Exploring E-Learning and Inclusion: A Bibliometric Analysis of Research Trends

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Abstract: In the context of the recent global transition to digital education, inclusion in e-learning has emerged as a topic of growing significance. This study conducts a bibliometric analysis of 731 publications retrieved from the Web of Science database, aiming to uncover prevailing research trends, thematic frameworks, and collaborative networks that have emerged around the intersection of e-learning and inclusion. The keyword analysis, conducted using VOSviewer software, revealed that 'e-learning' occupies a central position in the literature, exhibiting strong associations with related themes such as online learning, blended learning, higher education, and gamification. Notably, the concept of 'inclusion' demonstrated significant connections with terms such as accessibility, digital divide, diversity, and artificial intelligence, indicating a multidimensional approach to inclusion within technology-enhanced learning environments. These findings underscore that inclusion in such contexts is not a singular notion but a complex, multifaceted construct. Its strong associations with the aforementioned themes suggest that truly inclusive e-learning environments must address a broad spectrum of social, technological, and pedagogical dimensions. Moreover, temporal visualization illustrated a marked increase in scholarly attention to topics like COVID-19, mental health, and social inclusion in the post-2020 period, highlighting the pandemic's influence on educational research trends. Publication and citation analyses revealed a significant rise in scientific output and impact beginning in 2018, with a peak observed in 2022. Country-level collaboration maps identified the United States, Spain, Germany, and China as central contributors, while institutional analyses highlighted universities such as the University of British Columbia and the University of Melbourne as leading entities in the field. These findings underscore the necessity of designing e-learning environments that are not only technologically sophisticated but also socially inclusive. In the current landscape of digital education, increasing attention is being directed toward themes such as e-inclusion, web accessibility, and equity in education. This study contributes to the understanding of inclusive practices in e-learning and provides valuable insights for researchers, educators, and policymakers.

Keywords: E-learning, Inclusion, Digital Education, Accessibility, Social Inclusion in Online Learning, Bibliometric Analysis

1. Introduction

The global shift toward digital education has generated growing interest in how inclusive pedagogical practices can be sustained and enhanced in virtual learning environments. This interest has intensified particularly since the educational disruptions caused by the COVID-19 pandemic in 2020. As digital learning platforms have become central to educational delivery worldwide, concerns surrounding access, equity, and diversity have gained prominence. Within this evolving landscape, inclusion in e-learning has emerged as a critical topic, prompting interdisciplinary attention from education, technology, and social policy scholars alike. This study investigates the intersection of e-learning and inclusion through a bibliometric analysis of scholarly literature indexed in the Web of Science database. Employing quantitative mapping and visualization techniques, the study identifies prevailing research trends, central themes, and patterns of collaboration among countries and institutions. The findings aim to uncover the intellectual structure of this growing research domain and offer insights for future educational research and policy development.

2. Theoretical Background

The integration of inclusion within e-learning environments is rooted in broader discourses surrounding equity in education and the role of technology in reducing—or exacerbating—barriers to learning. Inclusion in this context refers not merely to physical access to digital platforms but also to the creation of educational experiences that are accessible, responsive, and supportive of learners from diverse backgrounds and with varied needs. Research in this domain has built upon foundational principles of universal design for learning (UDL), which advocates for flexible learning environments that accommodate individual learning differences (Meyer et al., 2014). At the same time, literature on the digital divide has emphasized the socio-economic and infrastructural disparities that prevent equitable participation in online learning (van Dijk, 2020). Concepts such

as web accessibility, assistive technologies, and digital literacy have increasingly been foregrounded in discussions on how to make e-learning more inclusive.

Recent studies have also focused on how artificial intelligence, gamification, and data-driven personalization can contribute to more inclusive educational experiences—provided they are designed with ethical considerations and learner agency in mind (Holmes et al., 2019). However, inclusion remains a multifaceted construct, encompassing issues of cultural sensitivity, language, mental health, and learner autonomy, all of which must be considered when designing digital education systems. This conceptual framework guides the current study's bibliometric investigation, aiming to identify how these diverse strands of research are reflected in the scholarly literature on e-learning and inclusion. By tracing thematic developments and collaborative patterns, the study seeks to illuminate how the academic community has engaged with these complex issues over time.

