

ORIGINAL ARTICLE

BIBLIOMETRIC ANALYSIS OF BRAZILIAN PRODUCTION ON DISTANCE EDUCATION IN THE WEB OF SCIENCE AND SCOPUS DATABASES (2020-2025)

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ABSTRACT

This study presents a bibliometric analysis of Brazilian scientific production on distance education indexed in the Web of Science (WoS) and Scopus databases between 2020 and 2025. Using network mapping tools (VOSviewer) and descriptive analysis, 1,085 records were examined, corresponding to 1.8% of the initial corpus. The co-occurrence analysis of keywords identified five main thematic clusters: e-learning and learning systems; distance education and COVID-19; teaching and virtual reality; educational technology and collaborative learning; and engineering education. The results show that the COVID-19 pandemic triggered a peak in publications in 2023, followed by stabilization in 2024-2025, with a predominance of studies in higher education. The study also identifies the low presence of Brazilian research in international networks, indicating the need for strategies to expand national scientific visibility.

Keywords: Research in Distance Education; Pandemic; Bibliometrics; Online Education.

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ANÁLISE BIBLIOMÉTRICA DA PRODUÇÃO BRASILEIRA SOBRE EDUCAÇÃO A DISTÂNCIA NAS BASES WEB OF SCIENCE E SCOPUS (2020-2025)

RESUMO

Este estudo apresenta uma análise bibliométrica da produção científica brasileira sobre educação a distância indexada nas bases Web of Science (WoS) e Scopus entre 2020 e 2025. Utilizando ferramentas de mapeamento de redes (VOSviewer) e análise descritiva, foram examinados 1.085 registros, correspondentes a 1,8% do *corpus* inicial. A análise de coocorrência de palavras-chave identificou cinco *clusters* temáticos principais: e-learning e sistemas de aprendizagem; educação a distância e COVID-19; ensino e realidade virtual; tecnologia educacional e aprendizagem colaborativa; e formação em engenharia. Os resultados evidenciam que a pandemia de COVID-19 catalisou um pico de publicações em 2023, seguido por estabilização em 2024-2025, com predominância de estudos no ensino superior. O estudo também identificou baixa presença brasileira em redes internacionais, indicando necessidade de estratégias de ampliação da visibilidade científica nacional.

Palavras-chave: Pesquisa em EAD; Pandemia; Bibliometria; Educação *on-line*.

ANÁLISIS BIBLIOMÉTRICO DE LA PRODUCCIÓN BRASILEÑA SOBRE EDUCACIÓN A DISTANCIA EN LAS BASES DE DATOS WEB OF SCIENCE Y SCOPUS (2020-2025)

RESUMEN

Este estudio presenta un análisis bibliométrico de la producción científica brasileña sobre educación a distancia indexada en las bases de datos Web of Science (WoS) y Scopus entre 2020 y 2025. Mediante herramientas de mapeo de redes (VOSviewer) y análisis descriptivo, se examinaron 1085 registros, correspondientes al 1,8% del *corpus* inicial. El análisis de coocurrencia de palabras clave identificó cinco clústeres temáticos principales: e-learning y sistemas de aprendizaje; educación a distancia y COVID-19; enseñanza y realidad virtual; tecnología educativa y aprendizaje colaborativo; y educación en ingeniería. Los resultados muestran que la pandemia de COVID-19 catalizó un pico de publicaciones en 2023, seguido de una estabilización en 2024-2025, con predominio de estudios en educación superior. El estudio también identifica una baja presencia brasileña en redes internacionales, lo que indica la necesidad de estrategias para aumentar la visibilidad científica nacional.

Palabras clave: Investigación en educación a distancia; Pandemia; Bibliometría; Educación en línea.

1. INTRODUCTION

Scientific production on distance education (DE) is characterized by a substantial volume of new information, concepts, and data. In this sense, bibliometric analysis becomes a valuable tool for systematically and quantitatively analyzing a significant volume of scientific literature, allowing the identification of publication patterns, thematic trends, and the collaboration network among authors and institutions (Aria; Cuccurullo, 2017, Zupic; Čater, 2015, Waltman et al., 2010).

From this perspective, an example is the bibliometric review by Makda (2025), which addresses the evolution of research on digital education and virtual teaching in higher education and analyzed 2,635 publications indexed in the Scopus database between 2012 and 2023. The results indicated accelerated growth in scientific production in this area beginning in 2020, driven by the COVID-19 pandemic and the expansion of digital technologies in higher education. The keyword analysis revealed a shift from the initial focus on virtual learning environments to approaches more closely related to personalized learning, artificial intelligence, educational data analysis, and hybrid teaching models (Makda, 2025).

