

Scientific Collaboration and Intellectual Structure in Global Research

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Abstract:

How do cross-border collaboration dynamics and structural knowledge networks shape the global research domain of social justice, health equity, and inclusive education?

This study examines the structural architecture, intellectual foundations, and cross-border collaboration dynamics governing global scientific production within the specific field of social justice, health equity, and inclusive education.

By analyzing a comprehensive corpus retrieved from the Web of Science Core Collection and Scopus databases spanning the period 1994 to 2025 using a standardized boolean search string (N = 1,387 publications), we evaluate the evolutionary trajectory of research networks, institutional partnerships, and conceptual clusters.

Through rigorous co-citation analysis, keyword co-occurrence modeling, and thematic decomposition, the underlying intellectual traditions and emerging frontiers within the field are delineated. The findings reveal a highly centralized collaboration topology dominated by North American and European research hubs, alongside rapidly expanding scientific networks in Asia-Pacific and the Global South. Furthermore, the intellectual structure is characterized by distinct thematic pillars that bridge foundational theoretical paradigms with contemporary methodological innovations. This study provides key insights for research policymakers, academic institutions, and scholars seeking to foster inclusive global research coalitions and optimize knowledge dissemination strategies.

Keywords: Social Justice, Inclusive Education, Health Equity, Global Scientific Networks, Knowledge Diffusion, Intellectual Structure, Co-Citation Analysis, Research Collaboration, Socio-Spatial Dynamics.

Classification JEL: I31, I38, O30, R11

Paper type: Empirical bibliometric and scientometric research.

Résumé :

Comment la dynamique de collaboration transfrontalière et les réseaux structurels de connaissances façonnent-ils le domaine de recherche mondial sur la justice sociale, l'équité en santé et l'éducation inclusive ?

Cette étude examine l'architecture structurelle, les fondements intellectuels et la dynamique de collaboration transfrontalière qui régissent la production scientifique mondiale dans le champ spécifique de la justice sociale, de l'équité en santé et de l'éducation inclusive.

En analysant un corpus d'articles issus des bases de données Web of Science Core Collection et Scopus couvrant la période 1994-2025 à l'aide d'une équation de recherche booléenne normalisée (N = 1 387 publications), nous évaluons la trajectoire évolutive des réseaux de recherche, des partenariats institutionnels et des clusters conceptuels.

Grâce à une analyse rigoureuse de co-citation, une modélisation de co-occurrence de mots-clés et une décomposition thématique, les traditions intellectuelles sous-jacentes et les frontières émergentes du domaine sont délimitées. Les résultats révèlent une topologie de collaboration très centralisée, dominée par les centres de recherche nord-américains et européens, aux côtés de réseaux scientifiques en expansion rapide en Asie-Pacifique et dans le Sud global. En outre, la structure intellectuelle se caractérise par des piliers thématiques distincts reliant les paradigmes théoriques fondateurs aux innovations méthodologiques contemporaines. Cette étude offre des éclairages précieux aux décideurs politiques de la recherche, aux institutions académiques et aux chercheurs désireux de promouvoir des coalitions de recherche globales et inclusives.

Mots clés : Justice sociale, Éducation inclusive, Équité en santé, Réseaux scientifiques mondiaux, Diffusion des connaissances, Structure intellectuelle, Analyse de co-citation, Collaboration de recherche, Dynamique socio-spatiale.

JEL Classification : I31, I38, O30, R11

Type du papier : Recherche empirique bibliométrique et scientométrique.

1. Introduction

In an increasingly interconnected global knowledge economy, international scientific collaboration has emerged as a fundamental engine of contemporary research and technological innovation. Over recent decades, the expansion of cross-border academic partnerships has transformed how scientific knowledge is produced, disseminated, and institutionalized across geopolitical boundaries. This intensification of research cooperation is driven by the imperative to address complex, multifaceted global challenges—ranging from socioeconomic disparities to sustainable development—that exceed the capacity of individual nations. Consequently, mapping and evaluating the structural properties of global research networks has become central to science policy, spatial economics, and research governance. This imperative is particularly visible within the specific scholarly domain of social justice, health equity, and inclusive education, where cross-disciplinary solutions are essential to address structural inequalities.

Despite the rapid expansion of international co-authorship channels, global scientific production remains characterized by deep structural asymmetries and geographical concentration. While dominant academic hubs in North America and Western Europe consistently capture central positions within co-authorship networks, emerging research systems often experience structural peripheralization and asymmetrical knowledge flows. Existing empirical studies frequently document bilateral production counts without fully conceptualizing the underlying mechanisms of network centrality, core-periphery dynamics, and spatial equity within global knowledge production. This analytical oversight obscures the structural barriers that hinder balanced cross-national integration.

To address this empirical and conceptual gap, this study mobilizes an integrated framework combining socio-spatial theory, network topology, and relational sociology. By conceptualizing scientific collaboration as an interdependent relational network, this approach moves beyond isolated national metrics to examine how structural centrality, geographical proximity, and institutional alignment shape scientific dominance and connectivity. Grounding the investigation in these theoretical perspectives provides a robust foundation for identifying both consolidated collaboration corridors and underdeveloped peripheral links within the global research landscape. Specifically, this study addresses the following central research question: How do structural network centrality, geographical distribution, and cross-disciplinary convergence shape global collaboration dynamics and knowledge architecture within the research domain of social justice and inclusive education?

