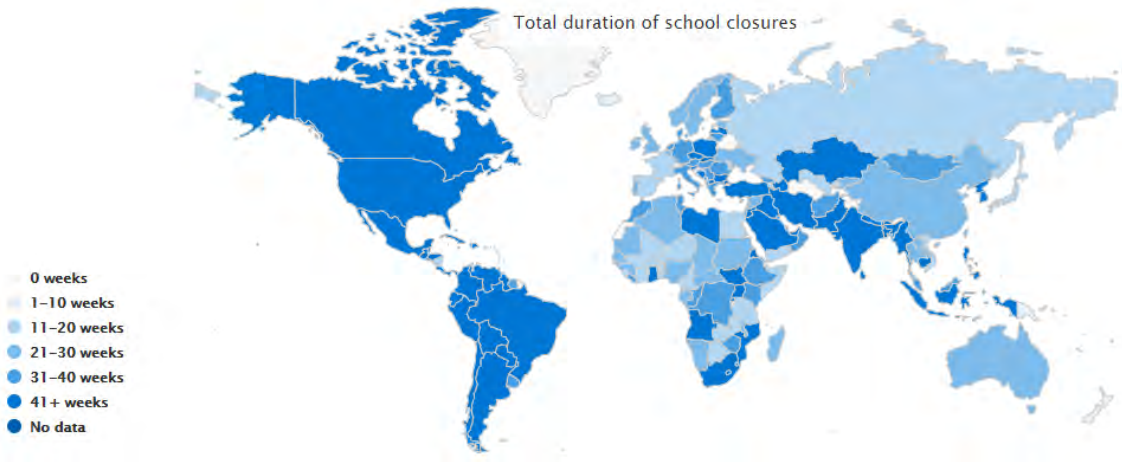

Figure 1. Total Duration of School Closures (UNESCO, 2021)

Figure 1 indicates that many countries had to suspend face-to-face education and teaching activities for 30 weeks or more. Many countries that want to control the pandemic spread preferred an approach based on distance education as their education policy (Ceesay, 2021). Thus, they aimed to keep the increase in cases at a minimum and sustainably continue health services. The fact that educational institutions cannot provide face-to-face education increased the interest in distance education and online learning environments. Additionally, the fact that distance learning can provide continuity in education and teaching activities has made distance education one of the routines of life (Moreno & Gortazar, 2020; Yucesoy-Ozkan et al., 2020). Moore & Kearsley (2011, p. 2) define distance education as:

> *Distance education is teaching and planned learning in which teaching normally occurs in a different place from learning, requiring communication through technologies as well as special institutional organization.*

Simonson et al. (2011) characterize distance education as one of the most critical changes in learning and teaching processes. Marpa (2021), on the other hand, emphasizes that the use of technology in education and teaching activities is of critical importance in terms of meaningful learning, especially during epidemic periods. Distance education applications, which first started with letters, continue with virtual interactive classes parallel with technological developments.

The COVID-19 outbreak has attracted many scientists working on science and social sciences, especially health sciences. This led to an increase in the number of studies on COVID-19 in a short time (Stoye, 2020). The relatively increasing interest in coronaviruses has led to the emergence of a new dataset (COVID-19 Open Research Dataset-CORD-19), presenting scientific articles about COVID-19 and historical coronavirus research (Aristovnik et al., 2020). Besides, it is noteworthy that in this process, special issues for COVID-19 were published by many journals, article review durations were shortened, and online congresses were organized (Fetters & Molina-Azorin, 2020; Palayew et al., 2020). Figure 2 shows the distribution of COVID-19 studies scanned in some databases by months.

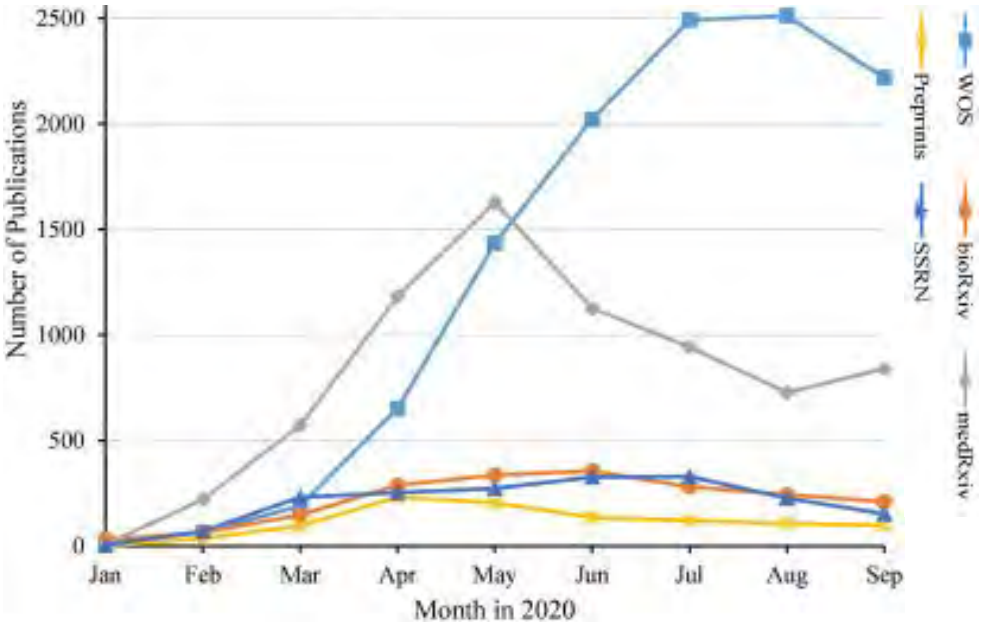

Figure 2. Distribution of COVID-19 Studies by Month (Wang & Tian, 2021)

As a result of the bibliometric study conducted by Wang & Tian (2021), it was revealed that as of October 2020, there were over 12 thousand scientific publications in the WOS database and close to 13 thousand in the bioRxiv, medRxiv, Preprints, and SSRN platforms. It is seen that COVID-19 studies, which were dominant in the field of health at the beginning of the epidemic, were increasing in other academic fields in the following periods (Colavizza et al., 2021).