The concentration of studies on the topic in higher education is also highlighted in other similar bibliometric studies. Zhang et al. (2022) show that more than one thousand publications analyzed between 2020 and 2021 primarily addressed this level of education. Cretu and Ho (2023) emphasize that higher education was the segment that stood out in research on education during the pandemic period.

Other bibliometric analyses focus on broadening the understanding of DE in a specific country, such as the study published by Çivril and Aruğaslan (2024), which analyzed Turkey's production indexed in the Web of Science between 2020 and 2024. By analyzing 1,229 articles, this study showed substantial growth in scientific production during the period, driven mainly by the effects of the COVID-19 pandemic. The authors conclude that Turkish production follows global trends in the expansion of distance education research, consolidating topics related to *online* teaching, digital learning, and post-pandemic educational transformation.

Although international bibliometric studies have identified global trends in DE research and some investigations have analyzed specific topics related to this modality, studies that comprehensively map Brazilian scientific production on DE in leading international databases are still limited. Therefore, little is still understood about how this production is organized, which topics predominate, and which trends characterize the recent national landscape.

In view of this gap and recognizing the importance of expanding such discussions at the national level, this investigation sought to answer the following research question: Which trends, emerging topics, and production patterns characterize Brazilian research on distance education (DE)?

To answer this question, the present study was developed with the objective of analyzing Brazilian scientific production in the field of DE indexed in the Web of Science and Scopus databases from 2020 to 2025. To this end, a bibliometric analysis was conducted, understood as a systematic study carried out in the scientific literature to identify patterns, trends, and impacts in a given field by examining and evaluating large amounts of scientific data (Passas, 2024).

Thus, to meet the proposed objective, the bibliometric analysis conducted in this study was based on co-occurrence networks of keywords and cited terms, using bibliometric research methods (Zupic; Čater, 2015) and network analysis (Waltman et al., 2010; Van Eck; Waltman, 2023). A descriptive analysis of the data provided by the WoS and Scopus databases was then conducted, including the number of publications per year and the most-cited works.

2. CONTEXTUALIZATION AND RESEARCH ON DISTANCE EDUCATION

The historical trajectory of DE is marked by a path of evolution and expansion both nationally and globally. Across different generations, distance education has evolved and has been grounded in an educational model that has transcended spatial and temporal limitations (Moore; Kearsley, 1996). Since the eighteenth century, when distance education still occurred through correspondence exchanges, this modality has undergone a continuous process of transformation, incorporating new technologies, methodologies, and forms of interaction. Today, DE not only expands access to education but also adapts to diverse cultural and social realities, promoting inclusion, accessibility, and flexibility (Mouro de Souza, 2024).

The historical evolution of Distance Education is marked by the expansion of its global reach and the consolidation of this modality in Brazil. It is noteworthy that, over recent decades, the Brazilian regulatory framework has included a series of presidential decrees detailing the organization, provision, evaluation, and supervision of DE in Brazil, such as Decrees No. 2,494/1998, No. 2,561/1998, and No. 5,622/2005. More recently, there is Decree No. 12,456, of May 19, 2025, which establishes the New Distance Education Policy for undergraduate programs at higher education institutions; MEC Ordinance No. 378, of 2025, which regulates Decree No. 12,456/2025 and details the minimum percentages of course hours in in-person, blended, and mediated activities for different fields of knowledge; and MEC Ordinance No. 381/2025, which defines the transition rules for institutions to adapt to the new DE regulatory requirements.

The historical and regulatory evolution of DE in Brazil consolidated foundations that proved strategic during and after the COVID-19 pandemic, when the modality established itself as an essential alternative for ensuring the continuity of educational processes (Soares; Silva, 2020; Rodrigues, 2020). The health crisis drove its large-scale adoption, allowing millions of students to maintain their connection with school through digital resources, in a context in which DE, although already established, took on an emergency character (Silva; Coutinho, 2024; Nariyoshi, 2024).

Thus, in the post-pandemic period, DE came to occupy a prominent role in the Brazilian educational ecosystem, gaining recognition in the reorganization of educational practices due to its flexibility, reach, and possibility of expanded access (Silva; Coutinho, 2024; Honorato; Marcelino, 2020). The modality therefore became consolidated as an inseparable element of contemporary educational discussions (Oliveira et al., 2020).

International bibliometric studies also highlight the growth of scientific production on the topic, with particular relevance for research related to e-learning, educational technologies, remote teaching, virtual reality, learning assessment, and collaborative learning (Aristovnik et al., 2023). In addition, recent analyses point to a transition in the research agenda, initially focused on emergency responses to the pandemic, toward investigations concerning the quality of *online* education, pedagogical innovation, and the sustainability of digital teaching models (Cretu; Ho, 2023; Erdoğan; Tanrıöğen, 2024; Levizze, 2024). Such studies provide important support for understanding the development of DE internationally and reinforce the relevance of investigations such as this one, which expand knowledge of the characteristics, trends, and particularities of Brazilian scientific production in this field.