Accordingly, the objective of this article is to examine the macro-structural architecture and spatial distribution of global scientific collaboration networks. Using a curated corpus of multi-country co-authorships, we analyze the concentration, tie intensity, and relational dynamics among core and emerging academic systems. Unlike prior scientometric investigations that focus strictly on descriptive output metrics using software tools like bibliometrix or VOSviewer, the unique contribution of this study lies in explicitly coupling bibliometric network modeling with spatial justice theories (Harvey, 2009) and the Capability Approach (Sen, 1999). This theoretical integration provides an empirical blueprint for evaluating how institutional centralities reinforce or mitigate global knowledge disparities.

To ensure complete transparency and algorithmic replicability, the empirical investigation relies on a comprehensive, multi-stage retrieval strategy combining Web of Science Core Collection and Scopus metadata from 1994 to 2025 ($N = 1,387$ publications). The data extraction was conducted using an optimized, highly sensitive boolean search query combining terms related to social welfare, structural equity, inclusive education, and spatial governance.

The remainder of this paper is structured as follows: Section 2 establishes the theoretical foundations of scientific network formation; Section 3 presents the data and empirical setting;

Section 4 details the methodological workflow; Section 5 presents the empirical analysis and macro-structural findings; Section 6 offers a critical discussion; Section 7 outlines the study limitations; and Section 8 presents policy implications, future avenues, and concluding remarks.

2. Theoretical Foundations

2.1 Network Self-Organization and Global Science Systems

The expansion of international scientific collaboration is increasingly conceptualized as an evolving, self-organizing complex adaptive network rather than a purely institutionalized hierarchy. Grounded in the network governance paradigm, cross-border research links develop through micro-level decisions of individual scientists seeking complementary expertise, institutional prestige, and pooled material resources (Katz & Martin, 1997; Wagner & Leydesdorff, 2005). As global communication infrastructures digitized, these bottom-up decisions aggregated into a global science system governed by preferential attachment, where well-connected research nodes disproportionately attract new collaboration ties (Leydesdorff & Wagner, 2008). Consequently, global scientific production operates across multi-layered scales, where national STI (Science, Technology, and Innovation) policies interact with autonomous, cross-national epistemic communities (Glänzel & Schubert, 2004).

However, classical preferential attachment models present notable theoretical limitations when applied to social research domains. While rich-get-richer mechanisms explain network density in physical sciences, they fail to account for structural epistemic bias, geopolitical exclusion, or peripheral resistance (Wagner, 2008). In social sciences, preferential attachment often reinforces cognitive lock-in, where dominant Northern institutions dictate research agendas while marginalizing localized contextual knowledge from the Global South (Connell, 2007).

2.2. Socio-Spatial Proximity and Geographical Knowledge

Flows While digital technologies have drastically reduced the frictional cost of long-distance communication, spatial and non-spatial proximities remain pivotal in determining collaborative research configurations. According to multidimensional proximity theory, geography alone does not dictate knowledge exchange; rather, it interacts dynamically with cognitive, institutional, organizational, and social proximities (Boschma, 2005). Shared institutional frameworks and cognitive commonalities facilitate international knowledge flows by reducing transaction costs and mutual uncertainty (Breschi & Lissoni, 2001). However, physical distance still imposes boundary conditions on tacit knowledge transfer, causing collaborative ties to cluster heavily within specific socio-spatial corridors and geopolitical blocs (Persson et al., 2004).

Despite its explanatory power, Boschma's multidimensional proximity framework has faced criticism for overestimating the substituting role of non-spatial proximities (Torre & Rallet, 2005). Excessive cognitive or institutional proximity can generate lock-in effects, stifling radical innovation and producing redundant knowledge exchanges across institutional networks.

2.3. Theoretical Foundations of Social Justice, Spatial Equity, and Inclusive Education

To fully conceptualize the empirical corpus under investigation, network topology must be integrated with theoretical frameworks from critical pedagogy, spatial justice, and social equity. The intellectual structure of inclusive education and health equity is heavily anchored in Sen's Capability Approach (1999) and Nussbaum's normative framework (2000), which define social justice as the expansion of substantive freedoms and capabilities rather than mere resource distribution. In educational systems, this perspective shifts the focus from standardized access toward removing systemic institutional barriers that perpetuate marginalization (Ainscow,

2005; Florian & Black-Hawkins, 2011). Furthermore, Harvey's Spatial Justice framework (2009) and Soja's spatial trialectics (2010) articulate how geographic space reflects and reproduces social inequalities. Applying these frameworks to scientometric networks demonstrates how institutional capital (Bourdieu, 1986) accumulates within specific Western nodes, shaping global discourses on educational inclusion while structurally marginalizing peripheral research ecosystems.