The impact of the epidemic in education and teaching has led to an increase in academic studies on COVID-19 and distance education in a short time (Ciotti et al., 2019; Kambhampati et al., 2020). A comprehensive examination of these studies and revealing their general tendencies are of great importance in terms of new studies to be designed (Chang et al., 2010). Different methods are used to reflect the research trends, one of which is bibliometric analysis. Researchers widely used this method in almost all disciplines in recent years.

When the literature is reviewed, it is seen that there are bibliometric studies on COVID-19 in different disciplines (health, education, business, and management) (Verma & Gustafsson, 2020; Wang & Tian, 2021; Yavuz et al., 2021). While some researchers discuss COVID-19 from a general perspective (Dehghanbanadaki et al., 2020; Hamidah et al., 2020), the others focus on a specific country or geography (Guleid et al., 2021; Turatto et al., 2021). Although the number of studies in the field of economics (Alshater et al., 2021), business and management (Verma & Gustafsson, 2020), marketing (Öztürk, 2020), and education (Sweileh, 2021) for the epidemic is increasing day by day, studies in the field of health are still well ahead. To this end, this situation is not surprising considering that COVID-19 is a health problem that has affected all countries in the world.

Education is one of the disciplines most affected by the COVID-19 pandemic after the health sector. The literature suggests that there is very limited bibliometric research for education. One of these studies is Yavuz et al. (2021). This study includes methodological trends (method, sample size, data collection tools, and analysis type) and bibliometric analysis (keyword, citation analysis, co-citation analysis, and co-authorship analysis) of

220 studies selected through WOS. Research results indicate that the United States (USA) and China are ahead in terms of the number of publications, the most used keywords are "COVID-19," "online education," and "distance education," the most cited author is "Chen et al." and the most-cited journal was "Sustainability." In another study, distance education research on health sciences education was discussed (Sweileh, 2021). The results of the study conducted over 4576 publications show that keywords such as "flipped classroom," "mobile learning," "blended learning," and "COVID-19" were frequently used. The researcher found out that the countries' contribution in Europe and America to the literature was high. Corell-Almuzara et al. (2021) analyzed the impact of COVID-19 on education and analyzed 940 publications in the WOS directory. The results of the research indicated that the publications were predominantly in English and US-based. Another study was conducted by Karakose and Demirkol (2021), and the data were collected via WOS. The research results presented that the studies focused on "online education" and "teacher training," the countries that contributed the most were the USA, the United Kingdom, Canada, and Spain, and the publications generally had a theoretical model. In the study by Aggarwal et al. (2020), publications on COVID-19 focusing on medical education were discussed superficially.

The literature reflects that the studies concentrating on the bibliometric analysis of distance education publications during the COVID-19 epidemic period were quite limited (Sweileh, 2021; Karakose & Demirkol, 2021; Yavuz et al., 2021). However, a study conducted by Aggarwal et al. (2020) on 3641 articles concluded that research on education is less than 1%. Based on the impact of the COVID-19 epidemic on education, increasing the quality and quantity of the research prepared in this direction is critical in terms of contribution to the literature and future research. In this direction, this study determines the trends of academic articles on distance education in the COVID-19 epidemic and provides a roadmap for possible future studies on this topic. In light of this research purpose, this study seeks answers to the following questions:

1. What is the distribution of articles on distance education in COVID-19 by year?
2. Which countries have the most articles on distance education during COVID-19?
3. What is the distribution of the journals with the highest number of articles on distance education during COVID-19?
4. What is the distribution of the most cited journals on distance education during COVID-19?
5. What is the distribution of articles on distance education by the publication language during COVID-19?
6. What are the most cited articles on distance education during COVID-19?
7. Which countries received the most citations regarding distance education during COVID-19?
8. What is the distribution of keywords used in distance education articles and the relationship between them during COVID-19?
9. What is the co-author relationship network of countries regarding distance education in COVID-19?
10. What is the co-citation network of journals related to distance education in COVID-19?

Method

Research Design

This research determines the bibliometric profiles of academic studies on COVID-19 and educational practices.

In this context, bibliometric and content analysis methods were used.

Bibliometric analysis is a research method with statistical methods to identify qualitative and quantitative changes in a particular scientific research topic, create a general profile of publications on the subject, and determine trends in a discipline (De Bakker et al., 2005). Additionally, "*content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use*" (Krippendorff, 2018, p. 24).

The content analysis method was used to analyze the articles by year, country, journal, and publication language. Within the scope of bibliometric analysis, citation analyses (journal, article, country), co-authorship analyses (countries), co-occurrence analyses (author keywords), and co-citation analyses (journal) techniques were used. The research process was carried out by considering the "Main Stages in a Typical Bibliometric Research" created by Öztürk (2021). The steps related to the research process are shown in Figure 3.

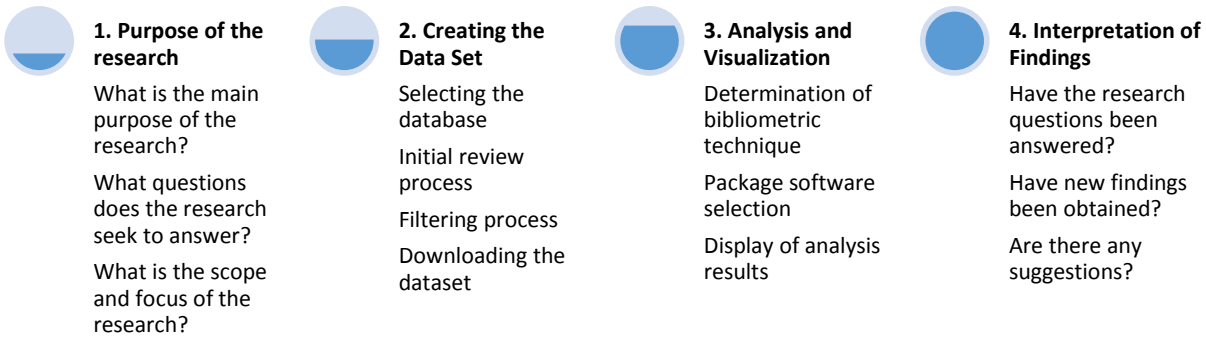

Figure 3. Research Process (Öztürk, 2021)

Data Collection

Within the scope of the research problem, the data were collected through the Web of Science Core Collection (WOS). WOS is one of the world's leading research directories that provides enriched bibliometric data for mapping information in a specific discipline, covering leading authors, institutions, and collaborating countries working in scientific research conducted by Clarivate Analytics (Hossain, 2020; Li et al., 2018). Moreover, there are 74.8 million studies in 254 different disciplines and over 21.100 high-quality journals, as well as conference proceedings and books on WOS (WOS, 2021). It is also among the databases frequently preferred by researchers in bibliometric research.