3. METHODOLOGY

This study employed a bibliometric approach to analyze reviews of the educational literature published between 2020 and 2025. Bibliometric network analysis was conducted, which relies on the inclusion of nodes and colors to group nodes into *clusters*. The approach used in this study combines the mapping and clustering of bibliometric networks, employing the mapping technique through the use of VOSviewer software (Van Eck; Waltman, 2023).

The review was guided by the stages outlined by Zupic and Čater (2015), and the research process involved (1) defining the research objectives and formulating the search expressions; (2) selecting the WoS and Scopus databases as sources for retrieving bibliographic data and information; (3) determining the units of analysis, including keywords, title and abstract terms, and publication trends (temporal distribution of publications, frequency by year); and (4) applying analytical techniques such as co-occurrence network analysis and descriptive statistics.

The Web of Science and Scopus databases were chosen for their extensive multidisciplinary coverage and searches categorized by specialized field. The search was conducted in titles and abstracts using a search *string* that included the following terms in English: “*distance education*” OR “*distance learning*” OR “*online education*” OR “*online learning*” OR “*e-learning*” OR “*virtual learning*” OR “*digital learning*”. Country filters were also applied, selecting Brazil, as well as field filters—“*Education Educational Research*” in WoS and “*Social Sciences*” in Scopus.

4. RESULTS

The initial search in WoS resulted in 112,772 records and the search in Scopus in 230,163 records, resulting in 342,935 records. After applying the filters according to Table 1, 1,085 records were analyzed, corresponding to 1.8% of the total records from the initial search.

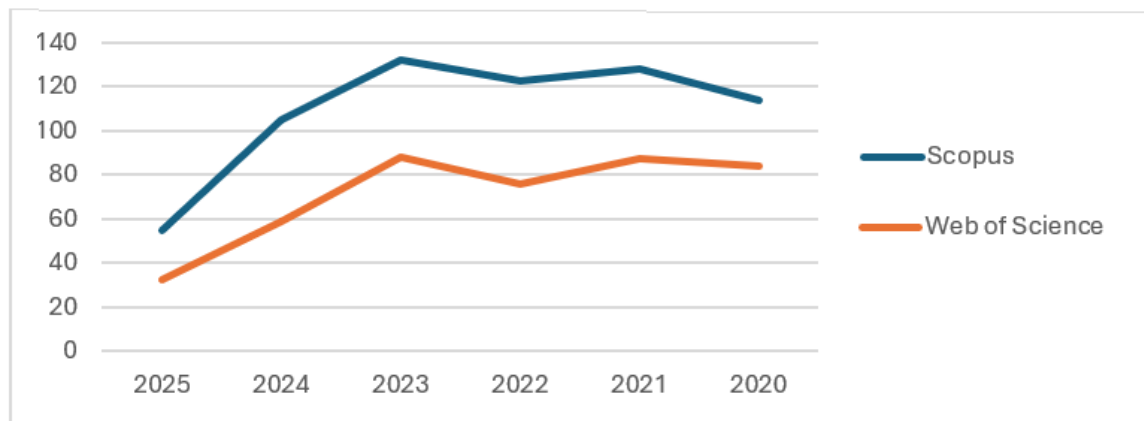
Table 1. Search results by database

		Scopus	WoS	Total	%
	Initial search	230.163	112.772	342.935	100,0
	Year: 2020-2025	116.027	46.861	162.888	47,5
Filters	Field	44.249	16.351	60.600	37,2
	Country: Brazil	657	428	1.085	1,8

Source: prepared by the authors.

The annual analysis of the records obtained from the databases reveals a downward trend in recent years. The analysis indicates that the largest number of publications occurred in 2023, with 132 records in Scopus and 87 in WoS. Because the search was conducted in October 2025, the total number of records for that year is not yet available. However, 2024 has the lowest number of publications, with 105 in Scopus and 59 in WoS, as shown in Chart 1.

Chart 1. Distribution of record frequency by year and database.



Source: prepared by the authors.

The first analysis of the co-occurrence networks was based on keywords extracted from the publications. The keyword co-occurrence network was generated using VOSviewer software (Van Eck; Waltman, 2023). The keywords totaled 3,348 records. For the analysis of keyword co-occurrence in VOSviewer, a minimum of 10 occurrences of a keyword in titles and abstracts was defined, resulting in 54 words. Synonymous terms and singular and plural spellings were controlled by treating them as synonyms through modification of the VOSviewer thesaurus terms file. The network and density of 48 words were then visualized.

A growth trend is observed between 2020 and 2023, peaking in 2023 (219 total records), followed by a decline in 2024 (164 records). This curve reflects the temporal impact of the COVID-19 pandemic on scientific interest in the topic, as will be discussed later.

