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Distance Learning in Focus: A Bibliometric and Thematic Network Analysis of the Global Research Trends

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Abstract. The COVID-19 pandemic has reshaped the global educational landscape, accelerating the adoption of distance learning and influencing teaching and learning in the post-pandemic context. This bibliometric and thematic network analysis has examined the research landscape of distance learning during the pandemic. Using a predefined search syntax in the Scopus® database, with publication years limited to 2018–2023 and language restricted to English, 14,525 research documents were retrieved for analysis. Bibliometric assessments of research production, temporal and spatial trends, impact, and collaboration were conducted using Excel and VOSViewer. Additionally, SciMAT was employed to visualize thematic density, centrality, and evolution through strategic diagrams, evolution maps, and stability maps. The findings indicate that distance learning research is predominantly conducted in Western nations, with the United States leading in publication output. The most common subject areas include social sciences, computer sciences, and engineering. The study also highlights significant methodological and theoretical interconnectedness, emphasizing the expansion of virtual and flexible learning environments. Furthermore, it underscores the growing role of virtual education, the gendered impact of online learning, and the increasing intersection of educational technology and academic performance. By mapping the conceptual evolution of distance education research, this study provides a strategic foundation for future investigations and policy development to enhance global distance learning frameworks.

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1. Introduction

The COVID-19 pandemic triggered a sudden and unprecedented global shift in education, forcing the closure of schools and universities in over 190 countries and impacting an estimated 1.6 billion learners (UNESCO, 2023). This enabled the introduction of distance learning. Distance learning has emerged as a powerful tool for democratizing access to knowledge and empowering individuals to pursue academic goals irrespective of geographical constraints.

Defined by the physical separation of instructors and learners, distance learning encompasses a diverse range of methodologies, from traditional correspondence courses to contemporary online platforms (Bates, 2019). Clark (2013) indicated that the first use of distance learning in the K-12 context may have been the use of educational film in public schools in New York around 1910. The telephone was used to provide access to instruction for high school students in Long Beach during the Spanish influenza pandemic. Educational radio was used in 1930, later followed by educational television in 1933, until the use of web-based instruction in 1993.

Current learning methods could not work as they should because of the COVID-19 outbreak and teachers faced challenges to determine learning methods that could be applied during the pandemic (Islam, M. S., & Rahman, 2021).
The protection of children and educational institutions is very important. Great care had to be taken to prevent the possible spread of COVID-19 in schools, which is why governments called for education at home. Thus, innovations in distance learning methods were prompted by some educational institutions. Some educational institutions currently have distance learning programs, and provide education with a distance learning system (Sailah, 2011). Distance learning offers flexibility and accessibility. Learners and educators are given a chance to manage their time and study and work at the convenience of their home, synchronously or asynchronously, and not neglect their education while accommodating other demands.

However, training teachers and students to use distance learning effectively is necessary for its optimal benefits (Bautista et al., 2022; Bautista et al., 2021). Providing reviews and literature about distance learning is essential in the post-pandemic world for it allows people to read past experiences, improves accessibility, and enhances the overall quality of education. Relatively, the impact of distance learning has been global and widespread, affecting countries across the spectrum of development and geographical location. The United States of America, Canada, Australia, and European nations actively pursued online learning initiatives even before the pandemic, primarily in higher education. Despite challenges, several developing countries such as India, Brazil, and Kenya displayed remarkable ingenuity and resourcefulness. They adopted mobile learning strategies, utilized radio broadcasts, and leveraged existing community networks to ensure continued learning access (World Bank, 2023).

Given the increasing significance of distance learning in the post-pandemic era, this study aimed to provide a comprehensive overview of the current state of distance learning research during the pandemic by analyzing bibliometric performance and thematic networks. This study is anchored in the globalization of distance education, which is a concept evident in the international collaboration networks and the global response to the pandemic era challenges.

While there is a wealth of literature and research with regard to distance learning, there is no bibliometric and thematic network comprehensive analysis that tracks the evolution of themes covering pre- to post-pandemic. Bibliometric analysis was ideal for this study due to its capacity to systematically and quantitatively evaluate large volumes of scientific literature. Thematic analysis complements the qualitative aspect of distance learning literature, enabling the identification of core themes and their interrelationships. This study aimed to identify the key trends, gaps, and future research directions in this field. Specifically, it sought to answer the following questions:

Questions on Bibliometric Performance

1. What is the production rate of distance learning research?
2. What is the citation rate for distance learning research?
3. In which countries do most research on distance learning originate?
4. What are the top publication venues of distance learning research?
5. Which countries are closely collaborating on distance learning research?

Questions on Thematic Network

1. What specific themes are prevalently studied in distance learning research?
2. How do the sub-themes of each distance learning theme cohesively connect?
3. How do the themes of distance learning connect with each other?
4. How did the distance learning research themes conceptually evolve during the pandemic?

2. Methodology

Bibliometric analysis is used to map the extensive available literature on a particular topic. The technique primarily maps the features and development of scientific production (Bagheri et al., 2023). This study focused on the bibliometric analysis of distance learning in the post-pandemic era and highlighted the production, time, impact, space, and degree of collaboration among various countries.

Moreover, in this study, the bibliometric features and thematic development of distance learning research were investigated. The researchers used the pre-generated search syntax in Scopus® to extract all documents identified in distance learning. This was done using the advanced search functionality of the database. The complete search keywords and syntax used in retrieving the relevant documents were as follows:

> TITLE-ABS-KEY (distance education) OR ({health} OR {comparative study} OR {information and communications technology} OR {coronavirus} OR {online systems} OR {educational institutions} OR {remote laboratories} OR {virtual reality} OR {distance learning} OR {academic achievements} OR {female} OR {risk factors} OR ({educational institutions} AND {remote laboratories}) OR {undergraduate students} AND {motivation} AND {distance learning} OR {MOOC})

The term "virtual reality" was included to capture research exploring the use of immersive technologies in distance learning. This term was vital because it addresses a growing area of innovation in online education, particularly in post-pandemic contexts in which educators are seeking engaging and interactive learning experiences. It allows for the retrieval of research on the development, implementation, and effectiveness of virtual reality in distance learning environments. It is also important to note that the pandemic increased the rate of the usage of virtual reality in education.