The data collection process was carried out in 2021 through the detailed search tab on WOS with keywords for research. In this context, the criteria used in the filtering process to obtain the documents are shown in Table 1. When Table 1 is examined, it is seen that the articles in all indexes containing the words COVID-19 and distance education are selected in the education category as the subject of the filtering process. As a result of the filtering process, a total of 767 articles were included in the research.

Table 1. Criteria for Filtering Process

Topic	TS=((“covid-19” **or** “covid19” **or** “covid” **or** “coronavirus” **or** “2019-nCoV”) **and** (“distance education” **or** “distance learning” **or** “e-learning” **or** “elearning” **or** “e learning” **or** “remote education” **or** “remote learning”))
Categories	education educational research **or** education scientific disciplines **or** education special **or** psychology educational
Documents Type	Article
Time Span	All years
Indexes	SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI

Data Analysis

Content analysis and bibliometric analysis methods were used in the analysis of the data in the research. In this context, the most published years, countries and journals, the most used language in the articles, the most cited journals, countries, and articles, the most used keywords, the most collaborating countries, the most co-cited countries were analyzed. VOSviewer 1.6.16 package software was used in the analysis and visualization of the data. Van Eck & Waltman (2013) developed this free software in Java programming language to create and visualize and explore maps based on network data.

VOSviewer can visualize three different types of maps according to the analysis type: (1) Network visualization, (2) Overlay visualization, (3) Density visualization. Analysis with VOSviewer contains circles of different colors, sizes, and distances. As the weight of the item increases, the label and circle size increase. Colors represent the set the item is included in, and they are located close to each other (Van Eck & Waltman, 2013). The distance between two items on the map indicates affinity and relatedness. The line thickness between the items shows the strength of the relationship between the two items (Çevik, 2021; Van Eck & Waltman, 2010, 2014, 2017).

Results and Discussion

Distribution of Articles by Year

The study examined the distribution of the studies published in the WOS database by year. Figure 4 suggests that the articles belong to the years 2020 and 2021, when COVID-19 initially showed its effect. In this context, there were 395 studies in 2020 and 372 studies as of July 2 in 2021. Considering that the COVID-19 epidemic started in December 2019 and the subsequent transition to distance education, this situation can be interpreted as an expected result. Yavuz et al. (2021) examined the articles about distance education during the pandemic and concluded that the studies were mainly published in the last quarter of 2020. Sweileh (2021) stated that publications on distance education in the field of health reached a peak in 2020. This can be considered normal when the article publishing process is taken into consideration (Day, 2000). In addition to the journals that published special issues related to COVID-19, it is seen that article review durations were completed in a shorter

time than usual (Horbach, 2020; Palayew et al., 2020).

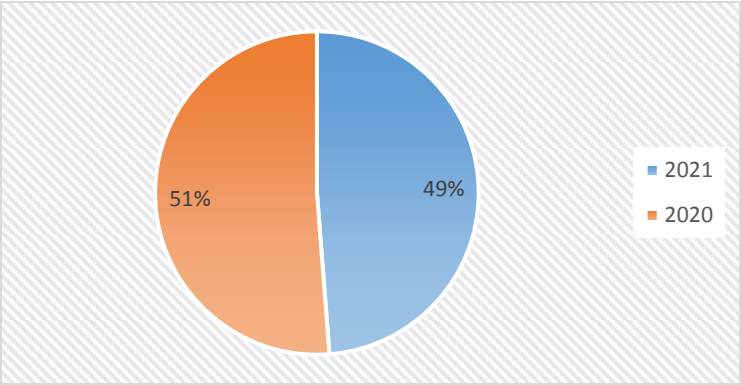

Figure 4. Distribution of Articles by Year

Distribution of Articles by Country

Within the scope of the research, the number of articles by country was examined. This is important for determining the academic productivity of countries during COVID-19. In this context, all countries with at least one publication were included in the analysis. The number of citations for the articles was excluded from the research scope. The result of the analysis is shown in Figure 5.

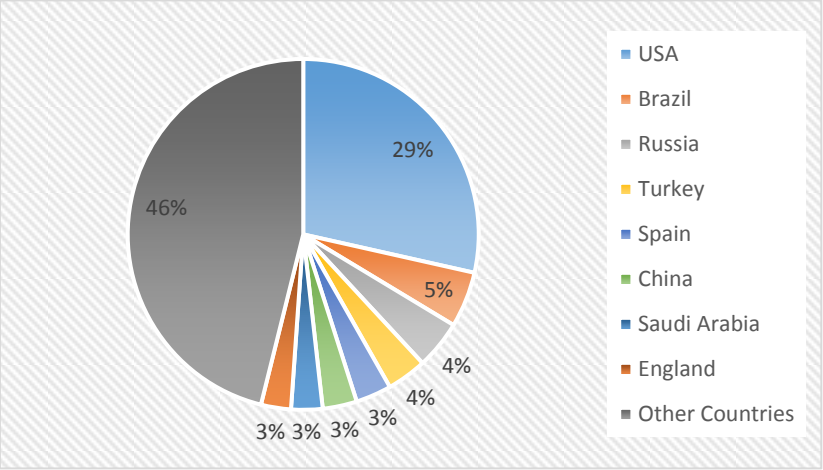

Figure 5. Distribution of Articles by Country

When Figure 4 is examined, it is indicated that the USA alone produces about 30% of all articles in this discipline. It is noteworthy that USA (30%; n=217), Brazil (5%; n=39), Russia (4%; n=34), and Turkey (4%; n=28) are leading in terms of number of publications. When the literature is reviewed, it is suggested that most of the studies on COVID-19 were carried out by the USA (Aristovnik et al., 2020; Dehghanbanadaki et al., 2020; Hossain, 2020; Joshua & Sivaprakasam, 2020; Lou et al., 2020). According to TÜBİTAK ULAKBİM Cahit Arf Information Center (2019) and World Bank (2018) data, when the number of scientific publications in countries was examined, the USA and China were found as the leading countries. Some researchers explained this by the high prevalence of COVID-19 in countries that first experienced the outbreak (Spiteri et al., 2020;

Wells et al., 2020; Zyoud & Al-Jabi, 2020). Dehghanbanadaki et al. (2020) evaluated the distribution of studies on COVID-19 by country with the number of confirmed cases. Accordingly, they concluded that the leading countries in terms of the number of publications were also ahead in terms of the number of cases.