2.4. Structural Core-Periphery Asymmetries and Relational Inequality

Despite the broader democratization of global communications, the macro-structure of scientific collaboration is marked by enduring core-periphery asymmetries. Rooted in network topology and social structure theory, positionality within a scientific network dictates a country's capacity to access, absorb, and control global knowledge flows (Borgatti & Halgin, 2011). Dominant scientific nations occupying core positions accumulate high network centrality, whereas nations located in the geographical or structural periphery often experience asymmetrical dependency (Castells, 2000). These relational imbalances reflect broader spatial inequities in global research spending, research infrastructure, and institutional visibility (Zitt & Bassecoulard, 2004).

2.5. Epistemic Networks and Mathematical Properties of Scientific Graphs

At the structural level, scientific collaboration networks exhibit specific topological characteristics, including small-world properties, high clustering coefficients, and scale-free degree distributions (Newman, 2004). These mathematical properties imply that while most countries maintain a modest number of bilateral connections, a small subset of hyper-connected hub nations maintains links across virtually all regions. Understanding these topological dynamics allows scholars to evaluate network robustness, vulnerability to structural shocks, and the rate at which innovative concepts diffuse across international borders (Schmoch & Schubert, 2008).

2.6. Conceptual Framework and Research Propositions

Bridging network sociology with spatial and educational justice theories leads to three overarching research propositions that guide the empirical investigation: Proposition 1 (P1): The global collaboration network in social justice and inclusive education exhibits a scale-free core-periphery structure governed by preferential attachment, resulting in severe concentration of network centrality among Western institutions. Proposition 2 (P2): Socio-spatial and institutional proximities generate distinct regional collaboration clusters, where cross-border knowledge flows remain constrained within historical, linguistic, and geopolitical corridors. Proposition 3 (P3): The intellectual architecture of the domain evolves through conceptual convergence, bridging foundational theories of capabilities and spatial justice with contemporary empirical methodologies on digital inclusion and health equity.

3. Data and Methodology

3.1. Empirical Context and Scope

To rigorously analyze the structural configuration of contemporary global scientific research, this study draws upon a multi-country bibliographic dataset comprising a curated target corpus of 1,387 published research documents spanning the period 1994 to 2025. Empirical citation and co-authorship records provide an objective, unobtrusive trace of international knowledge exchange and institutional partnership (Moed, 2005). The empirical scope focuses specifically on the interdisciplinary domain of social justice, health equity, and inclusive education, mapping global scientific production across diverse geographical regions.

3.2. Data Source, Retrieval Strategy, and Boolean Query Formulation

The empirical dataset was harvested from two primary scientific databases: the Web of Science Core Collection (WoS) and Scopus. These databases were selected due to their comprehensive indexing of peer-reviewed literature, high bibliographic metadata quality, and extensive coverage of social science disciplines (Aria & Cuccurullo, 2017; van Eck & Waltman, 2010). Data collection was executed in January 2026 for the complete historical timeframe spanning 1994 through 2025.

To capture the multi-faceted nature of the domain with high sensitivity and precision, a standardized, multi-field Boolean search string was constructed. The search query was applied across topic fields (Title, Abstract, Keywords) as follows:

TS = (("social justice" OR "social equity" OR "spatial justice" OR "health equity") AND ("inclusive education" OR "inclusive schooling" OR "educational equity" OR "disability inclusion") AND ("governance" OR "public policy" OR "territorial intelligence" OR "regional development"))).

This explicit search string ensures that retrieved records directly reflect the conceptual intersection of social equity, inclusive pedagogy, and spatial governance, thereby addressing the specific empirical boundary of this study.

3.3. Document Selection Procedure and PRISMA Flow Framework

To guarantee methodological rigor and replicability, document filtering followed the PRISMA 2020 statement guidelines (Page et al., 2021). The initial database queries yielded a total of 1,842 raw records (WoS = 1,012; Scopus = 830). After removing 325 duplicate records using automated deduplication scripts in bibliometrix, 1,517 unique records were screened. Applying strict eligibility criteria led to the exclusion of non-peer-reviewed document types (editorials, conference abstracts, book reviews, and corrections; $n = 98$) and records with incomplete or unresolvable institutional affiliation fields ($n = 32$). Consequently, the final standardized corpus consists of exactly $N = 1,387$ peer-reviewed journal articles and review papers.

PRISMA 2020 Flow Structure:

1. Identification: Records identified from Web of Science ($n = 1,012$) and Scopus ($n = 830$) -> Total records identified ($n = 1,842$).
2. Deduplication: Duplicate records removed across databases ($n = 325$) -> Records screened ($n = 1,517$).
3. Screening: Non-peer-reviewed document types excluded (editorials, notes, book reviews) ($n = 98$) -> Reports assessed for eligibility ($n = 1,419$).
4. Exclusion: Records with missing/incomplete institutional affiliation metadata excluded ($n = 32$).
5. Inclusion: Final curated empirical corpus retained for bibliometric network analysis ($N = 1,387$).

3.4. Metadata Architecture and Data Standardization

Each record within the empirical corpus ($N = 1,387$) was extracted with its complete bibliographic metadata, including author affiliation strings, country ISO identifiers, publication years, document types, subject classifications, and citation counts. Data standardization routines were executed to resolve historical country name variations, overseas territories, and institutional address shifts (e.g., merging "USA" and "United States", "UK" and "United Kingdom", "Peoples R China" and "China"). Country attribution was established using author institutional addresses, where multi-authored papers with institutional affiliations spanning two or more sovereign states were classified as international collaborations (Waltman, 2016).