The foundation of the search was built upon the fundamental terms "distance education" and "distance learning." These were essential to ensure the retrieval of documents directly addressing the central topic of the study. "Information and communications technology," "online systems," "remote laboratories," and "MOOC" (massive open online course) were incorporated to capture the technological infrastructure and delivery methods associated with distance learning. "Coronavirus" was crucial for filtering results related to the pandemic's impact on distance learning, a primary focus of the study. "Health" and "risk factors" where included to capture the related research that was produced during the pandemic, "educational institutions," "academic achievements," "undergraduate students," and "motivation" were included to capture the educational context and student-related aspects of distance learning. "Female" was included to capture research about gender differences within distance learning. "Comparative study" was included to capture research that compares different distance learning methods.

To refine the search and capture specific intersections of concepts, combined terms such as "educational institutions and remote laboratories" and "undergraduate students and motivation and distance learning" were used. Boolean operators ("or" and "and") were used to construct a flexible and precise search syntax. The search was limited to the "TITLE-ABS-KEY" field to ensure that the keywords appeared in the most relevant parts of the documents.

Scopus is a bibliographic database with the most comprehensive coverage (AlRyalat et al., 2019; Elsevier, 2020; Visser et al., 2021; Zhu & Liu, 2020). It indexes about 44,000 sources, with about 65% in active status. Over the years, Scopus has maintained a reputation for quality, accuracy, and reliability (Harzing & Alakangas, 2016; Zhu & Liu, 2020) making it the best fit repository for the objectives of this study.

Using the pre-generated search syntax, the initial search returned approximately 101,400 relevant records in the database. The data were limited to the year 2018–2023 in order to not to go further from new practices, recent discoveries and theories, and current processes. The initial results were screened using the year (2018–2023) and language (English only) criteria. These two criteria were essential as far as the research problem was concerned. After screening, the results were reduced to 49,781. This was the final sample size that advanced to the formal analysis and visualization. The retrieval was made on February 21, 2024.

While Scopus® is a comprehensive and widely-respected bibliographic database, it is essential to acknowledge its inherent limitations as the sole data source for this bibliometric analysis. Like any database, Scopus® exhibits coverage biases, potentially disproportionately representing certain disciplines, languages, and publication types. Notably, its stronger emphasis on English-language publications and peer-reviewed journals may have resulted in an underrepresentation of research published in other languages or in non-traditional formats, such as conference proceedings, grey literature or books, thus potentially skewing the representation of research from non-English-speaking regions or disciplines reliant on these formats. Furthermore, Scopus® may possess subject area biases, with certain fields more comprehensively indexed than others, which could have impacted the representation of interdisciplinary or emerging research. Citation counts, a key metric in bibliometric analysis, are also susceptible to biases stemming from publication language, journal visibility and self-citation practices, potentially affecting the accurate assessment of research impact. Database updates and indexing lags may have led to the exclusion of recent research.

The results of this study were also dependent on the keywords selected and, if other keywords were missed, research could have been missed. In addition, the limited metadata provided by Scopus® might not have captured all relevant information, potentially restricting the depth of analysis regarding research methodologies or contextual factors. To mitigate these limitations, this study explicitly acknowledged these potential biases. The methodology was designed to be transparent and replicable. Additionally, great care was taken in the keyword selection process. Since this was a collaborative work, the researchers also worked together to ensure that the findings from the analysis were validated among themselves. Future research could further enhance the robustness of findings by triangulating data with other databases, such as Web of Science or Google Scholar, providing a more comprehensive overview of the field.

As previously indicated, the research questions that this study aimed to address were divided into two sets. The first set of questions pertains to bibliometric performance and the other set pertains to thematic structure and dynamics. The bibliometric performance analysis was conducted using the metadata from Scopus® and was visualized using Excel and VOSViewer. The Excel visualization and summary tables provided information on production, time, impact, and space while the VOSViewer provided the visualization of inter-country collaboration calculated based on co-author parameters.

The analysis of thematic structure and dynamics, or thematic mapping and evolution, was conducted using SciMAT, a science mapping analysis tool (Cobo et al., 2012). SciMAT uses a strategic diagram and thematic network. Strategic diagrams were generated to visualize the thematic density and centrality of the corpus, while a thematic network was produced to map the evolution of themes and corresponding subdomains. Centrality measures the degree of interaction of a theme with all other themes in the diagram, whereas density assesses the strength of its thematic network (Callon et al., 1991). Centrality is the measure of importance of a particular theme in the research field, while density denotes the degree of internal cohesiveness of the theme. Simply, centrality measures how strongly a theme connects with other themes, while density measures how strongly the subthemes connect with each other within a theme.

The assessment of the centrality and density of the themes allows their distribution into four groups of themes: motor, basic, specialized, and emerging/declining themes, based on their positions in the strategic diagram (Gutiérrez-Salcedo et al., 2018). Motor themes (upper right quadrant, Q1) are characterized by strong internal cohesion and strong external links across other themes. This could imply that the theme is well-developed and highly important in the research field. Basic themes (lower right quadrant, Q4) are characterized by high centrality and low density. This suggests that the themes are highly connected or transversal or the themes are important in the research field but not well-developed. Specialized themes (upper left quadrant, Q2) are highly developed but isolated themes that connote marginal importance in the research field. The emerging or declining themes (lower left quadrant, Q3) can either connote the beginning of a potentially important theme or expiration of an existing theme. For example, motor themes that move to the lower left quadrant can be construed as the decline of its internal development and its interconnectedness.

The assessment of the centrality and density of the themes across the three periods was distributed into seven groups: surveys and questionnaires, educational institutions, information and communication technologies, MOOC, distance learning, virtual reality, and students. Surveys and questionnaires and educational institution's themes are deemed to have the strongest connection in the research field on distance learning. It implies that research conducted has utilized these themes better but they are not well-navigated. Meanwhile, students and distance learning themes are taken as the most important focus of studies and research but they are studied and explored in separation. The information and communications technologies and the MOOC are also deemed to be of strong connection, yet they are of marginal importance in the research field. Finally, the virtual reality theme can either connote the beginning of a potentially important theme or expiration of an existing theme.