3. Methodology

Bibliometric techniques serve as a valuable complement to traditional literature reviews, particularly in the analysis of large bodies of research, by offering an objective, transparent, and replicable methodological structure (Öztürk et al., 2024). This approach enables a multidimensional mapping of the field's development through indicators such as publication performance, patterns of collaboration, and thematic clustering (Galvagno, 2017; Lim & Kumar, 2024). This study adopts a bibliometric approach to examine the evolution and structure of academic research at the intersection of e-learning and inclusion. Bibliometric analysis offers a systematic method to quantify scholarly output, map intellectual structures, and uncover emerging patterns in scientific publications (Donthu et al., 2021). In this research, the methodology integrates both performance analysis and science mapping techniques to provide a comprehensive overview of the field.

3.1 Data Source and Selection Criteria

The data for this bibliometric analysis were retrieved from the Web of Science (WoS) Core Collection, a database frequently preferred in scholarly research due to its high indexing standards and extensive citation network. The search was conducted on April 15, 2024, using the keywords "e-learning," "inclusion," "accessibility," "equity," and "digital education." Only peer-reviewed journal articles and conference proceedings published in English were included, while editorials, book reviews, and non-refereed content were excluded. Publications from the period 1992 to 2023 were fully included in the analysis. Although publication numbers were relatively low between 1992 and 1999, these records were retained to ensure comprehensive coverage. Records from 2024 and 2025 were excluded, as they were either not fully indexed or listed as early access at the time of data extraction. This exclusion was made to maintain the validity of year-based comparisons.

Following data cleaning and filtering processes, a total of 731 publications were included in the final analysis. The data were exported in plain text format, including full records and citation information. Figure 1 displays the annual distribution of publications and total citation counts between 1992 and 2023. The presence of data points for 2024 and 2025 in the figure is due solely to system-level tagging discrepancies and was not considered in the analysis.

3.2 Analytical Tools and Techniques

The data were analysed using VOSviewer (version 1.6.19), a specialized software tool for constructing and visualizing bibliometric networks. The analysis focused on three key dimensions:

- Keyword Co-occurrence Analysis: to identify dominant themes and conceptual linkages between key terms.
- Temporal Analysis: to explore the evolution of topics over time.
- Co-authorship and Institutional Collaboration Networks: to identify key countries, institutions, and their levels of collaboration.

Keywords were normalized by merging semantically similar terms (e.g., "e-learning" and "elearning"), and a minimum occurrence threshold was applied to filter out noise. The overlay visualization feature of VOSviewer was utilized to trace the chronological development of themes. This methodological framework enabled the identification of both quantitative publication trends and qualitative shifts in thematic focus, offering a rich, multi-dimensional understanding of how research on inclusive e-learning has evolved over the past two decades.

4. Results

This section presents the results of the bibliometric analysis in four main areas: publication trends, keyword co-occurrence patterns, thematic evolution, and collaboration networks across countries and institutions.