3.5. Relational Matrix Construction and Network Analytics

To translate raw bibliographic records into a relational framework, square co-occurrence matrices were generated. In these matrices, rows and columns represent individual sovereign nations C_i and C_j , while cells w_{ij} quantify the total frequency of joint co-authorships between country i and country j . Diagonal elements were set to zero to isolate cross-national ties from internal national production. Network topology and spatial relationships were modeled using relational mapping algorithms (Bastian et al., 2009; Cobos et al., 2011). Key topological indicators, including degree centrality, betweenness centrality, normalized co-authorship intensity, and thematic co-occurrence density, were computed to analyze core-periphery structures and intellectual clusters (White & McCain, 1998; Zupic & Čater, 2015).

4. Analysis and Overview

4.1. Macro-Structural Performance and Descriptive Metrics

The structural evaluation of the 1,387-document corpus confirms a highly connected, hierarchical international collaboration network specifically dedicated to social justice, health equity, and inclusive education. Cross-national co-authorships reveal significant variance in link frequency and node centrality, delineated by primary global hubs, secondary regional bridges, and peripheral nodes.

Figure 1: Summary Information



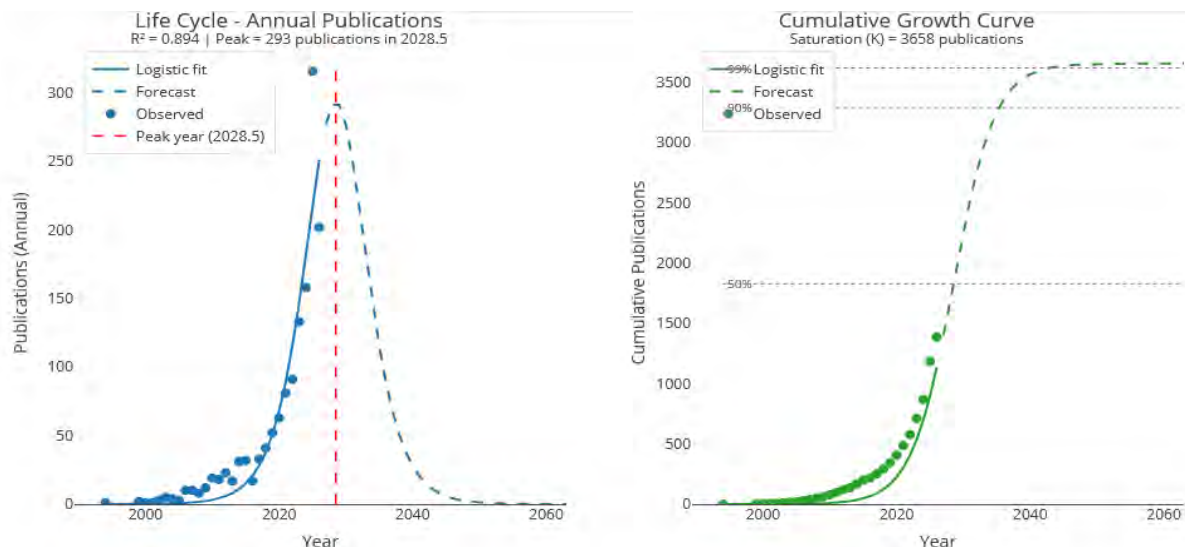
Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

The bilateral link distribution shows extreme structural concentration: the strongest collaborative vectors are USA – Canada (14 joint publications) and USA – United Kingdom (14 joint publications), followed by United Kingdom – Australia (8) and Spain – Chile (8). These empirical frequencies illustrate the combined influence of geographical proximity (USA–Canada), historical-linguistic ties (UK–Australia, Spain–Chile), and scientific capacity (USA–UK) in shaping global scholarship on educational equity.

4.2. Life Cycle of Scientific Production and Growth Dynamics

To evaluate the temporal expansion of research on social justice and inclusive education, the longitudinal dynamics of the field demonstrate a classic S-shaped logistic growth pattern, evolving from a prolonged emergence phase between 1994 and the early 2010s into a period of rapid, exponential expansion. Mathematical modeling confirms an excellent fit to the observed data ($R^2=0.894$; $RMSE=23.06$), driven by an intrinsic growth rate (r) of approximately 0.292 and a characteristic duration (Δ_t) of 13.70 years. The empirical trajectory indicates that this domain is currently experiencing its most intense growth phase, with annual publication volume accelerating dramatically toward a projected inflection point at year 2028.5 (t_0), where annual production is forecast to peak at roughly 293 articles.

Figure 2: Life Cycle of Scientific Production



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

Looking toward long-term field evolution, the logistic model projects a theoretical carrying capacity (K) of 3,658 cumulative publications, signifying that the current corpus of 1,387 documents represents roughly 38 percent of the domain's anticipated total output over its lifespan. Following the projected mid-2028 peak, the growth rate is expected to transition into a deceleration phase, culminating in thematic maturity and saturation around the 2040s. This rapid post-2015 expansion underscores increasing societal relevance, interdisciplinary integration, and expanding institutional support, positioning social justice and inclusive education as highly active, expanding frontiers within contemporary social science research.