The periodization of this study into three distinct timeframes—pre-pandemic, pandemic, and post-pandemic—was crucial for accurately mapping the thematic evolution of distance learning research. This division allowed for the observation of significant shifts in research focus and trends corresponding to the

unprecedented changes brought about by the COVID-19 pandemic. The pre-pandemic period, encompassing years prior to 2020, served as a baseline, revealing established research themes and practices in distance learning before the widespread adoption of emergency remote teaching. The pandemic period, roughly spanning 2020–2021, saw a surge in research addressing the immediate challenges and adaptations of distance learning during lockdowns and widespread educational disruption. This period's analysis highlighted the rapid evolution of technologies, pedagogical approaches, and research priorities driven by the urgent need for remote education. Finally, the post-pandemic period, including 2022 and beyond, allowed for the examination of sustained changes, emerging trends, and the long-term impact of the pandemic on distance learning research. This time frame facilitated the identification of enduring innovations and the consolidation of new knowledge, providing insights into the future trajectory of distance education in a transformed educational landscape. Therefore, these three periods were selected to provide a clear and nuanced understanding of how global events shaped the research landscape of distance learning.

3. Results and Discussion

The presentation of the results and discussion is divided into two parts based on the two general categories of research questions that this study addressed. The first part addressed the research questions on bibliometric performance and the second part addressed the research questions on thematic networks.

3.1 Bibliometric Performance Analysis

The bibliometric performance analysis examined the production and citation rates per country, publication venue, and collaboration pattern of research on distance learning. This study explored research on distance learning, using data from Scopus®. It examined several factors such as where the research was conducted, countries and journals, what year it was published, and how much impact it had in terms of citations and h-index. To do this, the researchers analyzed metadata and made charts in Excel. A key part of the research was identifying which countries were leading in distance learning, both in terms of how much research they produced and its influence. Table 1 summarizes the 10 most productive countries in this regard.

Table 1: Production and impact metrics of the most productive countries on distance education

No	Country	f	%	C	CPD	CD	%CD	h-index	%GSC
1	United States	2535	29%	24994	10	1826	72%	59	17%
2	Russian Federation	1137	13%	2958	3	579	51%	22	8%
3	China	1027	12%	6928	7	628	61%	38	7%
4	United Kingdom	759	9%	9107	12	573	75%	45	5%
5	Turkey	691	8%	4284	6	537	78%	29	5%
6	Indonesia	622	7%	2541	4	314	50%	21	4%
7	Italy	545	6%	3854	7	383	70%	30	4%
8	Brazil	475	5%	2599	5	306	64%	23	3%
9	Ukraine	446	5%	1615	4	266	60%	18	3%
10	Spain	443	5%	4883	11	336	76%	35	3%

Note: *(f) number of documents; (%) percentage relative to total number of documents; (C) number of citations; (CPD) number of citations per document; (CD) number of cited documents; (%CD) number of cited documents relative to the total number of documents; (h-index) latest h-index recorded in Scopus; (%GCS) percentage relative to the total global number of citations*

Table 1 shows the research on distance learning, revealing that over 70% of research originates from the top five countries, with the United States leading the group at 29% of global production. The United States also boasts the highest h-index at 59 and citations per document (CPD) at 10. The geographical distribution of research suggests that the majority of research comes from the West, indicating that Western countries dominate the field. This implies that Western epistemologies heavily influence the knowledge base of distance learning because of their numerous approaches toward education. As posited by Omodan (2024), the dominance of Western epistemological frameworks has significantly influenced the dissemination and validation of knowledge within academic settings, subsequently marginalizing non-Western, indigenous, and alternative knowledge systems. This finding suggests a further evaluation of current academic practices. In addition, it challenges the universality of accepted knowledge, requiring that researchers should actively incorporate perspectives and methodologies not just from the West, but also those originating from indigenous and non-Western nations as they may also provide valuable data. Notably, the Russian Federation and Ukraine have low CPD at 3 and 4 and h-index at 22 and 18 respectively. Ukraine contributes only 2% of global citations, highlighting a significant gap in academic impact compared to other countries. While this country produces a substantial number of research papers, its impact, as measured by citation metrics, remains low.

The study also analyzed where the most productive countries published their research. Among the ten countries examined, the United Kingdom favors the Open Learning Journal (SJR, Q2). Several other countries, including the United States, Russian Federation, China, Indonesia, Brazil, and Ukraine published in conferences not ranked by Scimago®. Indonesia tends to publish in a low quartile journal. This result implies that, in the field of research, the overall impact of the research published by these countries has not yet been assessed. This is mainly

due to their deficiency in citations and level of relevance to the current trends in research.

Table 2: The major publication venue of studies on distance learning across the most productive countries

Country	Major Source	Publisher	CiteScore	Scimago JR
United States	ACM International Conference Proceeding Series	ACM	1.1	not assigned
Russian Federation	CEUR Workshop Proceedings	CEUR-WS	1.1	not assigned
China	ACM International Conference Proceeding Series	ACM	1.1	not assigned
United Kingdom	Open Learning	Taylor & Francis		Q2
Turkey	Turkish Online Journal of Distance Education	Anadolu Universitesi	3.3	Q2
Indonesia	AIP Conference Proceedings	AIP	0.7	not assigned
Italy	Communications in Computer and Information Science	Springer Nature	1	Q4
Brazil	Proceedings - Frontiers in Education Conference, FIE	IEEE	1.1	Not assigned
Ukraine	CEUR Workshop Proceedings	CEUR-WS	1.1	Not assigned
Spain	Sustainability (Switzerland)	MDPI	5.8	Q1

Examining the trend of the scientific production for 2018–2023, the data were plotted using Excel (Figure 1a). As can be gleaned from the figure, research production in distance learning increased in 2018–2019, and rapidly increased in 2019–2021. However, from 2021, research production decreased until 2023, when the data were retrieved.

Figures 1a and 1b show the document distribution in terms of publication year and subject area.