4.1 Publication and Citation Trends

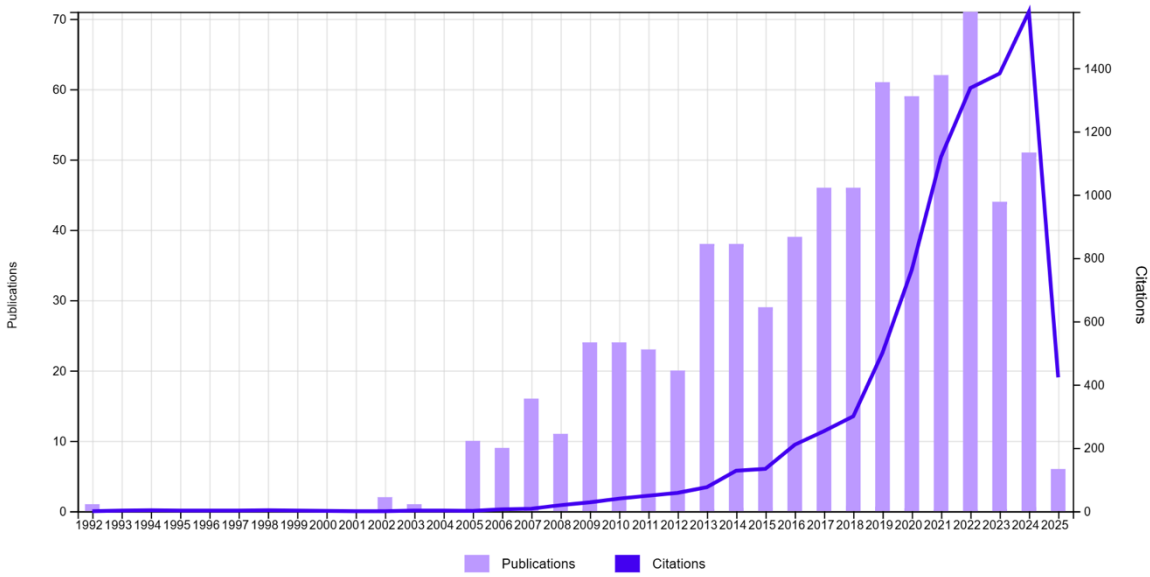

Figure 1: Publication and citation trends

The volume of publications on e-learning and inclusion has grown steadily since 2000, with a particularly notable increase observed after 2018. The number of annual publications peaked in 2022, reflecting intensified research efforts in response to global educational disruptions caused by the COVID-19 pandemic. Citation counts followed a similar trajectory, suggesting both increased interest and impact in this research domain.

4.2 Keyword Co-Occurrence Analysis

Figure 2 presents the keyword co-occurrence network generated from the titles and abstracts of 731 publications. Five clusters are highlighted using modularity-based colour coding. The term “e-learning” was retained in the network as it appears in all publications and plays a central role by linking the clusters and establishing structural coherence across the dataset.

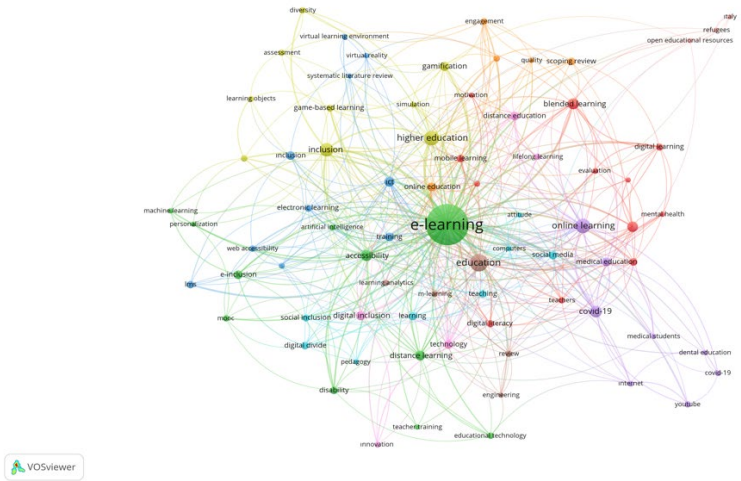

Figure 2: Keyword co-occurrence network map

4.2.1 Cluster 1 (Red): Pedagogical Design and Online Learning

This central cluster includes terms such as e-learning, online learning, learning environment, instructional design, and student engagement. These keywords highlight ongoing research on how digital learning platforms are structured and how learners interact with them. The prominence of blended learning and gamification within this cluster also signals a growing interest in hybrid approaches and motivation-enhancing strategies.

4.2.2 Cluster 2 (Green): Higher Education and Assessment

Keywords such as higher education, assessment, learning outcomes, course design, and MOOCs are grouped here. This suggests a body of research focused on the implications of inclusive e-learning in tertiary education settings. Topics like student performance, academic success, and formative feedback further indicate that inclusion is increasingly framed around equitable achievement metrics.

4.2.3 Cluster 3 (Blue): Inclusion, Equity, and Accessibility

This cluster centres around terms such as inclusion, accessibility, digital divide, diversity, and equity. It reflects a growing scholarly focus on the structural and systemic barriers that impact learners' ability to fully participate in digital education. The frequent co-occurrence of policy, barriers, and support systems points to the relevance of institutional and governmental roles in shaping access.

4.2.4 Cluster 4 (Yellow): Technology and Innovation

Featuring keywords like artificial intelligence, adaptive learning, educational technology, and mobile learning, this cluster emphasizes the technological advancements driving personalized and inclusive learning experiences. It also suggests a parallel discourse on how innovation can either reduce or reinforce exclusion depending on design intentions.

4.2.5 Cluster 5 (Purple): Mental Health and Social Inclusion

Emerging more prominently in recent years, this cluster includes terms such as mental health, well-being, social inclusion, and emotional support. These keywords signal a shift toward a more holistic understanding of inclusion—one that integrates affective, psychological, and community-based dimensions of learning.