The fact that China lags in this research compared to other studies can be explained by the fact that although China had more publications at the beginning of the epidemic, other countries increased the number later on. However, it is known that China was most affected by the pandemic in the early days, and therefore Chinese resources contributed significantly to COVID-19 research and played an essential role in response to the epidemic. On October 14, 2020, most of the reports submitted to WOS with a rate of 20.7% belong to China, while as of July 2020, the USA overtook China with 21.7% in the number of publications. The WOS July 2021 data show that while the USA had over 48 thousand publications, this figure was around 19 thousand in China. Wang & Tian (2021) presented that the rate of US-based publications on WOS was approaching 40%. It can be said that the USA's better conditions in terms of financing, resources, advanced equipment, and talented researchers also contributed to this situation (Tao et al. 2020).

Number of Articles Related to Journals

Journals are considered in terms of the number of articles they have in line with the research objectives. Evaluation results are shown in Table 2.

Table 2. Top 5 Publishing Journals

Journal	Number of Articles	Total Link Strength
Journal of Chemical Education	130	15
Education Sciences	33	10
Education and Information Technology	28	19
International Journal of Technologies in Higher Education	17	6
Revista Romaneasca pentru Educatie Multidimensionala	16	0

According to Table 2, "Journal of Chemical Education" is by far ahead in terms of the number of publications. It is seen that the journals titled "Education Sciences" and "Education and Information Technology" follow, respectively.

Although the research results have similar results to Corell-Almuzara et al. (2021), it is different from many studies in the literature (Aristovnik et al., 2020; Gupta et al., 2020; Zyoud & Al-Jabi, 2020). This may be related to the scope of the relevant studies. To this end, many bibliometric studies in the literature evaluated COVID-19 from a general point of view. It is significant to note that studies with a good article and citation count were published in prestigious journals (such as JAMA, Nature, and The Lancet) (ElHawary et al., 2020; Gupta et al., 2020; López-López et al. 2020). Nevertheless, studies on more specific disciplines such as education are more limited than the others.

Citation Analysis for Journals

Journals were analyzed in terms of the number of citations. All journals that have articles on the research topic were included in the analysis process. In this direction, "Citation" was chosen as the analysis type, and "Sources" was chosen as the analysis unit. The size of the circles in Figure 5 increases as the number of citations received by the journals increases. Analysis results are shown in Figure 6.

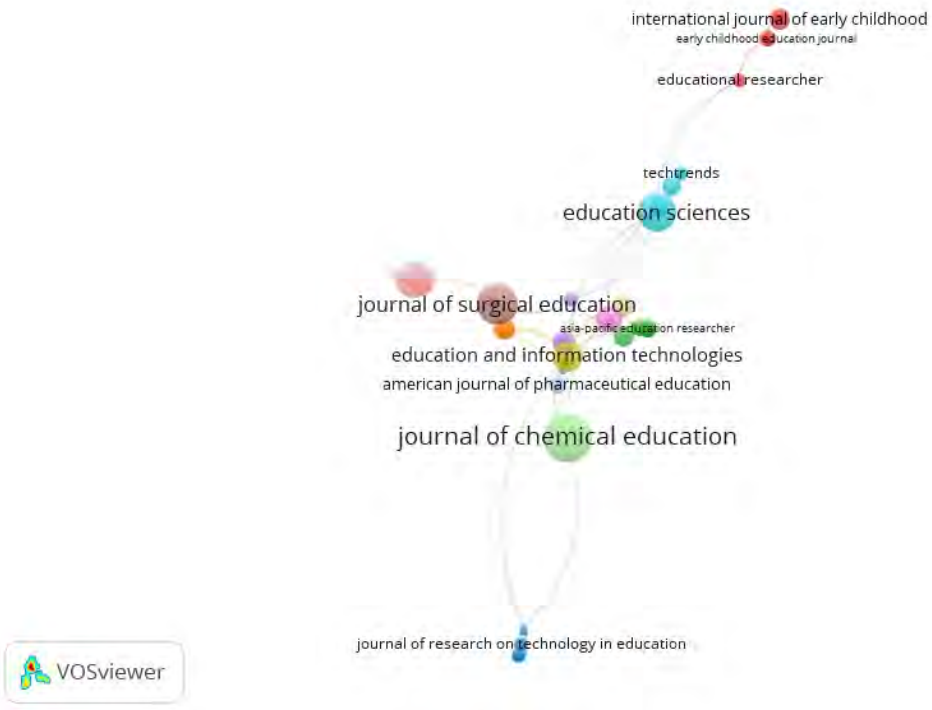

Figure 6. Network Map of Journals Based on Citation Analysis Results

Journals concentrated on thirteen different clusters (Figure 6). The clusters were formed basically according to the subject areas of the journals. It is seen that the clusters are generally formed according to the field of the journal. "Journal of Chemical Education" (n=280), "Journal of Surgical Education" (n=164), "Education Sciences" (n=120), "Anatomical Sciences Education" (n=112), and "Education and Information Technology" (n=58) journals are the most cited journals.

When the journals are considered in terms of the number of articles and citations, it is indicated that the journals in the field of health take the lead. This case can be explained by the increasing interest in the field of health sciences during the pandemic and the production of qualified studies in this field. Hence, Kaya & Erbay (2020) concluded that the research areas of studies in the field of COVID-19 were health-oriented such as "General Internal Medicine," "Infectious Diseases," "Virology," "Public Environmental Occupational Health," and "Microbiology." Aristovnik et al. (2020) determined that studies on the subject area of "Health Sciences" constitute approximately 65% of all studies among 16,866 documents based on the Scopus database. Besides, many studies in the literature concluded similar results (Hamidah et al., 2020; Lou et al., 2020; Zhai et al., 2020).