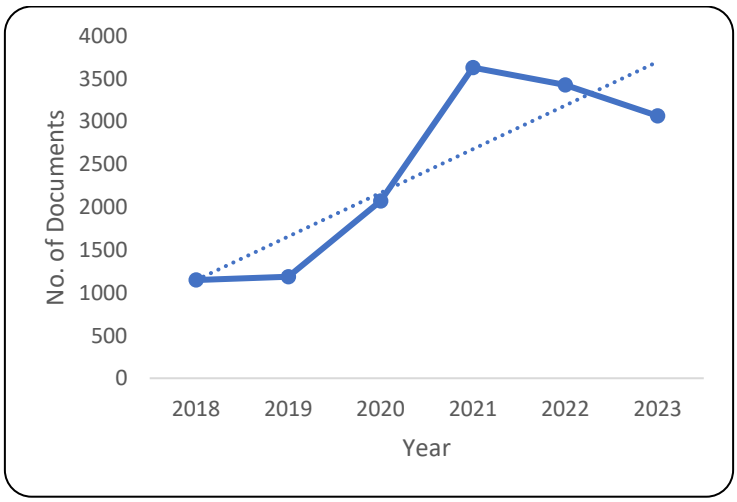

Figure 1a: Yearly production of distance learning research

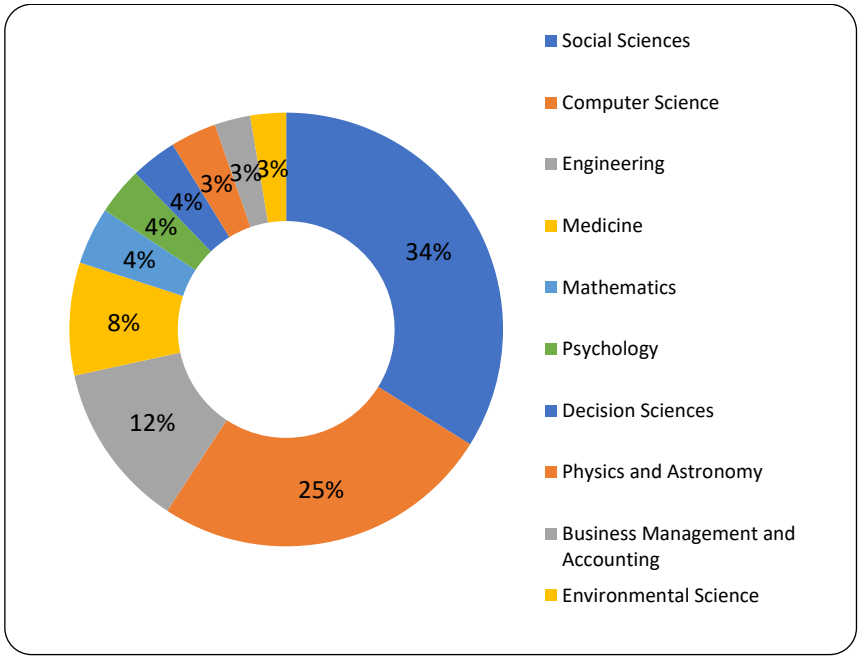

Figure 1b: Distance learning research per subject area

There are several factors as to why research production declined within this period, one of which is the shifting research focus. Researchers are constantly competing for resources and recognition. With this, the availability of funding and support for researchers greatly impacts the researcher productivity. This suggests that there should be a policy to allocate enough funds to researchers who have been actively engaged in research. Additionally, it also suggests that recognition be given to individuals who excel in research across different fields to ensure motivation among them.

In terms of the distribution of relevant papers per subject area, social science is the first on the list (Figure 1b) with 7472 documents, followed by computer science which comprises 25% of the total population. Topics about environmental science,

business management and accounting, and physics and astronomy comprise 3% respectively. Given the underrepresentation of these three areas, it is recommended that future researchers consider exploring and prioritizing interdisciplinary studies on environmental science by examining the impact of distance learning technologies on topics such as environmental sustainability and others. Furthermore, it is also recommended that studies on business management and accounting explore the impact of digital platforms on entrepreneurship and small business development across diverse cultural contexts. Similarly, studies on physics and astronomy should focus on fostering international collaborations to share data and resources for large-scale physics and astronomy projects.

Social science is first on the list based on the data served. Compared to other subject areas, social science research has direct implications for various aspects of society, including public policy, educational programs, urban designs, marketing strategies, and a variety of research methods including qualitative and quantitative analyses, surveys, and data collection.