Taken together, the co-occurrence map illustrates how the concept of inclusive e-learning is not confined to access alone but is distributed across diverse pedagogical, technological, institutional, and emotional domains. The dense interlinkages among clusters also reveal that these themes are not isolated silos but intersecting facets of a broader discourse on equitable digital education. This map visualizes the co-occurrence of terms in the dataset, highlighting five major thematic clusters that define current research directions.

4.3 Thematic Evolution Over Time

Figure 3 presents an overlay visualization illustrating the temporal evolution of keyword usage based on the average publication year of the associated documents. In this network, node colours represent temporal trends—ranging from shades of blue for earlier studies (e.g., pre-2015, which predominantly addressed infrastructure and basic accessibility) to yellow for more recent research (up to 2023). The visualization captures a shift in research focus over time, with themes such as social inclusion and mental health gaining prominence particularly after 2020. While colour plays a central role in conveying these temporal dynamics, node size and spatial positioning further support interpretation.

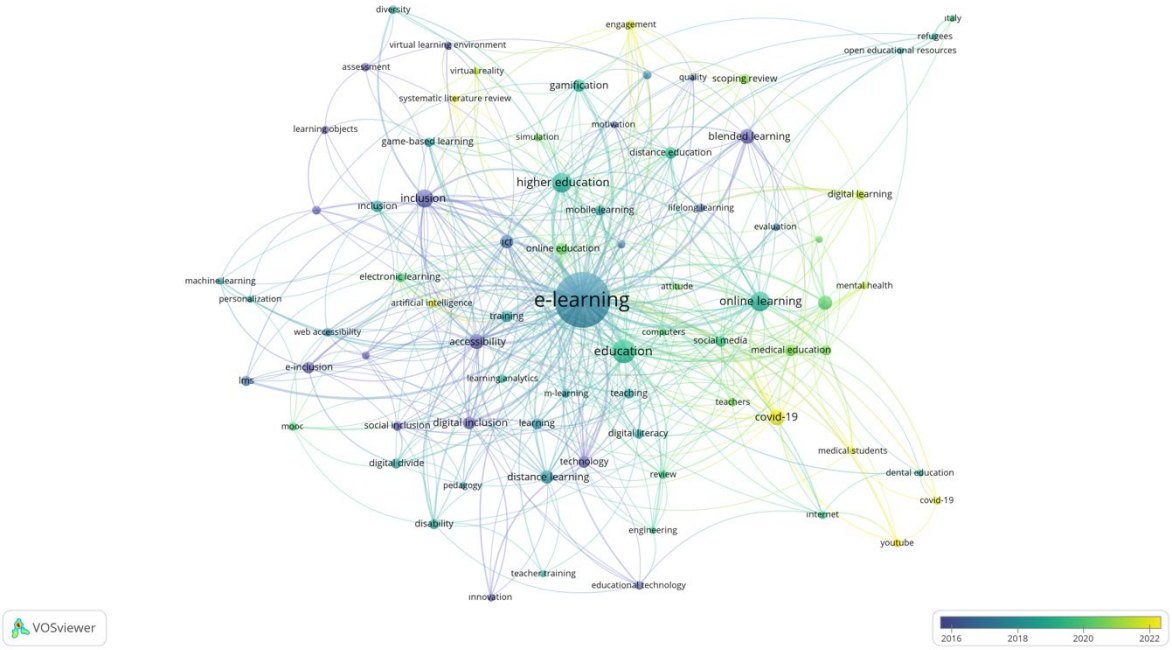

Figure 3: Overlay visualization of keyword development over time

Earlier research (2005–2015) predominantly emphasized the technological infrastructure and access dimension of e-learning. Terms such as ICT, web-based learning, learning management systems, and accessibility were dominant during this period. These topics reflect an early-stage preoccupation with building the foundations of digital learning environments and ensuring basic technical participation. Between 2016 and 2019, the field began to incorporate themes related to learner diversity, instructional design, and higher education policy. Keywords like inclusive education, MOOCs, course design, and formative assessment gained visibility. This shift marks a growing pedagogical interest in how digital education could support diverse learners and institutional adaptation.