Distribution of Articles by Publication Language

The distribution of the articles by publication language was examined. It is seen that the articles were written in 13 languages. The five most frequently preferred languages as the publication language in the articles are shown in Figure 7.

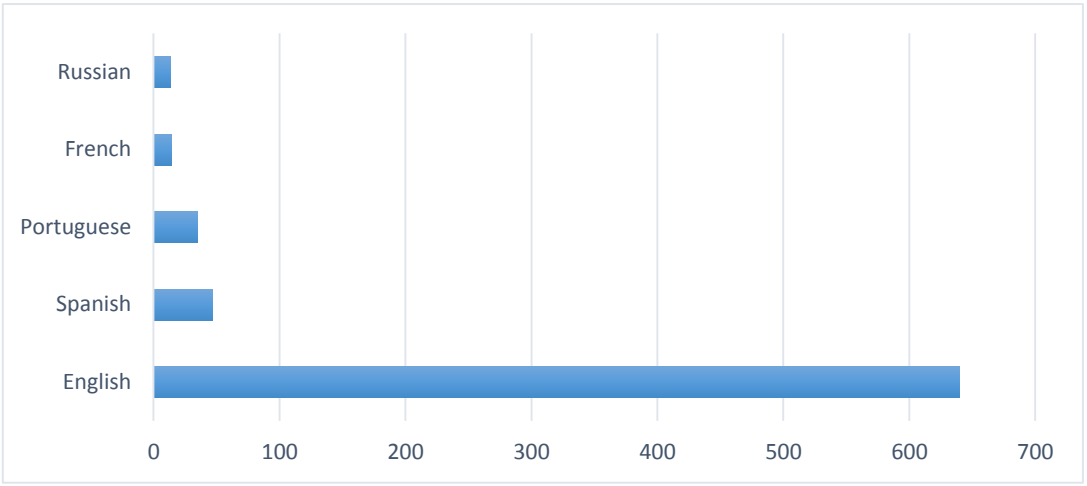

Figure 7. Distribution of Articles by Publication Language

When Figure 7 is examined, it is seen that a result similar to the distribution of the articles by country emerged. The figure reflects that the most frequently used publication languages are English (n=640), Spanish (n=48), Portuguese (n=35), French (n=14), and Russian (n=13). Kambhampati et al. (2020) and Lou et al. (2020) have similar results. However, considering the pandemic days, Chinese articles were approximately 2.5 times more than English articles as of February 2020 (Gong et al., 2020). This may be because the pandemic first heavily affected China. Additionally, the number of studies in English also increased due to the worldwide impact of the pandemic. Hence, researchers may have preferred English for their work to have a widespread impact. From another perspective, it can be regarded as a natural consequence of WOS's focus on the Anglo-Saxon field (Corell-Almuzara et al., 2021).

Citation Analysis for Articles

No conditions were applied in the review made for the most cited articles. Accordingly, "Citation" was chosen as the analysis type, and "Documents" was chosen as the analysis unit. Evaluation results are shown in Table 3. The table shows the article title, author, year, journal, and citation numbers of the top 5 most cited studies in the WOS database. In this context, Chick et al. (2020) have 157 citations, Pather et al. (2020) have 65 citations, and Almaiah et al. (2020) have 48 citations. It is important to underline that the publications were in health education journals such as "Journal of Surgical Education" and "Anatomical Sciences Education." The results of this research are similar to the study by Corell-Almuzara et al. (2021). Although the cited articles constitute an intellectual dynamic, they are accepted as a key indicator of the evolution and trend of knowledge and the field (Bozkurt, 2019). In this context, the citations to the articles on the field of distance education developed a

tendency towards the field of health in this period. It is striking that highly cited articles are published in journals with high impact factors. It is an expected scenario that researchers publish their publications in high-quality and high-impact factor journals (Kiraz & Demir, 2020).

Table 3. The Most Cited Articles

No	Article	Author(s)	Year	Journal	Number of Citations
1	Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic	Chick et al.	2020	Journal of Surgical Education	157
2	Forced Disruption of Anatomy Education in Australia and New Zealand: An Acute Response to the COVID-19 Pandemic	Pather et al.	2020	Anatomical Sciences Education	65
3	Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic	Almaiah et al.	2020	Education and Information Technologies	48
4	Strength, Weakness, Opportunity, Threat (SWOT) Analysis of the Adaptations to Anatomical Education in the United Kingdom and Republic of Ireland in Response to the Covid-19 Pandemic	Longhurst et al.	2020	Anatomical Sciences Education	47
5	U.S. Faculty and Administrators' Experiences and Approaches in the Early Weeks of the COVID-19 Pandemic	Johnson et al.	2020	Online Learning Journal	37

Citation Analysis for Countries

Within the scope of the research, the citation rankings of the countries were examined. In this direction, "Citation" was chosen as the analysis type, and "Country" was chosen as the analysis unit. Countries with at least 1 article and at least 20 citations in the context of COVID-19 and education were included in the analysis process. The minimum cluster size value was set to 2.

As a result of the analysis, countries were distributed into five different clusters (see Figure 8). The most populated cluster is the red cluster, which also includes the USA. USA (n=558) and Spain (n=75) were in the red cluster, Saudi Arabia (n=95) and Jordan (n=74) were in the green cluster, Australia (n=89) and New Zealand (68) were in the blue cluster, England (n=109) and Italy (n=29) were in the yellow cluster, and Ireland (n=48)

and China (n=39) were in the purple cluster. These countries were also leading by the number of citations in their clusters.