4.3. Structural Mapping of the Intellectual Pipeline via Three-Field Plot

The structural mapping of the global intellectual pipeline using a three-field Sankey diagram reveals strong geographic and institutional axes connecting author countries, prolific scholars, and academic institutions. At the national level, research production is primarily driven by Australia and the United States, closely complemented by substantial contributions from the United Kingdom, Canada, South Africa, and India. Within this structural network, prominent scholars such as S. Singh, N.R. Jain, R. Valdés, and A. Bozkurt emerge as pivotal intellectual nodes, bridging primary geographic affiliations with leading research centers.

Figure 3: Three-Field Plot



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

At the institutional level, the topology displays a marked concentration centered around major research hubs, notably the University of KwaZulu-Natal, the University of Johannesburg, and Monash University. Strong author-institution pairings—such as S. Singh and N.R. Jain with South African universities, or R. Valdés with Monash University—underscore localized institutional clusters that sustain high-volume output in social justice and inclusive education. While these dominant nodes highlight key centers of scientific excellence, the broader flow illustrates a globally distributed network where interdisciplinary scholarship links diverse national contexts to core research universities.

4.4. Synoptic Textual Synthesis of Core Bibliometric Indicators

A comprehensive synthesis of the core empirical indicators across the 1,387-document corpus delineates the primary structural dimensions governing the field. The temporal trajectory is characterized by an intrinsic logistic growth rate of $r = 0.292$ ($R^2 = 0.894$), projecting an annual output peak in mid-2028. Geographically, scientific production is led by the United States with 343 corresponding author papers and 949 total country occurrences, representing the primary node in the global collaboration topology. However, international collaboration ratios vary significantly: New Zealand demonstrates the highest multiple-country publication ratio at 29.2 percent, whereas the United States maintains a strongly domestic research profile with a 9.3 percent collaboration ratio. In terms of scholarly influence, New Zealand leads in citation efficiency with an average of 28.60 citations per paper, while the United States records the highest absolute volume with 5,016 total citations. At the document level, foundational scholarship is anchored by Dube (2020) with 276 global citations. Synthesizing these metrics with thematic co-occurrence network structures confirms that "social justice" (601 occurrences) acts as the principal motor theme driving global research on educational and territorial equity.

5. Bibliometric Analysis by Country

5.1. Corresponding Author Country Analysis

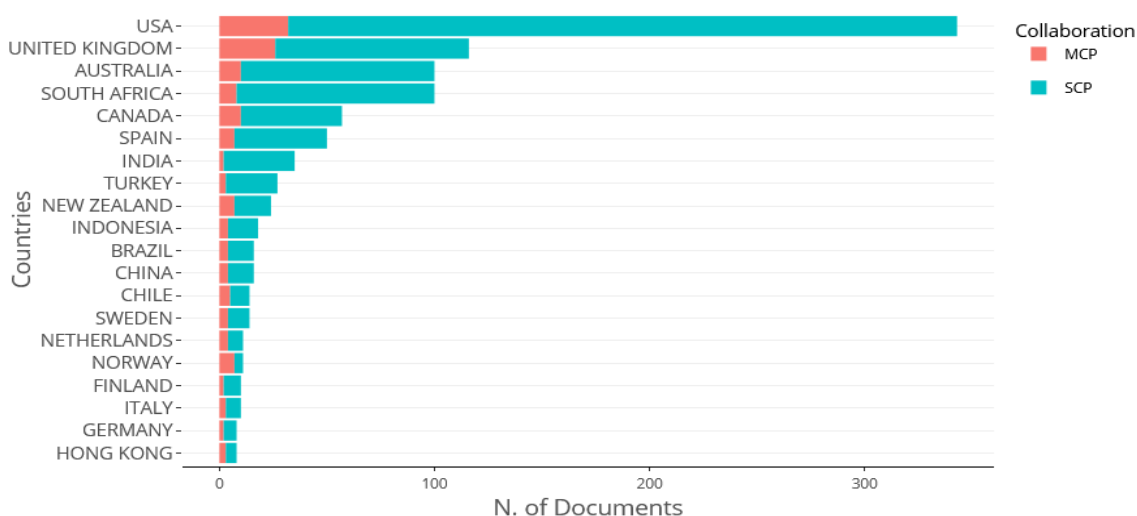
An analysis of corresponding author affiliations underscores a clear geographic concentration dominated by the United States, which leads global output with 343 articles accounting for 24.7 percent of the total collection. The United Kingdom follows with 116 articles (8.4 percent), while Australia and South Africa share equal volume with 100 articles each (7.2 percent). Additional notable scientific contributions stem from Canada (57 articles, 4.1 percent), Spain (50 articles, 3.6 percent), India (35 articles, 2.5 percent), Turkey (27 articles, 1.9 percent), New Zealand (24 articles, 1.7 percent), and Indonesia (18 articles, 1.3 percent), together forming the principal geographic foundation of the research corpus.