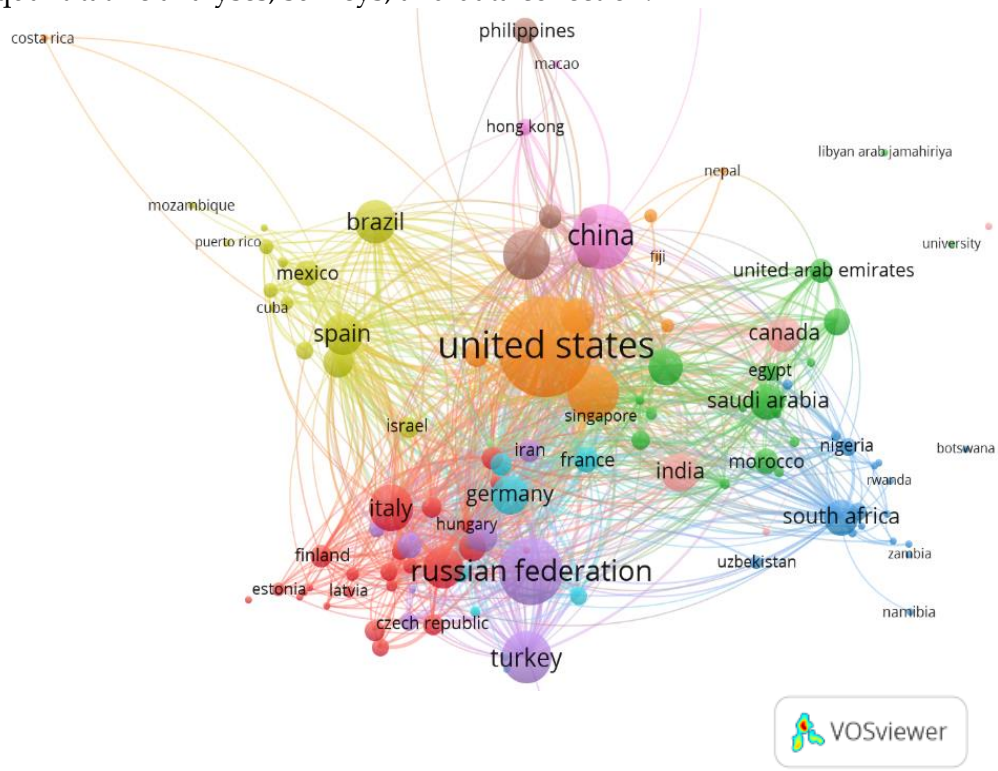

Figure 2: Co-author analysis by country using VOSViewer

The extent of collaboration among countries on distance learning research was presented using VOSViewer (Figure 2). The sphered represents the volume of research production, while the lined represents the degree of association calculated using co-authorship parameters. The color distinguishes each cluster from the other. Figure 2 shows that scientific production on distance learning can be grouped into 11 geographical clusters and shows that the United States is the most preferred collaborating nation among all other countries, as it leads the co-authorship analysis linked with most other countries.

It is noteworthy to mention that, in the study of distance and hybrid learning, countries tend to collaborate with researchers who do not just share a common cultural background but an inter-collaboration among them, such as China, Spain, and South Africa to name a few. It is also notable that India and Canada belong to the same cluster.

3.2 Thematic Network Analysis

The thematic network analysis covers the prevalent themes of distance learning research, internal cohesion of sub-themes, interconnectedness of themes, and the evolution of themes across three periods. SciMat was primarily used to conduct these analyses, particularly using word co-occurrence and simple centers algorithm (Coulter et.al, 1998). The publication year was divided into three periods: the pre-pandemic period (2018–2019), the pandemic period (2020–2021), and the post-pandemic period (2022–2023). Figure 3a shows the thematic evolution across three periods. Figure 3b shows the strategic diagram of the pre-pandemic period. Figure 3c presents the strategic diagram of the pandemic period. Figure 3d shows the strategic diagram of the post-pandemic period. Figure 3e presents the inclusion index across three periods.

The evolution map in Figure 3a shows the dominant research themes on distance learning in pre-pandemic (left column), during the pandemic (middle column), and post-pandemic (right column). The solid line that connects two themes connotes a conceptual nexus while the broken line connotes a component nexus. A conceptual nexus means when different research themes across time periods represent the same fundamental concept or belong to the same conceptual category. Although the terminology may change, the core idea remains consistent. For example, surveys and questionnaires (pre-pandemic) evolved into Health Survey (pandemic) and later into comparative study (post-pandemic), meaning that while the names shifted, they all refer to the same overarching research method. A component nexus describes a hierarchical relationship where one research theme becomes a subset or integral part of a broader theme over time. This means that a later theme does not stand alone but is embedded within a larger research focus. For instance, semi-structured interview became a component of the education program, which in turn was absorbed into surveys and questionnaires. This indicates a layered progression, where each theme builds upon and contributes to a larger research framework.

Figures 3b, 3c, and 3d trace the movement of themes before, during, and after the pandemic periods, showing four general types of thematic development. The first is the movement within Q1 which suggests that the themes remained well-developed and well-connected. This is true in the case of the conceptual nexus SURVEYS AND QUESTIONNAIRES to FEMALE to RISK FACTOR, and SURVEYS AND QUESTIONNAIRES to HEALTH SURVEY to COMPARATIVE STUDY. While these themes may have been named differently in the other periods, they are believed to be conceptually similar.

Figures 3a, 3b, 3c, 3d and 3e show the bibliometric map of themes across the three periods.

Figure 3a: The evolution map of themes from pre-pandemic period (2018–2019) to pandemic period (2020–2021) to post-pandemic period (2022–2023)

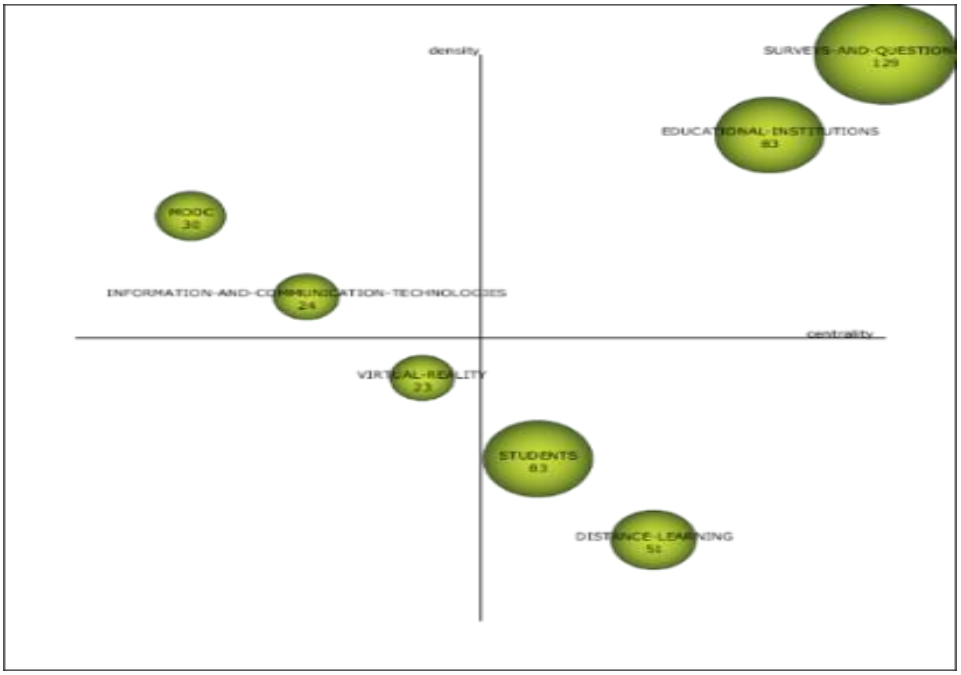

Figure 3b: Strategic diagram for pre-pandemic period (2018–2019)