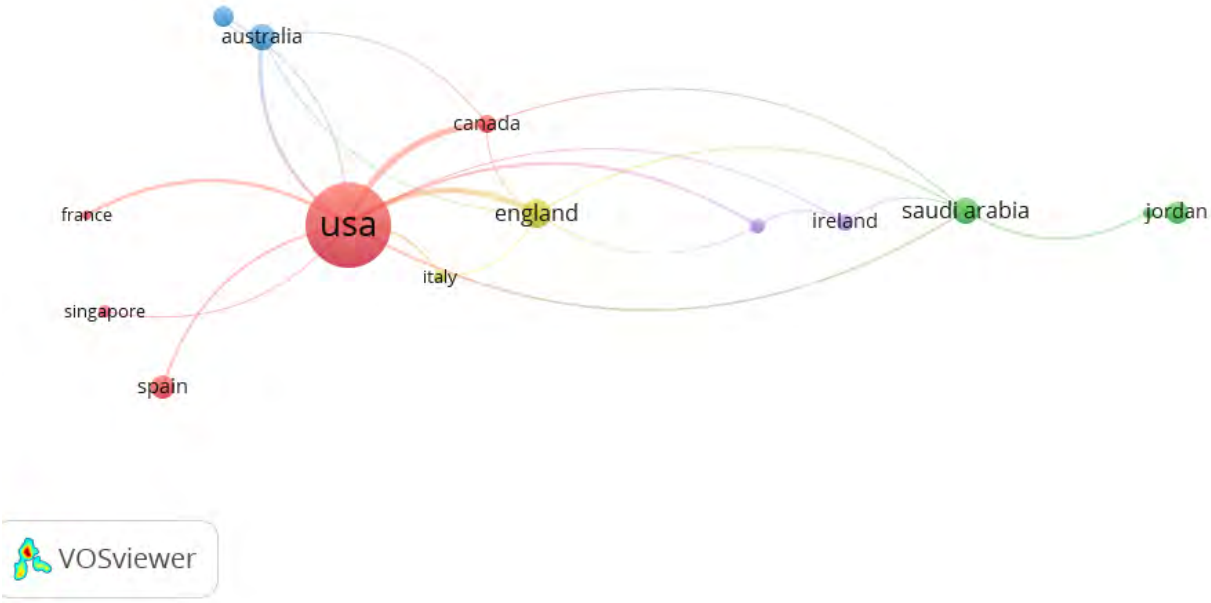

Figure 8. Network Map of Countries Based on Citation Analysis Results

When the countries are reviewed in terms of the number of articles, it is found that the USA (n=217), Spain (n=25), China (n=24), Saudi Arabia (n=22), and England (n=21) are leading. There are studies with similar results in the literature. In this context, ElHawary et al. (2020) and Zhai et al. (2020) revealed in their studies that the USA and China were leaders in this field. Considering that the USA is also the leader in the number of publications, the result is acceptable. Besides, considering that these countries are developed and developing countries, it can be explained to understand preserving and sustaining development in education. Countries with a strong research tradition, such as the USA (Bonilla-Aldana et al., 2020), have a large number of qualified publications in a short time, which may be another factor explaining this result.

Co-occurrence Analysis

In the analysis of the most used keywords within the scope of the research, "Co-occurrence" was chosen as the analysis type, and "Author keywords" was chosen as the unit. Among 1705 terms used in the keywords section of 767 documents obtained from the analysis, 95 keywords were identified repeatedly at least five times. The network structure for the relationships between keywords is shown in Figure 9. The size of the circles in the image represents the frequency of using the keywords, and the color of the circles represents the publication years of the studies in which the keywords were used.

Figure 9 shows the layer visualization results in which the most used keywords are hierarchically categorized based on publication year criteria. The concepts of "COVID-19" and "distance learning" were more preferred in

studies after mid-2020 (areas shown in yellow and green).

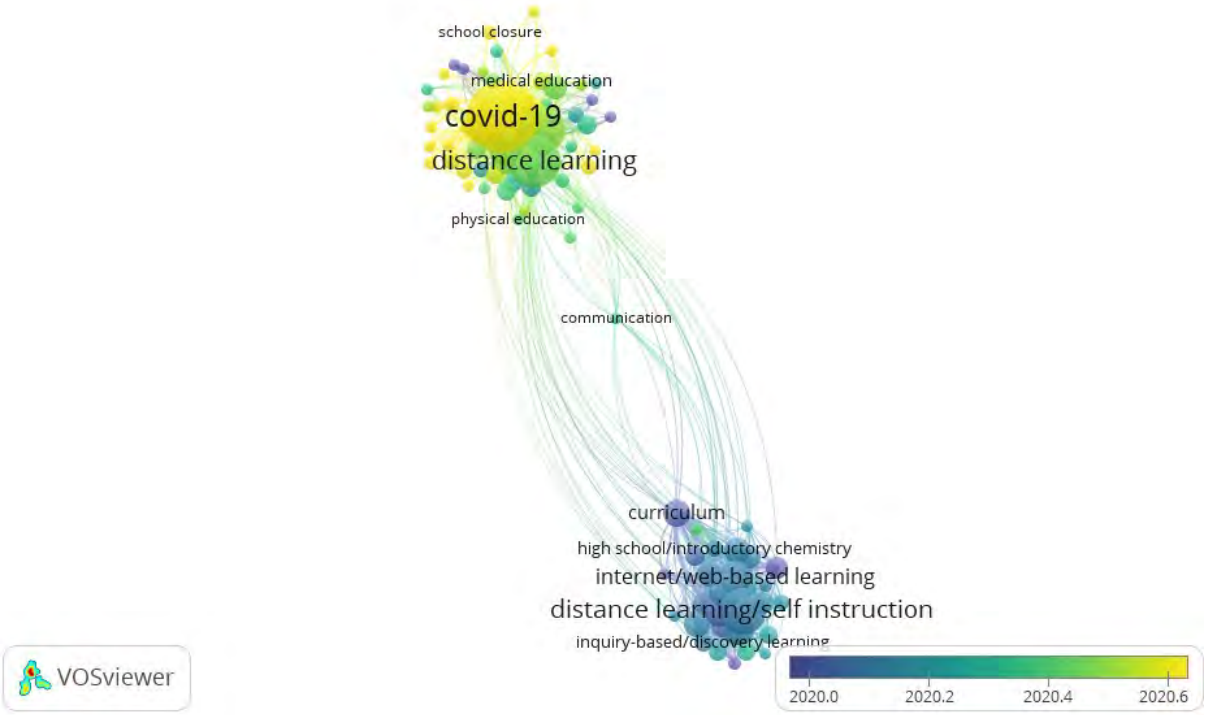

Figure 9. Layer Map of Most Used Terms in Keywords

At the beginning of 2020, terms such as "distance learning" and "internet/web-based learning" were more preferred than the others. The relevant situation can be interpreted as that researchers were searching for how education could be sustained at the beginning of the pandemic. To this end, the trends in this process were concepts such as "internet-based learning," "self-instruction," and "inquiry-based learning." Since education has a significant impact on a country's development (Petrakis & Stamakis, 2002), competitiveness (Lachmann, 1999), and socio-economic development (Sakmurzaeva, 2018), the collected results are acceptable. The findings regarding the keyword analysis within the scope of the research were similar to the keywords in the studies conducted by Yavuz et al. (2021), Karakose & Demirkol (2021), Kaya & Erbay (2020), and Sweileh (2021).