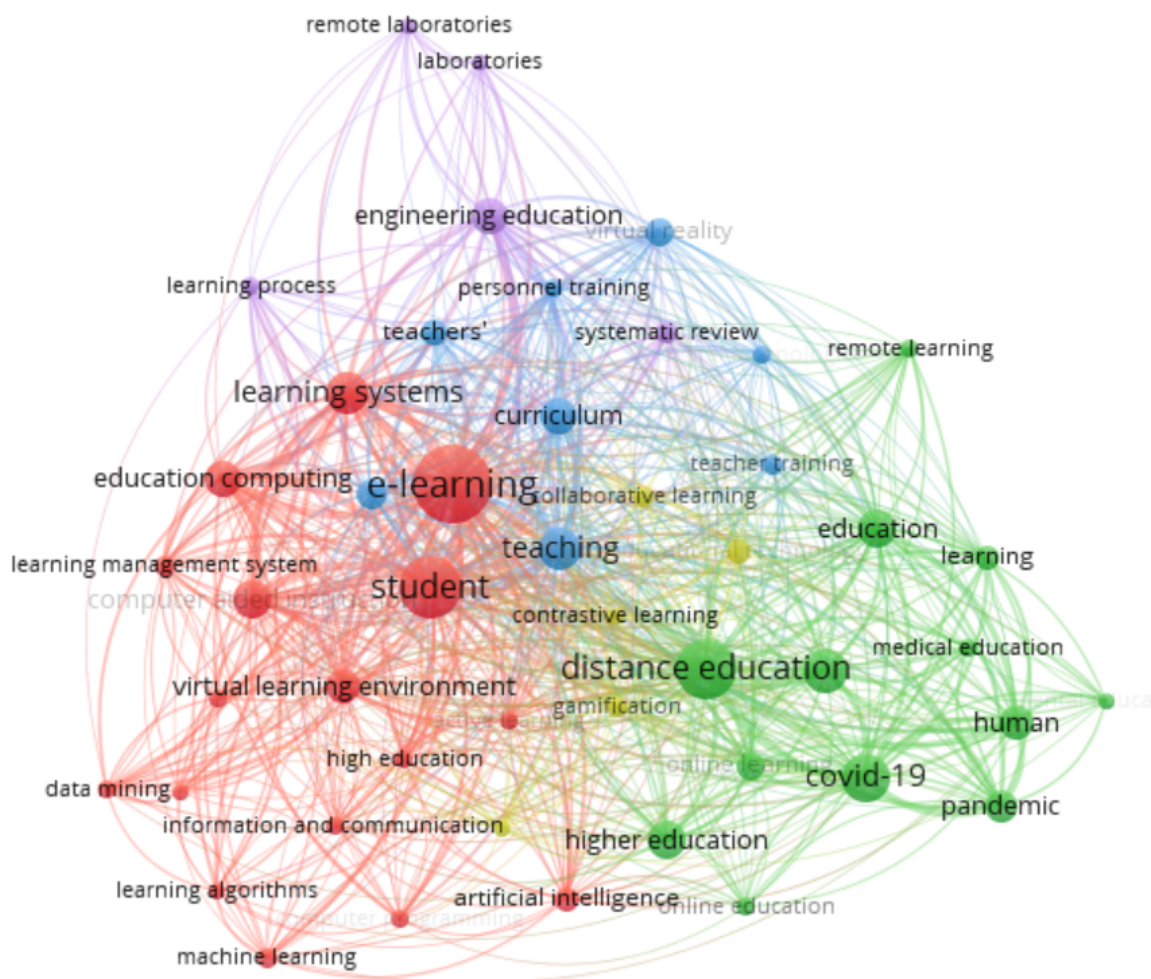
The keyword analysis resulted in 5 *clusters*; that is, the 48 items (keywords) were grouped into *clusters*. In general, a *cluster* is a set of items included in a map (Van Eck; Waltman, 2023). The prominence of an item in the *cluster* takes its weight into account: an item with a greater weight is considered more important than one with a lower weight, and the most important items appear prominently in the network (Van Eck; Waltman, 2023). Thus, in a map visualization, items with greater weight are shown with greater prominence.

Figure 1 shows 5 *clusters* in the keyword network. The first, represented in red (17 items), highlights the centrality of *e-learning* (223 occurrences and 47 *links*); students (140 occurrences and 47 *links*) and *learning system* (67 occurrences and 41 *links*) indicate a strong concentration of studies on systems and learning processes mediated by digital technologies.