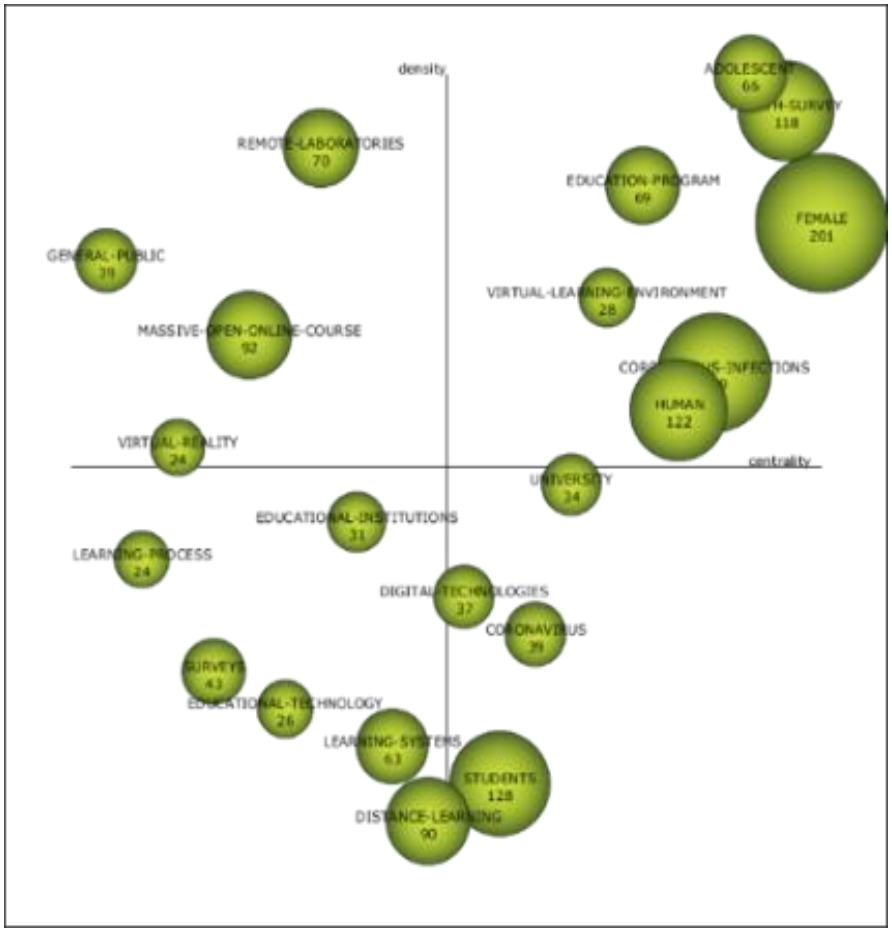

Figure 3c: Strategic diagram for pandemic period (2020–2021)

Figure 3d: Strategic diagram for post-pandemic period (2022–2023)

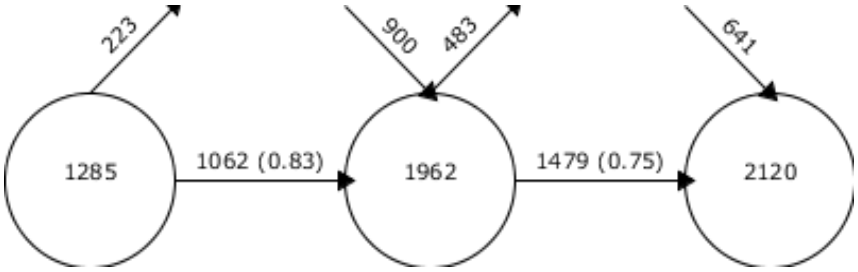

Figure 3e: Stability index across three periods

For example, a closer qualitative examination of the relevant documents would show that the RISK FACTOR as well as FEMALES is conceptually like SURVEYS AND QUESTIONNAIRES. This has been elaborated on in the discussion section. The second type of thematic movement is from Q1 to Q2 which pertains to well-developed themes that become isolated. This result is illustrated in the case of EDUCATIONAL INSTITUTIONS to REMOTE LABORATORIES then LABORATORIES.

The third type is illustrated by EDUCATIONAL INSTITUTIONS to DIGITAL TECHNOLOGY to ONLINE SYSTEMS which moved from Q1 to Q4. This type of movement suggests that EDUCATIONAL INSTITUTIONS remains an important theme in distance learning although research has slowly relaxed internally that its density has significantly reduced. This could partly explain the fact that EDUCATIONAL INSTITUTIONS have conceptually evolved to the ONLINE

SYSTEMS theme. The fourth type of thematic movement is moving within or into Q3. Moving within pertains to new and emerging themes. A new and emerging theme may be part of the component nexus or a new theme that slowly gains attention in distance learning research. The case CORONAVIRUS INFECTIONS is an example of a component theme that gained attention especially during the pandemic.

Figure 3e provides the stability index of thematic evolution. The circles represent the periods and the number of their associated keywords. The arrow connecting the two circles represents the keywords that appear in distance learning research before, during, and after the pandemic. In this case, it can be deduced that research documents before, during, and after the pandemic are highly similar in which about 1062 keywords are shared. This translates to about 83% similarity in research documents between the two periods. The incoming and upcoming arrows represent the keywords that are either forwarded or removed from each period. For example, the 223 keywords in the pre-pandemic period are no longer present in the pandemic period and 483 keywords in the pandemic period that are no longer present in the post-pandemic period. There are also 900 keywords in the pandemic period and 641 keywords in the post-pandemic period that emerged which were not present in the preceding periods.

Based on the bibliometric map of the research themes across three periods, some important conceptual nexuses are noteworthy, evident in Table 3.

Table 3: Conceptual nexus of the research themes on distance learning

Conceptual Nexus	P1	P2	P3	Interpretation
Surveys and Questionnaires Female Risk-factor	Q1	Q1	Q1	H-H-L density
Educational Institutions Remote Laboratories Laboratories	Q1	Q2	Q2	H-H-H centrality
Virtual Reality Virtual Learning Environment Academic Achievement	Q3	Q1	Q1	H-H-H density
Students Students Students	Q4	Q4	Q3	H-L-L centrality
MOOCs Massive-Open-Online-Courses MOOC	Q2	Q2	Q2	L-H-H density

3.3 Impressions

Conceptual Nexus among Surveys and Questionnaires, Female, and Risk Factor

Surveys and questionnaires, females, and risk factors are highly significant research themes among the countries across the three periods. Researchers made use of surveys and questionnaires from 2018–2019 but later focused more on studies about females in 2020–2021, at the height of the pandemic. Maintaining its high significance, it evolved to risk-factor studies in the third period that covers 2022–2023. Feminism is a thematic component of surveys and questionnaires in the second period but gained momentum in the 2022–2023 period, replaced by risk-factor studies. Based on the data, these three themes are conceptually the same.