The keywords also suggest that the distribution of distance education based on the internet environment, one of the web technologies, comes to the fore. Besides, due to the nature of distance education, theories that encourage learners to learn autonomously, self-regulated, and self-directed learning form the basis of many types of research. However, it can be interpreted that individual inquiry-based learning (personnel inquiry learning) and community-of-inquiry (COI) continue to constitute a necessary theoretical foundation for distance education.

Cross-Country Co-authorship

Based on the research scope, the authors' co-author relationships over their countries were analyzed. In the

bibliometric analysis carried out in this context, “Co-author” was chosen as the analysis type, and “Countries” was chosen as the analysis unit. All countries with any publications were included in the analysis process. The connection strength of all countries and the total connection strength with other countries were calculated. The size of the circle is proportional to the number of publications of the country, while the color of the circle corresponds to the year of publication. The thickness of the lines is proportional to the frequency of cooperation and the strength of the connection. The countries linked to each other as a result of the co-authorship analysis are shown in Figure 10.

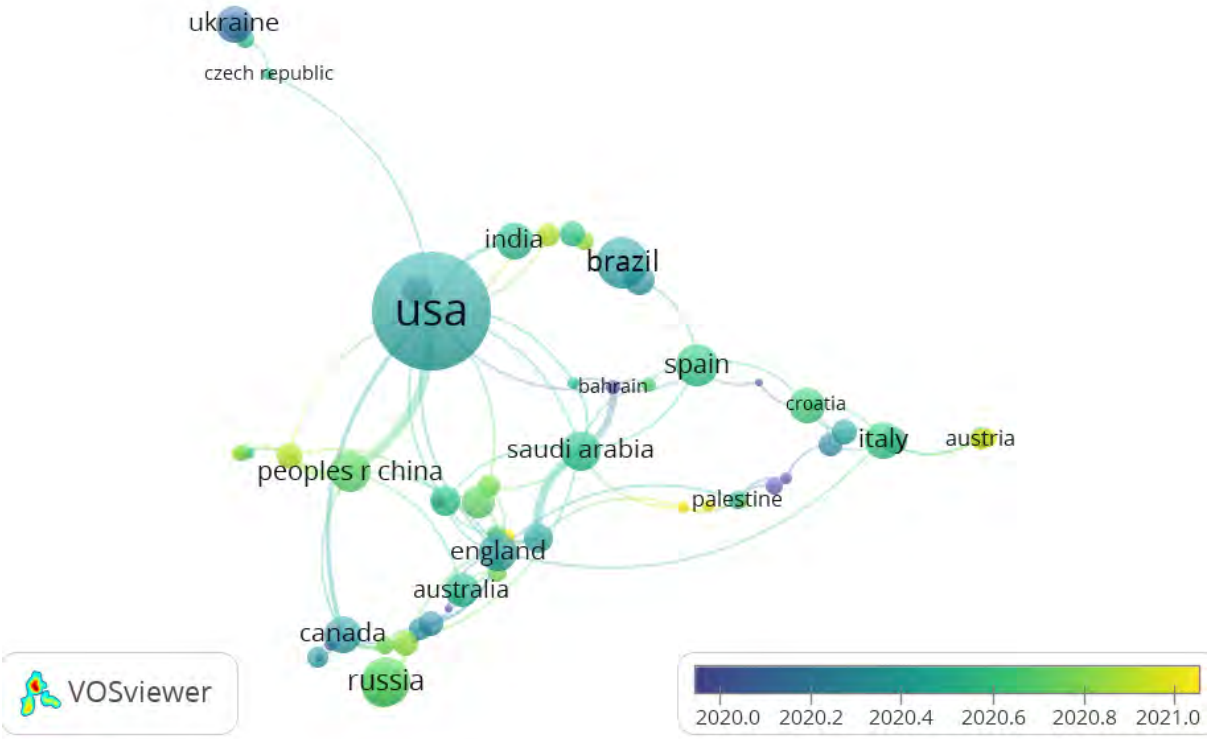

Figure 10. Layer Map for Cross-Country Co-authorship in the Context of Time

As a result of the co-author analysis, the most cooperated countries were found as USA (link: 16), England (link: 12), Canada (link: 8), and China (link: 5). The USA with China, Canada, and India; China with Taiwan, the United Arab Emirates with Canada and Russia; and Saudi Arabia with Jordan and Bahrain has a higher total connection power. The co-authorship periods of the studies were between mid-2020 and 2021 (see Figure 10).

The fact that the USA and England are at the top in terms of co-authorship from different countries may be related to the number of researchers from different ethnic backgrounds in these countries. Additionally, the fact that people who go to these countries as researchers for a certain period cooperate with US and British researchers could be another explanation for the emerging case. The current situation may also be since these countries receive the most brain drain in the world. In this sense, it is known that the number of scientists with doctorate degrees from different ethnic origins has been increasing in the USA since the 70s (Dodani & LaPorte, 2005).

The literature review proposes studies with similar results (Kaya & Erbay, 2020; Zhai et al., 2020). In this context, Karakose and Demirkol (2020) concluded in their study that during the pandemic period, US scientists published their studies with co-authors from more than 30 different countries. Another remarkable finding of this research is the high connection power between the USA and China. In the studies conducted by Gong et al. (2020) and Kaya & Erbay (2020), China was at the center of the map, while the USA took over in this research. This can be explained by the fact that studies on the epidemic process have become USA-centered over time.