The second, green *cluster* (13 items) stands out for the incidence of the terms “distance education” (*distance learning*; 135 occurrences and 46 *links*), “COVID-19” (82 occurrences and 39 *links*), and “higher education” (54 occurrences and 27 *links*). The blue *cluster* (8 items), in turn, prominently features the terms “teaching” (68 occurrences and 45 *links*), “curriculum” (47 occurrences and 43 *links*), and “virtual reality” (29 occurrences and 29 *links*).

In the fourth *cluster*, represented in yellow (5 items), the terms “educational technology” (28 occurrences and 22 *links*) and “collaborative learning” (15 occurrences and 26 *links*) stand out. Finally, the last *cluster*, in lilac (5 items), highlights “*engineering education*” (48 occurrences and 35 *links*), “learning process” (12 occurrences and 23 *links*), and “laboratories” (11 occurrences and 17 *links*).

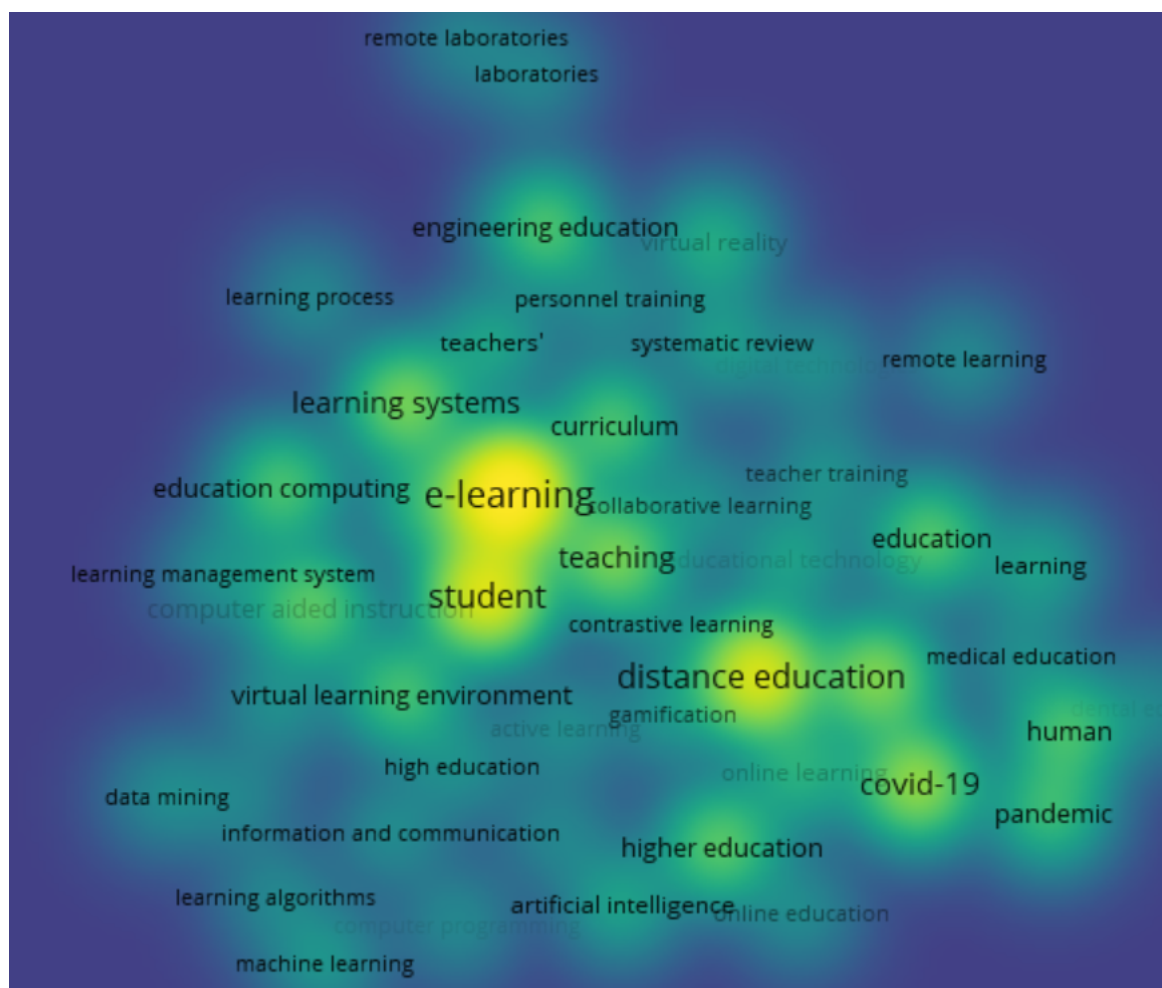
Figure 1. Visualization of the keyword co-occurrence network.



Source: prepared by the authors.

Complementarily, Figure 2 presents the visualization of the keywords by density. The following stand out: *e-learning*, *students*, *distance education*, and COVID-19. Their prominence can be observed through the yellow color and the size of the words.