From 2020 onwards, there is a clear thematic expansion into socio-emotional, health-related, and ethical issues, aligning with the onset of the COVID-19 pandemic. The emergence of terms such as mental health, digital well-being, social inclusion, equity, and remote learning suggests that inclusion is no longer viewed solely through a structural or technological lens, but also through the lens of emotional resilience, digital fatigue, and student support systems. This evolution highlights a broadening of the concept of inclusion, encompassing not just physical or technological access but also psychological safety, equitable engagement, and social justice. The overlay visualization thus serves as evidence of a maturing academic discourse that is increasingly concerned with the human-centred dimensions of e-learning. This figure illustrates the chronological layering of research themes, showing the shift from infrastructure-based inclusion toward holistic and learner-centred concerns in recent years.

4.4 Country-Level Collaboration Networks

Figure 4 illustrates the international collaboration network in the field of e-learning and inclusion. Countries are represented as nodes, where node size reflects the total number of publications and the thickness of connecting lines indicates the strength of co-authorship ties. Country names appear as indexed in the Web of Science database (e.g., “Türkiye” instead of “Turkey”). Some smaller countries are not labelled due to node overlap, which resulted in their automatic suppression by VOSviewer. This visualization highlights the global distribution of research activity and provides insight into patterns of international scholarly collaboration.

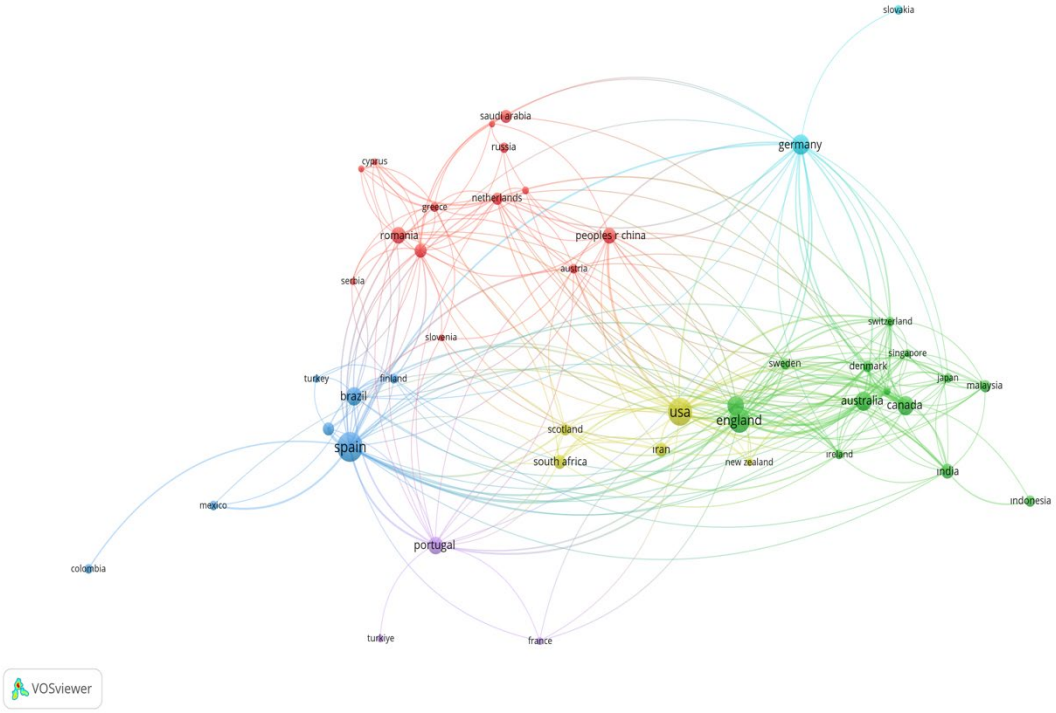

Figure 4: Country Collaboration Map

The United States appears as the most prominent hub, maintaining extensive bilateral connections with numerous countries, including the United Kingdom, Canada, and Germany. Its centrality in the network reflects both its research capacity and influence in setting global educational technology agendas. Spain, Germany, and China also stand out as highly collaborative and productive countries. Spain, in particular, demonstrates strong ties across Europe and Latin America, suggesting that linguistic and regional affiliations may facilitate international cooperation. Germany and China show significant academic engagement, especially in producing policy-oriented and technology-driven studies.