Co-Citation Analysis for Journals

Co-citation analysis was performed to reveal the most cited journals. For analysis, "Co-citation" was chosen as the analysis type, and "cited sources" was chosen as the analysis unit. Scientific journals with at least 30 citations were included in the analysis process. The results of the co-citation analysis are shown in Figure 11.

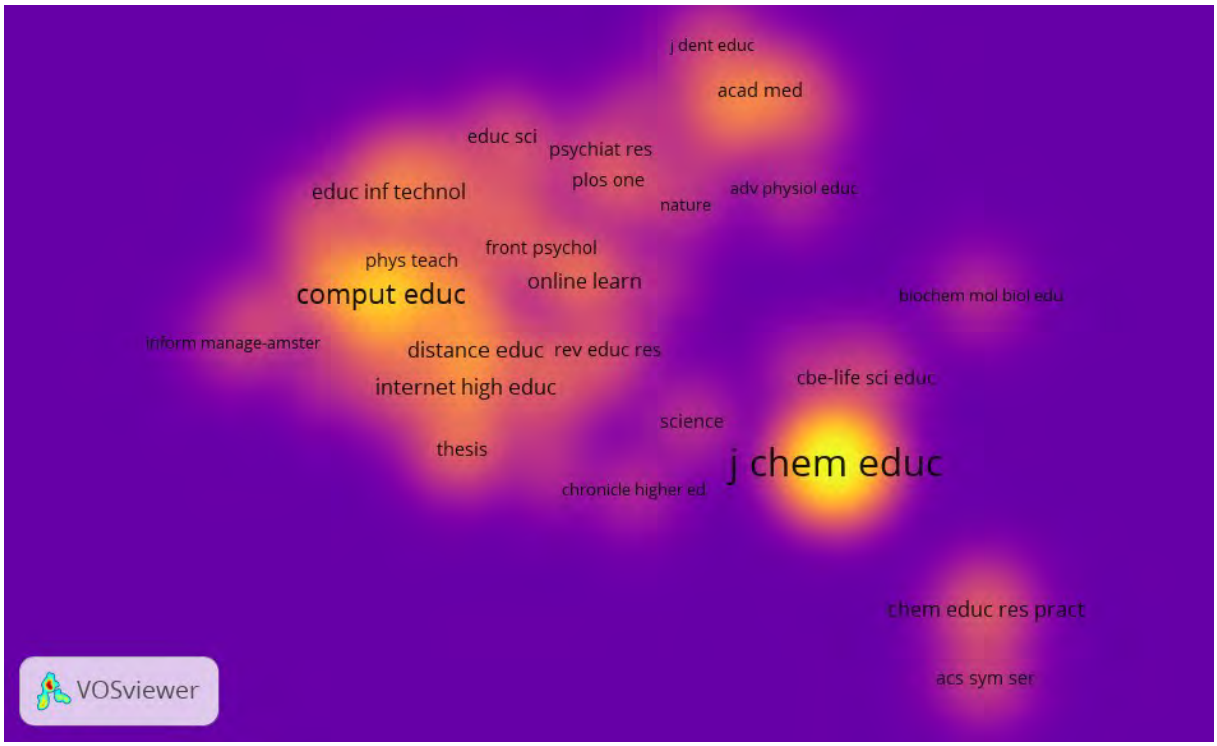

Figure 11. Item Density Map of Journals' Co-citation Analysis Results

The results of the co-citation analysis show that the journals titled "Journal of Chemical Education" (1226 co-citation), "Computer & Education" (432 co-citations), and "Computers in Human Behavior" (175 co-citations) take the lead (Figure 11). The obtained result is similar to the study of Yavuz et al. (2021).

Co-citation analysis of academic journals was frequently used in bibliometric research on COVID-19 (Dehghanbanadaki et al., 2020; Yu et al., 2020; Zhai et al., 2020). However, this result obtained from the research differs from the studies in the literature (Kaya & Erbay, 2020). The journals that make a difference in terms of citation in most of the studies in the literature are world-renowned journals such as "New England Journal of Medicine," "The Lancet," "Journal of the American Medical Association (JAMA)," "Nature," and

"Science" (ElHawary et al., 2020; Gupta et al., 2020; López-López et al. 2020; Nasab, 2020). It is thought that this happened due to the fact that this research was aimed at articles in the field of educational sciences. When the item density map is examined, the journal "Journal of Chemical Education" receives approximately three times more co-citations than the nearest journal. Besides, the journal has a special issue for COVID-19. This finding can be explained by the fact that the relevant journal has many qualified studies on COVID-19.

Conclusions

The following results were collected with this research, which examines the studies on distance education during COVID-19:

- Articles were published between 2020 and 2021, and the number of articles was very close to each other.
- The USA is far ahead of other countries in terms of the number of articles. Approximately 30% of the article studies in this field were conducted by the USA, followed by Brazil, Russia, and Turkey.
- The top three journals with the highest number of articles are "Journal of Chemical Education," "Education Sciences," and "Education and Information Technology."
- Almost all of the articles were written in English, followed by Spanish and Portuguese.
- "Journal of Chemical Education," "Journal of Surgical Education," and "Education Sciences" are among the most cited journals.
- "Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic" by Chick et al. (2020) is the most cited article, followed by the study "Forced Disruption of Anatomy Education in Australia and New Zealand: An Acute Response to the COVID-19 Pandemic" conducted by Pather et al. (2020).
- The most cited countries are the USA, England, Saudi Arabia, and Austria, respectively.
- "COVID-19," "distance learning," "self-instruction," and "internet/web-based learning" are the frequently used keywords by the authors.
- The most cooperating countries are the USA, UK, Canada, and China.
- Journals titled "Journal of Chemical Education," "Computer & Education," and "Computers in Human Behavior" stand out in terms of common citation analysis results.

Suggestions

Suggestions for future research are as follows:

- This research includes only the studies in the WOS database. A more comprehensive review can be done by including other databases.
- Analysis diversity can be further increased.
- Studies on more specific areas can be carried out (such as higher education, high school level).
- Comparative studies can be conducted in the context of countries.
- Only articles were evaluated in this study. Studies that include all academic studies can be done.

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* Top 5 most cited articles.

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