Figure 2. Keyword density.



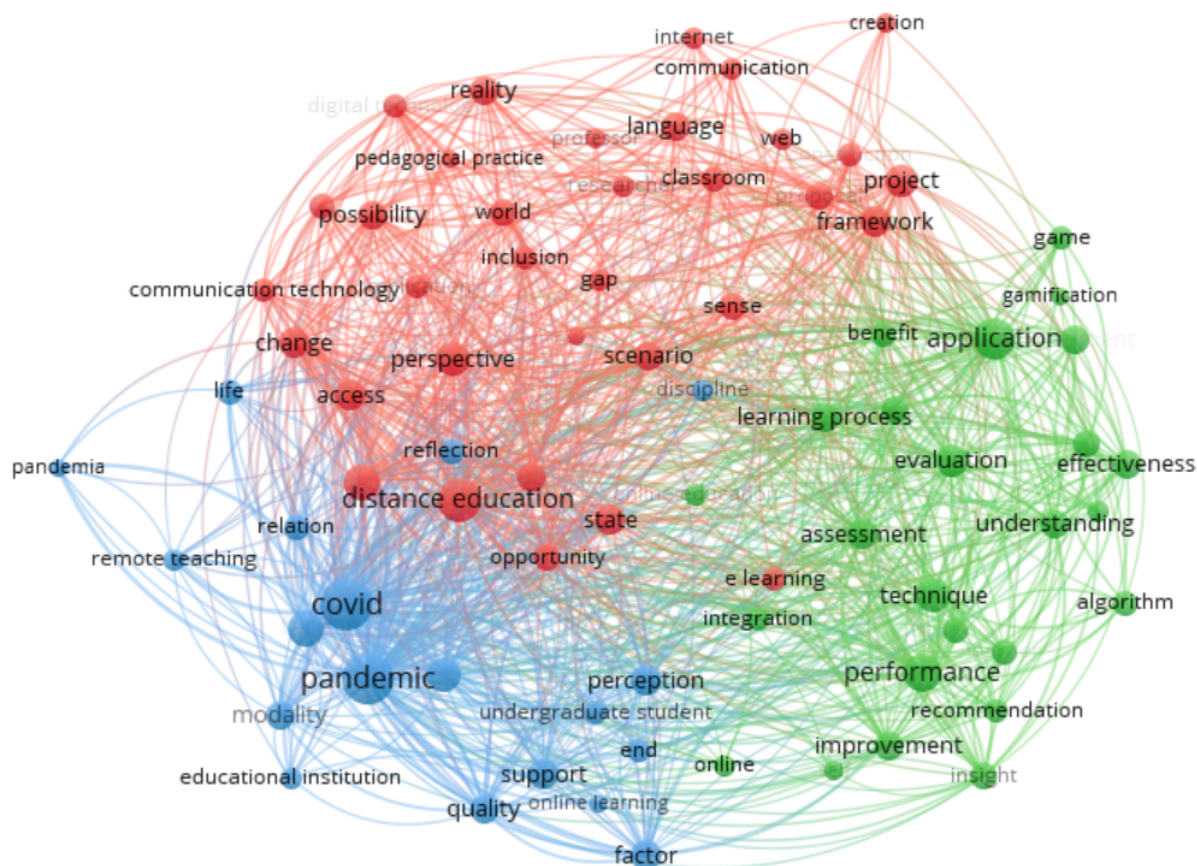
Source: prepared by the authors.

Figure 3 presents the term-occurrence analysis, which was based on the titles and abstracts of the publications and used a minimum occurrence of 30 as the criterion for inclusion in the network. The analytical method used was *binary counting*, in which each item receives only one point per document, regardless of how many times it appears in that document.

VOSviewer recorded a total of 13,702 terms. With the minimum set at 20 occurrences, 193 terms were selected. However, based on the score, 60% of the most relevant terms were adopted as the standard, resulting in the co-occurrence analysis of 116 terms.

The terms were analyzed by the researchers, after which a control procedure was conducted, excluding terms recurring in the abstract that were unrelated to the topic or associated with the methodology, such as *goal*, *interview*, *number*, and *sample*.

Figure 3. Occurrence network of terms in the publications.



Source: prepared by the authors.

Figure 3 shows that the occurrence analysis generated 3 *clusters*. In the first, represented in red, terms such as “distance education,” with 113 occurrences and 76 links; “perspective,” with 76 occurrences and 71 links; “change,” with 60 occurrences and 75 links; *framework*, with 56 occurrences and 76 links; and “higher education,” with 79 occurrences and 74 links, stand out.