Regarding distance education, surveys and questionnaires cover the research areas such as human, adult, female, skill, and procedures. At the height of the pandemic, cross-sectional, comparative, and retrospective studies focused more on adults, specifically on female respondents of these studies. Females, as primary caregivers and a significant portion of the teaching workforce, were at the forefront of adapting to distance education. They experienced elevated levels of stress, anxiety and depression, managing family care and work-from-home demands. In addition to this, risk-factor studies during the post-pandemic concentrated on emotion, anxiety disorder, and epidemic since classes are shifting back gradually from the virtual to face-to-face.

Moreover, data collection during the pandemic became more in-depth. This is exemplified by the conceptual shift from surveys and questionnaires to cross-sectional studies which highlighted the health situation of the people despite lockdown. According to Ducanes and Ramos (2023), females who were heads of households or spouses with children faced a higher risk of losing paid jobs during the lockdown. This disparity was more significant for women with two or more children, suggesting that the lockdown worsened the challenges faced by working mothers. Female gender and concern for a university career were significant risk factors for high levels of negative affectivity and low levels of positive affectivity (La Rosa & Commodari, 2023). This is supported by the study of Charbonneau-Gowdy and Galdames (2022), who revealed that the impact on COVID-19 on mental health appeared to be more common in female teachers in their fifth decade of life and with pre-existing psychiatric comorbidities.

In addition, distance learning institutions were well prepared, designing and implementing any new technology-based learning system to justify the investment and minimize failure risk. It can be achieved by systematically assessing the readiness of all stakeholders through surveys and questionnaires (Bakhsh et al., 2018). Distance learning, which has strengthened medical education (Guará et al., 2018), is a feasible mechanism for enhancing nurses' involvement in tobacco dependence treatment and promoting evidence-based clinical practice (Sarna et al., 2018).

It is not surprising that surveys and questionnaires were the most prevalent form of data-gathering in the context of distance learning. Teachers' attitudes towards distance education and digital literacy levels were determined using a survey method. By collecting information through surveys and questionnaires, researchers gather valuable insights into different aspects of distance learning. This enables them to identify areas for improvement and make necessary adjustments, ultimately enhancing the outcomes of education.

The findings from this conceptual nexus address the evolving needs of educators and students. Different educational institutions can implement distance learning systems that are inclusive and adaptive to the present challenges.

Conceptual Nexus among Educational Institutions, Remote Laboratories, and Laboratories

Over time, research in educational institutions and remote laboratories has spanned various periods. Initially, there was a balance between these areas. However, there has been a shift towards focusing solely on remote laboratories, away from educational institutions, leading to a decrease in research that bridges both fields. While studies still examine educational institutions and remote laboratories separately, this shift suggests a growing disconnection between them, resulting in a decline in comprehensive research that integrates these two domains.

In the first period covering 2018–2019, educational institutions included themes that focus on educational and learning environments, as well as information and learning systems. To note that, research about remote laboratories during the second and third period were on themes such as virtual laboratories and websites, embedded systems, and animals. Garcia-Loro et al. (2018) mentioned in their study that those remote laboratories, developed to meet the changing demands of technical education, provided advantages beyond just online learning. Remote laboratories consist of a system of real equipment that can be operated over an internet connection by an offsite end user (Zawko et al., 2018). In the face of new challenges, remote laboratories have become a crucial solution for adapting technical education.

The laboratory is an important component of engineering and applied science education (Jasti, Kota, & P. B., 2021). In response to the abrupt closure of various educational institutions during the pandemic, science and engineering courses, which heavily rely on hands-on labs, shifted to virtual or remote alternatives. While this solution ensured the continuity of education through distance education, especially for students in critical fields such as medicine and engineering, it is not surprising that researchers gradually decreased on these themes. This is evident in the decline of its centrality during the pandemic period.

Conceptual Nexus among Virtual Reality, Virtual Learning Environment, and Academic Achievement

Before the pandemic (2018–2019), research on virtual reality in education was limited. However, the pandemic caused a rapid increase in studies about virtual learning environments as a necessary response to the disrupted education. This is evident in the paradigm shift from the third quadrant to the first quadrant. This shift in focus led to an increased interest in studying the academic performance of students in the post-pandemic period, coinciding with the return to face-to-face learning, increasing its density and centrality.

Virtual reality in distance learning has been used in different ways, such as online systems, virtual labs, and websites but, during the pandemic, the focus moved to virtual learning environments. Research explored communication skills, student attitudes, social connections, and interactions in these virtual learning environments. Moreover, studies on academic success in virtual reality-based learning mostly focused on undergraduate students, especially in medical schools. With the resumption of face-to-face classes, researchers began to assess

the impacts of virtual reality and virtual learning environments on the academic achievement of students. These studies often use the flipped classroom model and examined how different learning styles were affected.

The recent increase in virtual reality adoption has opened up exciting and new opportunities for research and development (Larin & Gunko, 2021). In a study by Romano (2023), Italian teachers state they are interested in learning and integrating virtual reality into their lessons. In the education modality known as distance learning, the virtual learning environment is the main platform that students use to take courses. Therefore, it should be designed to meet users' expectations and needs and to be appropriate, following the innovations in the field of technology and education (De Oliveira et al., 2018; Qayyum & Zawacki-Richter, 2018; Silveira et al., 2023).

Virtual reality is quickly developing and has the power to significantly change how education is delivered remotely. The COVID-19 pandemic caused a growing interest in immersive virtual reality and the metaverse for distance education (Romano et al., 2023). As virtual reality technology improves and becomes more affordable, it is likely to become a key tool for teachers, providing students with immersive, interactive, and captivating learning experiences across various academic disciplines.

From virtual reality to virtual learning environments, the focus shifted to understanding how these tools influenced learning outcomes, the engagement of the students, and the overall academic success of students, particularly in the critical fields such as medicine and engineering. In addition to this, studies started to examine how these innovations enhanced academic outcomes by providing more interactive and realistic simulations, evaluating the academic performance of the students in the fields of medicine and engineering.