Beyond these central actors, the visualization reveals a second layer of emerging contributors, notably Türkiye, India, and Brazil. These countries, while producing comparatively fewer publications, are increasingly visible in international collaborations. Their growing presence indicates a gradual diversification of the research ecosystem and highlights the rising importance of inclusive digital education in developing and transitional economies. However, the map also suggests persistent geographical imbalances. Several regions—particularly Sub-Saharan Africa, Southeast Asia, and parts of the Middle East—remain underrepresented in terms of both research output and collaborative integration. This points to a need for more inclusive global research partnerships that can bridge knowledge gaps and support capacity building across underserved regions. This map visualizes co-authorship and citation-based connections among countries, highlighting central actors, emerging contributors, and underrepresented regions in the global discourse on e-learning and inclusion.

4.5 Institutional Collaboration Patterns

Figure 5 illustrates the co-authorship network among the most productive universities in the field. Due to the limited number of clusters and relatively weak inter-institutional collaboration, the network appears sparse. Node size represents the number of publications per institution, while the thickness of connecting lines reflects the strength of co-authorship links. The horizontal spacing in the visualization results from VOSviewer's layout algorithm, which separates distant clusters to optimize clarity.

At this institutional level, prominent universities such as the University of British Columbia, the University of Melbourne, and the University of Copenhagen emerge as central research hubs. The network highlights clusters of institutions connected through joint publications and shared thematic orientations, suggesting that research in this domain remains concentrated around a limited number of leading academic centres.

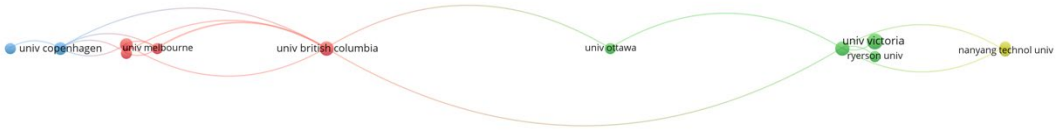

Figure 5: Institutional Collaboration Network Map

5. Discussion

The findings of this bibliometric study suggest that the rapid transformations observed in the post-2020 period—such as the widespread adoption of digital learning, the evolution of social inclusion policies, and increased attention to accessibility—may not yet be fully captured in the empirical literature. Consequently, the dataset analysed in this study is more reflective of conceptual and policy-oriented publications than of practice-based empirical research. Given that bibliometric analyses primarily uncover the structural and trend-based dimensions of a field rather than its content depth, such temporal lags are contextually expected (Donthu et al., 2021). Furthermore, this study is limited to English-language publications indexed in the Web of Science Core Collection. This constraint may result in the underrepresentation of research published in local languages, particularly from regions such as Asia and Africa. Nevertheless, this restriction was a deliberate methodological choice, intended to ensure data consistency, citation traceability, and standardized terminology (Zupic & Čater, 2015). Despite these limitations, the study provides a robust overview of the thematic contours of the field and serves as a foundational framework for guiding future empirical and qualitative inquiries.

The analysis reveals a rapidly growing body of literature at the intersection of e-learning and inclusion, mirroring broader transformations in digital education. The marked increase in publication and citation activity since 2018 aligns with global disruptions such as the COVID-19 pandemic, which intensified the imperative to secure equitable access to education. This surge underscores a paradigmatic shift in which inclusion has moved from the periphery to the forefront of educational research and policy discourse in the digital age. Moreover, the keyword analysis shows that while e-learning remains the dominant anchor concept, its connections to terms such as accessibility, diversity, equity, and digital divide indicate an evolving recognition of the complex layers that constitute inclusive learning environments. Earlier studies often treated access as a binary condition—either a learner has internet access or not—whereas more recent research explores psychological, cultural, linguistic, and cognitive dimensions of participation. This thematic broadening aligns with global calls for education systems that are not only inclusive by design but also responsive to learners' lived realities (UNESCO, 2020).

The temporal analysis further suggests that recent scholarship is increasingly concerned with socio-emotional aspects of learning, such as mental health and digital well-being. These themes, largely absent from early e-learning literature, point to a deepening understanding of the learner experience in digital contexts. It is not sufficient to provide technological infrastructure; inclusive e-learning also demands pedagogical models that foster community, empathy, and individualized support. Collaboration networks across countries and institutions reinforce the global relevance of this field. High levels of engagement from countries such as the United States, Spain, and Germany indicate mature research infrastructures, while emerging contributions from regions like Latin America and Southeast Asia reflect growing international interest in inclusive education. However, the observed clustering of institutional partnerships also suggests potential barriers to broader knowledge diffusion, particularly among underrepresented regions.