Cross-border collaboration dynamics reveal varying degrees of internationalization across these leading nations. While the United States and South Africa demonstrate strong domestic research independence with predominant Single Country Publications (311 and 92 articles, respectively) and relatively low Multiple Country Publication ratios (9.3 percent and 8.0 percent), other nations exhibit much higher international collaboration rates. New Zealand records the highest proportion of international co-authorship at 29.2 percent, closely followed by the United Kingdom (22.4 percent), Indonesia (22.2 percent), Canada (17.5 percent), and Spain (14.0 percent). These metrics highlight a dual structure within the field, balancing large, domestically anchored research outputs with highly collaborative international research networks.

However, interpreting these national productivity metrics requires a critical understanding of the structural biases inherent in major bibliometric databases. The strong concentration of publication volume in Anglo-American institutions is partially amplified by the English-language indexation bias of Web of Science and Scopus. Consequently, high-impact non-English or regionally published research on social justice from Southern perspectives remains

structurally underrepresented, artificially lowering the observed citation counts and collaboration centrality of peripheral research nodes (Mongeon & Paul-Hus, 2016).

Figure 4: Affiliation Productivity Over Time

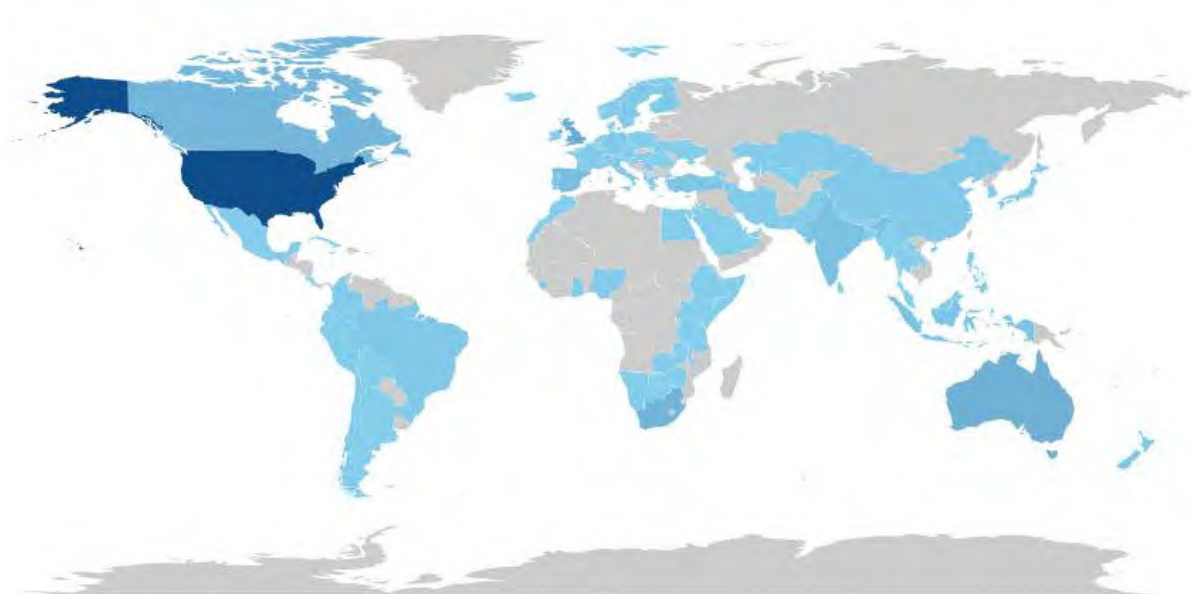


Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

5.2. Scientific Output Analysis by Country

An analysis of total scientific output by country—accounting for all author affiliations across multi-authored publications—further confirms the dominant position of the United States, which leads global production with 949 occurrences. The United Kingdom and Australia follow as major international research pillars, contributing 240 and 209 occurrences respectively. South Africa (184 occurrences) and Canada (166 occurrences) also demonstrate substantial scientific presence, highlighting strong institutional involvement across both the Global North and Global South.