In the green *cluster*, words such as “application,” with 101 occurrences and 77 links; “technique,” with 73 occurrences and 74 links; “performance,” with 85 occurrences and 76 links; and “assessment,” with 57 and 71, respectively, stand out. The third, blue *cluster* highlights the terms “pandemic,” with 183 occurrences and 128 links, followed by “COVID,” with 161 occurrences and 77 links. Other prominent terms are “perception,” with 59 occurrences and 76 links; “support,” with 55 occurrences and 77 links; and “quality,” with 54 occurrences and 71 links.

5. DISCUSSION

The analysis of the number of records obtained showed a decline in publications on the topic between 2024 and 2025 compared with the first three years of the period analyzed. This difference suggests a movement toward stabilization after a broad range of scientific studies prompted by the need to respond quickly to the challenges imposed by the abrupt migration to remote teaching formats because of the COVID-19 pandemic.

Other bibliometric studies conducted in recent years reinforce this result. Analyses conducted by Barbosa and Barbosa (2023), Cretu and Ho (2023), and Erdoğan and Tanrıöğen (2024) show that, between 2020 and 2021, there was a concentrated peak in publications related to emergency remote teaching (ERT) and DE in higher education, characterizing a phenomenon typical of exceptional events that rapidly mobilize the academic community. With the gradual return of in-person activities, the urgency decreased, which explains the recent contraction in the number of studies.

In Brazil, this predominance also relates to the historical configuration of DE itself, which, according to legislation (Brasil, 1998; 2005; 2025), became consolidated mainly as a modality intended to offer undergraduate and *lato sensu* graduate programs. Thus, the prominence of higher education in the publications reflects both a global trend and the regulatory and institutional structure that guides distance education in the country.

The database search also indicated a low presence of Brazilian studies on DE in international networks. These findings support the understanding of Morosini and Corte (2018) and Ramos and Mattar (2025) that national scientific production still circulates little globally because of institutional, linguistic, and structural barriers. Several factors contribute to this context. The Qualis system has historically favored highly rated national journals (A1 and A2), which strengthens endogenous production and helps reduce the pressure to submit to international journals. The language barrier also has an influence: even in open or blind reviews, stylistic patterns allow editors and reviewers to perceive the authors' origin, which may produce ideological biases and geopolitical asymmetries. Added to this are instability in funding and the difficulty of ensuring exclusive dedication to research, making competition unequal (Largent; Snodgrass, 2016).

In this sense, strategies such as strengthening interinstitutional partnerships and internationalization actions become essential, as advised by CAPES (2017), which highlights international academic cooperation and bilingual initiatives as central elements for expanding Brazilian participation in global scientific production.

The analysis of the keyword co-occurrence network (Figure 1) reveals five structural axes of production between 2020 and 2025. The green *cluster* confirms the centrality of DE in higher education, bringing together studies that problematize models and challenges consolidated during the pandemic. The blue *cluster*, devoted to virtual reality, indicates the advancement of immersive solutions aimed at engagement and experimentation, while the yellow *cluster* highlights collaborative learning and the use of educational technologies, reinforcing the importance of teacher-support communities and pedagogical sharing in sustaining emergency practices (Ferreira et al., 2023; Wenger-Trayner, 2018). Finally, the lilac *cluster* brings together studies on education and learning processes, completing the thematic set represented in the bibliometric mapping.

These results converge with studies in the international literature, such as Aristovnik et al. (2023), which shows that, during the pandemic, there was intense global scientific collaboration and a strong thematic concentration on *e-learning*, digital technologies, virtual reality, and collaborative strategies—jointly identified in the *clusters* of this study. Similarly, Levidze et al. (2024) show the international predominance of terms such as *e-learning* and educational technologies, as well as the unequal geographic distribution of production, concentrated especially in the United States, China, the United Kingdom, and India. Both studies used methodologies comparable to those adopted here, based on co-occurrence networks, bibliographic coupling, and citation analysis.

The methodological and thematic convergence reinforces the legitimacy of the present mapping, demonstrating that the identified *clusters* relate to global trends (Aristovnik et al., 2023; Levidze et al., 2024). By extending the period analyzed beyond the critical years of COVID-19, this investigation also shows the post-pandemic consolidation of axes such as *e-learning*, educational technology, *online* collaboration, and virtual reality as persistent foundations of the contemporary digital-education agenda.

The term co-occurrence analysis (Figure 3) reveals three thematic groupings (*clusters*) that synthesize the main lines of research on DE in the context of the COVID-19 pandemic. The semantics of the *clusters* and the chronological distribution of the *corpus* (a peak in 2023 and a decline in 2024) make it possible to interpret a conceptual and evolutionary trajectory between 2020 and 2025, in accordance with patterns documented in the national and international literature. The interpretive analysis of each identified *cluster* is presented below.