Despite the richness of the existing literature, the analysis highlights several underexplored areas. For example, the role of artificial intelligence and adaptive learning technologies in promoting or hindering inclusion remains insufficiently examined. Likewise, while accessibility features are frequently discussed, few studies interrogate how learners themselves perceive and interact with these tools in diverse cultural settings.

In sum, the findings underscore a shift toward more nuanced, interdisciplinary perspectives on inclusion in e-learning. They call for future research that bridges technical, pedagogical, and social concerns—especially in designing systems that prioritize equity, learner agency, and ethical digital practices.

Beyond mapping thematic and collaborative trends, this study contributes to the academic debate by highlighting a conceptual transition in the literature—from a predominantly access-based understanding of inclusion toward a more holistic, affect-oriented framework. While prior research often equated inclusion with technological accessibility or infrastructure, our analysis reveals an emerging discourse that positions emotional well-being, social connectedness, and learner agency as integral to inclusive digital education. This shift remains under-theorized in current frameworks and suggests a need to reconceptualize inclusion as a multidimensional construct that bridges technological, pedagogical, and socio-emotional domains. By uncovering this trajectory, the study invites future research to engage critically with the normative assumptions embedded in digital inclusion policies and to develop theoretical models that reflect the lived realities of diverse learners in online environments.

6. Conclusion and Recommendations

This study provides a comprehensive bibliometric analysis of research at the intersection of e-learning and inclusion, drawing on 731 peer-reviewed publications indexed in the Web of Science database. Through performance and science mapping techniques, the study has identified prevailing themes, influential contributors, and emerging directions in this rapidly evolving field. Findings indicate that inclusive e-learning has become a central concern in digital education scholarship, particularly in response to global challenges such as the COVID-19 pandemic. The literature has progressively shifted from a narrow focus on technological access to a broader exploration of equity, diversity, and learner-centred design. This evolution underscores the growing recognition that inclusive education must encompass not only infrastructure but also culturally responsive content, emotional well-being, and adaptive pedagogical approaches. Keyword co-occurrence and temporal analysis revealed increasing attention to mental health, accessibility, and social inclusion—topics that reflect contemporary educational concerns in digitally mediated contexts. The visualization of global collaboration patterns highlights both established centres of research and emerging contributors, while also pointing to regional disparities that merit further attention.

Based on the findings, several recommendations emerge to support the advancement of inclusive e-learning environments. First, fostering interdisciplinary collaborations among educators, technologists, and policymakers is essential for the development of inclusive learning systems that are responsive not only to cognitive but also to social, emotional, and cultural dimensions of learner diversity. In addition, expanding research efforts to explore learner experiences with digital inclusion tools—particularly in underrepresented regions and among marginalized populations—will help generate more equitable solutions and address existing gaps in the literature. Furthermore, ensuring transparency and upholding ethical considerations in the deployment of emerging technologies such as artificial intelligence and learning analytics is critical to prevent the reinforcement of existing inequalities and to promote equitable access and participation. A key priority should also be investment in institutional capacity building, especially in the Global South, to enhance the participation of these institutions in international research networks and enable their contributions to the global discourse on inclusive education. Through a structured examination of current trends, this study contributes to the ongoing dialogue on digital equity and inclusive pedagogy, serving as a valuable reference for researchers, educators, and practitioners committed to designing e-learning systems that are not only technologically sophisticated but also socially just.

Ethics Declaration

This study is based exclusively on a bibliometric analysis of secondary data derived from published scholarly articles indexed in the Web of Science database. While it does not involve human participants or experimental interventions, it does include publicly available bibliographic metadata (e.g., author names and affiliations), which may be considered personal data under certain data protection frameworks. As such, all data were used in compliance with ethical guidelines for research involving secondary use of public data, and no ethical approval was required.

AI Declaration

No generative AI tools were used to create, analyse, or synthesize data in this study. However, language-enhancement features of AI-based writing assistants (e.g., grammar and clarity suggestions) were selectively employed during the manuscript editing process. The authors maintained full control over the content and

interpretation of the findings. Any automated suggestions were reviewed and verified for accuracy and alignment with the scholarly intent of the work.

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