Figure 5: Scientific Output by Country



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

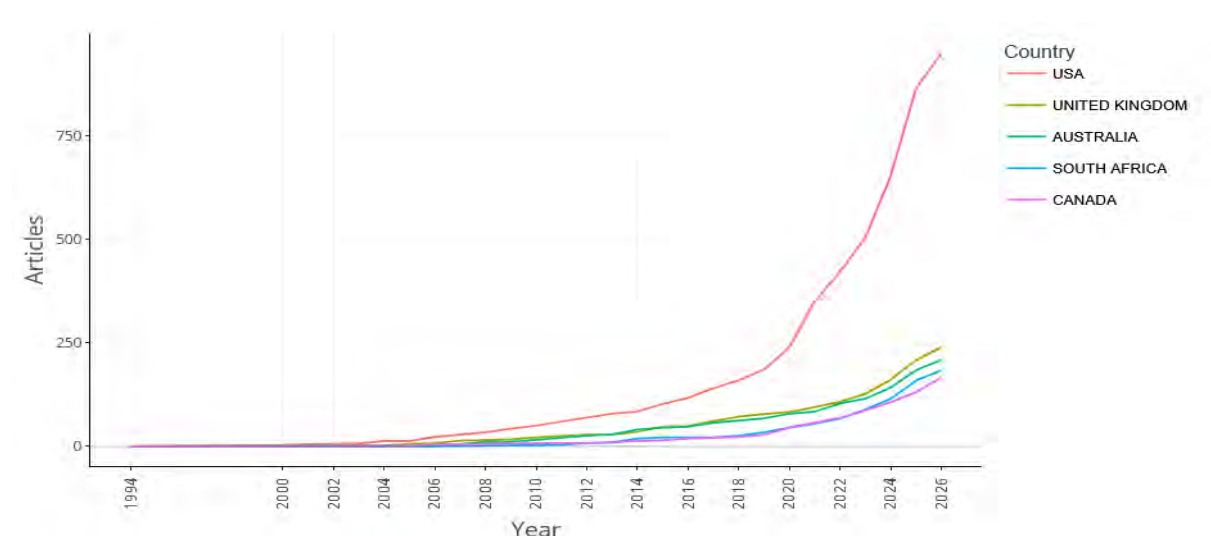
Spain (107 occurrences) and India (85 occurrences) represent key regional hubs driving research on educational equity and social justice within Europe and Asia. Furthermore, Indonesia (62 occurrences), Turkey (57 occurrences), and Chile (43 occurrences) round out the

top publishing nations, reflecting a growing regional diversification in scholarly contributions. Overall, these output distribution metrics illustrate an active international research landscape where established Anglo-American academic centers coexist alongside rapidly expanding research nodes in Latin America, Asia, and Africa.

5.3. Longitudinal Analysis of National Scientific Production

The longitudinal trajectory of national scientific production from 1994 to 2026 illustrates an extraordinary acceleration across leading countries, transitioning from sporadic early outputs into exponential, sustained growth. The United States has consistently maintained the leading trajectory, expanding from a single publication in 1994 to 103 by 2015, before surging dramatically to reach 949 articles by 2026. Similarly, the United Kingdom pioneered early European contributions starting in 1999, achieving steady growth to reach 48 articles in 2015 and culminating in 240 cumulative articles by 2026.

Figure 6: Countries' Production over Time



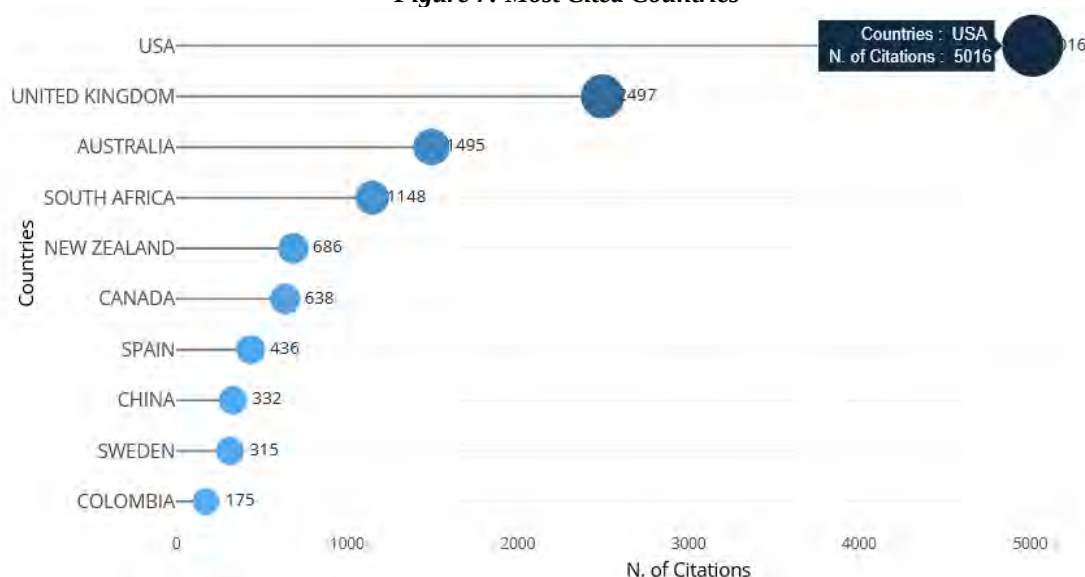
Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

Emerging national trajectories highlight a rapid post-2015 expansion among key regional hubs in the Global North and Global South. Australia, despite entering the dataset in 2006, experienced rapid institutional momentum, climbing from 45 articles in 2015 to 209 in 2026. Concurrently, South Africa and Canada demonstrated steep, parallel growth curves; South Africa expanded from a single document in 2003 to 184 articles in 2026, while Canada grew from its first publication in 2004 to 166 articles by 2026. This collective upward trend underscores a global intensification of research on social justice and inclusive education, driven by expanding international interest over the past decade.

5.4. Citation Impact and Academic Influence by Country

An analysis of citation impact and academic influence reveals significant variations in total citation volume and citation efficiency across major publishing nations. In absolute terms, the United States leads global scholarly impact with 5,016 total citations, followed by the United Kingdom with 2,497 citations, Australia with 1,495 citations, and South Africa with 1,148 citations. Other notable cumulative citation outputs originate from New Zealand (686 citations), Canada (638 citations), Spain (436 citations), China (332 citations), Sweden (315 citations), and Colombia (175 citations), reflecting substantial overall visibility across diverse regional platforms.