The first *cluster* (blue) is dominated by *pandemic*, *covid*, *remote teaching*, *support*, *quality*, and *perception*. This configuration clearly reflects the impact of COVID-19 as a catalyst for research on the perceptions of educational *stakeholders* and concerns about the quality of emergency remote teaching. This result reinforces that distance education and emergency remote teaching (DE/ERT) became central to the continuity of educational processes at different levels, which was directly reflected in the volume of and interest in scientific production (Silva; Coutinho, 2024; Aristovnik et al., 2023).

Also in the blue *cluster*, the centrality of “perception” aligns with global research trends that seek to understand the experiences, attitudes, and impressions of students and teachers regarding remote teaching. The presence of “support” and “quality” shows recognition that a successful transition to DE requires not only technological infrastructure but also adequate pedagogical, emotional, and institutional support.

The second *cluster*, identified in green, connects *application*, *learning process*, *assessment*, *performance*, *evaluation*, *technique*, and *gamification*. This configuration demonstrates a central concern with practical aspects of implementation, measurement of results, and learning assessment in virtual environments. The connection between the application of techniques and performance assessment reflects a trend documented in the international literature concerning the need to develop assessment methods appropriate for *online* contexts. *Assessment* in *e-learning* is considered fundamental to the success of *online* training programs, not only to measure student progress but also to improve the quality of the learning experience.

The emphasis on “performance” suggests that Brazilian researchers are investigating the effectiveness of DE in terms of learning outcomes and developed competencies. Comparative studies between in-person and online modalities became particularly relevant in the pandemic context, with varied results depending on course design, the technologies used, and the support available.

The third *cluster*, in red, connects *distance education*, *framework*, *perspective*, *change*, *pedagogical practice*, and *communication technology*. The joint presence of these terms suggests that Brazilian research is focused on understanding the structural and paradigmatic transformations of higher education in the face of the expansion of DE. The emphasis on “perspective” and “change” indicates that researchers are examining not only technical or operational aspects but also philosophical, epistemological, and social dimensions of distance education. The term “framework” suggests a search for theoretical models and conceptual structures to understand and guide DE practices. In the

post-pandemic context, various *frameworks* have been proposed to assess quality, effectiveness, and equity in *online* education, reflecting the maturation of the field.

After the pandemic, it can be inferred that scientific production shifted toward a phase of optimizing and improving practices, aimed at pursuing effectiveness and innovation. Studies such as those by Moresi et al. (2022) and Silva et al. (2022) analyze methodological transformations, the use of digital tools, and pedagogical adjustments that emerged as institutions and teachers began to reflect on quality, engagement, and learning assessment. This stage coincides with the technical and institutional maturation of the field, in which DE ceases to be merely a contingent response and comes to be perceived as an opportunity to modernize education.

Finally, beginning in 2023, a phase of consolidation and critical reflection can be observed, in which the discussion expands to structural aspects, institutional policies, and the development of sustainable pedagogical models. Articles such as those by Mateus et al. (2025) and Cruz and Ecar (2024) address the legacy of the pandemic for higher education, arguing that the experience of remote teaching catalyzed permanent transformations in the ways of teaching and learning. This literature highlights the need for continued investment in infrastructure, teacher education, and the integration of digital technologies into in-person curricula, consolidating DE as a strategic dimension of Brazilian educational policies.

Thus, these studies support the temporal interpretation inferred in this work: a movement of reaction, followed by improvement and, finally, a process of consolidation, which reflects both the publication curve and the conceptual maturation of the field. This progression demonstrates that the academic debate on DE evolved from emergency responses to structural reflections on innovation, inclusion, and pedagogical sustainability.

6. FINAL CONSIDERATIONS

This bibliometric analysis of Brazilian scientific production on distance education in the Web of Science and Scopus databases (2020-2025) revealed significant patterns that reflect both the impact of the COVID-19 pandemic and the consolidation of DE in the national educational landscape. The identification of five main thematic *clusters* demonstrates the diversity and maturity of the field, with an emphasis on *e-learning*, educational technologies, assessment methodologies, and professional education.

The peak in publications in 2023, followed by stabilization in 2024-2025, confirms that the pandemic acted as a catalyst for scientific investigations, generating intensive production focused on perceptions, quality, and institutional adaptation. The predominance of studies in higher education relates to the historical and regulatory structure of DE in Brazil, consolidated primarily at this level of education.

The low presence of Brazilian production in international networks, as identified, points to an urgent need for internationalization strategies, including interinstitutional partnerships, bilingual publications, and greater inclusion in high-impact journals. Such actions are fundamental to expanding the visibility and recognition of national research on the global stage.

As a limitation, it should be noted that the study focused on only two databases, although they are the most internationally representative. Future studies could broaden the scope to other

databases (ERIC, LILACS) and conduct longitudinal analyses that follow the post-pandemic evolution of scientific production on DE.

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