Conceptual Nexus of Students

The student is another highly essential research theme across countries. Moving from the lower right quadrant of the strategic diagram to the lower left quadrant suggests that student is a decreasing research field in the Philippines. This means that not only the component theme of student is declining in density but its integration in other research themes is decreasing as well. The shift of students from the lower right quadrant of the strategic diagram to the lower left quadrant suggests a global trend where students as a research theme is losing prominence. This means that fewer studies are being conducted with students as a central theme due to the increasing complexity of educational challenges that go beyond individual student experiences.

It can be noted in the literature that research on students has a highly similar thematic pattern until 2022. This examines research themes such as learning experiences and outcomes, human computer interaction, student interactions, and higher education institutions. The second half of the pandemic showed minimal thematic components, focusing only on teaching methods, surveys, college students, and smartphones.

The pandemic-induced focus on social isolation caused rapid shifts in various aspects of life. Education was particularly affected, with in-person classes hastily transitioning to distance learning, which brought unforeseen difficulties for students and teachers alike (Burgos-Videla et al., 2021; de Almeida Barbosa Franco et al., 2022). According to Figard and Carberry (2022), poor accessibility standards, a lack of administrative support, and numerous other barriers contributed to the ever-present digital equity gap for students with disabilities. The digital equity gap has continued to widen as schools continue to increase the use of virtual or distance learning after the COVID-19 pandemic.

MOOCs as Modern Synergetic Environment

The use of MOOCs is a very important theme in distance learning. The theme is very important in online learning. It is a developed yet isolated one since it kept the same broad title from its second quadrant name across three eras. Moreover, it has preserved inner cohesion and thematic connectedness in the strategic diagram's top left quadrant for all three periods. In the pre-pandemic period, MOOCs were about research on open educational resources, instructional designs, and learning analytics. In the first half of the pandemic, MOOCs shifted to a term that involved studies about learning behavior, learning algorithms, and course content. In the second half of the pandemic era there was much research on MOOCs, instead of case studies, neural networks, as well as many other online courses.

Additionally, clear and accurate communication is crucial for preparing for a pandemic. To combat the spread of misinformation about COVID-19, training individuals to pass on reliable information using effective communication techniques is a key strategy. Various studies have been conducted on the preparation and utilization of MOOCs to provide the public with the knowledge, and skills about vaccine mitigation (Limaye et al., 2023), obstetrics and gynecology clerkship (Feng et al., 2018; Liao et al., 2023), and engineering (Zhao, et al., 2021).

Distance learning and MOOCs, while distinct, are complementary rather than competing. MOOCs are a specific way of providing distance education. However, distance learning covers a broader spectrum of methods for delivering online education. With the continuous development of the MOOC, many learners have joined the online classroom. Distance education has the advantage of being free from time and geographical restrictions (Shearer & Park, 2018). Both MOOCs and distance learning play vital roles in making high-quality education more accessible and in continuously shaping the educational landscape. Thus, a need exists to conduct more studies about MOOCs in enhancing educational systems across countries.

In a broad sense, MOOCs can be seen as one form of distance learning that promotes availability without barriers, adaptable studying, and self-learning about subjects. However, MOOCs may not always serve as substitutes for organized online learning courses where guided learning is facilitated by

qualified tutors with whom learners can interact and are issued certificates upon completion.

Furthermore, MOOCs aim to eliminate boundaries, whether they be that of culture, economics, and geography by providing easy or cost-effective methods of learning. In the aftermath of the COVID-19 pandemic, there have been strides in the use of technological tools, virtual reality, adaptive learning systems, and artificial intelligence in the designing of courses. These course designs have involved MOOCs because they are useful in testing comprehension and other learning tools. Compared to traditional learning models, MOOCs can implement gamification, flipped classrooms, and microlearning strategies on a larger sample space.

4. Conclusion

This study examined research on distance learning using bibliometric and thematic network analyses. By specifically examining publications and citations, this study revealed patterns in distance learning research. Western countries dominate this field, with the United Kingdom and United States being major contributors. Ukraine, however, has a relatively low impact on global research, indicating a gap in influence. Notably, collaborations between countries with different cultural backgrounds are found to be vital in advancing distance learning research.

Distance learning research has shifted. Analyzing publications from before the pandemic (2018–2019), during the pandemic (2020–2021), and after the pandemic (2022–2023) shows a different pattern of research interests. Interestingly, despite the thematic change, the overall research focus remained somewhat consistent across these periods. Educational institutions, along with surveys and questionnaires, continued to be prominent research themes. However, emerging themes such as MOOCs and the impact of coronavirus infections on education are gaining attention. This highlights the growing importance of further exploration in these new areas. While research on students signals a possible gap in addressing fundamental issues related to students' needs, experiences, and outcomes, such findings present valuable insights that can inform the methods and theoretical frameworks to be used in future and ongoing research about distance education.

5. Recommendation

The bibliometric and thematic network analysis of distance learning research provides significant insights into worldwide research trends, leading contributors, and developing themes. These findings should be regarded as a strategic measure for identifying research focal points and deficiencies, which can direct resource distribution, inform policy development, and assist in establishing future academic priorities. Educational institutions, scholars, and governing bodies should cooperatively utilize these findings to create a resilient, diversified, and adaptable educational system that addresses both current disruptions and long-term innovation and equity.

This study emphasizes the necessity of promoting cross-cultural research collaborations, especially with underrepresented nations such as Ukraine, to enhance global perspectives in distant education. As research themes progress—focusing more on MOOCs and pandemic-related challenges—there persists an urgent necessity to investigate student-centered concerns, such as learning outcomes, well-being, and engagement. Subsequent research should embrace inclusive frameworks and varied approaches to encapsulate these intricacies more effectively.

This study is, nonetheless, constrained by its dependence on bibliometric and thematic network analysis data, which may neglect qualitative nuances and emergent, yet under-cited, research. The study is limited to papers indexed in certain databases, potentially omitting pertinent studies published in non-English or regional journals.

6. Declaration

The authors declare no conflict of interest in the conduct and publication of this study.

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