Figure 7: Most Cited Countries



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

When evaluating citation performance on a per-paper basis (Average Article Citations), higher citation efficiency is frequently observed among countries with selective or highly collaborative publication profiles. New Zealand achieves the highest average impact with 28.60 citations per article, followed closely by Colombia (25.00), Sweden (22.50), the United Kingdom (21.50), and China (20.80). Conversely, countries with large publication volumes, such as Australia (14.90), the United States (14.60), South Africa (11.50), Canada (11.20), and Spain (8.70), demonstrate more moderate citation averages. This contrast underscores how targeted, highly integrated research outputs can yield exceptional academic influence relative to total publication volume.

6. Document-Level Bibliometric Analysis

An analysis of the most globally cited documents highlights the intellectual anchors that define the theoretical and empirical foundations of this research field. Leading the global citation impact is the foundational study by Dube (2020), published in the *Multidisciplinary Journal of Educational Research*, which has accumulated 276 total citations and demonstrates an exceptional annual citation rate of 39.40. This is closely followed by landmark contributions from Pantić (2015) in *Educational Inquiry* (271 citations; 22.60 per year) and McKenzie et al. (2008) in *Educational Administration Quarterly* (258 citations; 13.60 per year). Additional fundamental scholarship driving the intellectual core includes influential papers by Archer (2007) in *Teaching in Higher Education* (207 citations) and Mensah (2018) in *Teachers College Record* (198 citations; 22.00 per year).

Complementing these foundational works are highly impactful contributions that examine inclusive pedagogy, educational leadership, and systemic equity across diverse institutional contexts. Pantić (2015) in *Teachers and Teaching: Theory and Practice* (197 citations) and Polat (2011) in the *International Journal of Educational Development* (192 citations) serve as key reference points for teacher agency and development policy. Furthermore, critical studies by Santamaría (2014) in *Educational Administration Quarterly* (177 citations), Portillo et al. (2020) in *Sustainability* (172 citations; 24.60 per year), and Salmi (2021) in *Policy Reviews in Higher Education* (168 citations; 28.00 per year) demonstrate exceptional citation velocity. Together, these highly cited papers reflect a strong scholar consensus bridging critical pedagogy, educational leadership, and policy-level inclusion frameworks.

Figure 8: Most Global Cited Documents



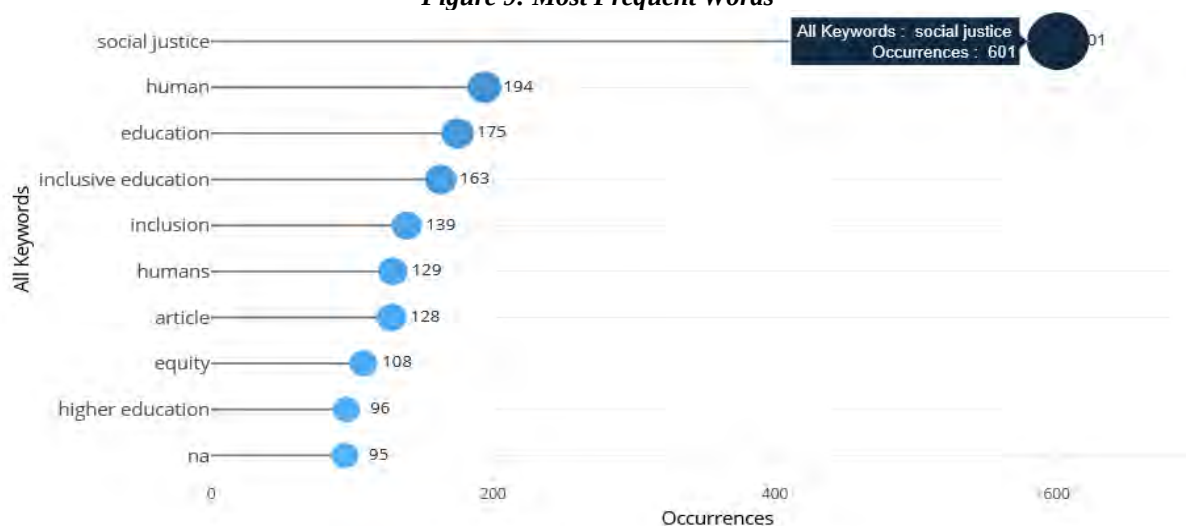
Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

7. Bibliometric Analysis by Keywords

7.1. Lexical Density and Most Frequent Keywords

An analysis of lexical density and keyword frequencies highlights the primary conceptual pillars that define the thematic structure of the collection. The most dominant term across the corpus is "social justice," appearing 601 times, which underscores its role as the overarching theoretical framework governing the literature. Major educational dimensions are represented by core terminology including "education" (175 occurrences), "inclusive education" (163 occurrences), "inclusion" (139 occurrences), "equity" (108 occurrences), and "higher education" (96 occurrences), reflecting a clear focus on structural fairness and pedagogical access across institutional levels.

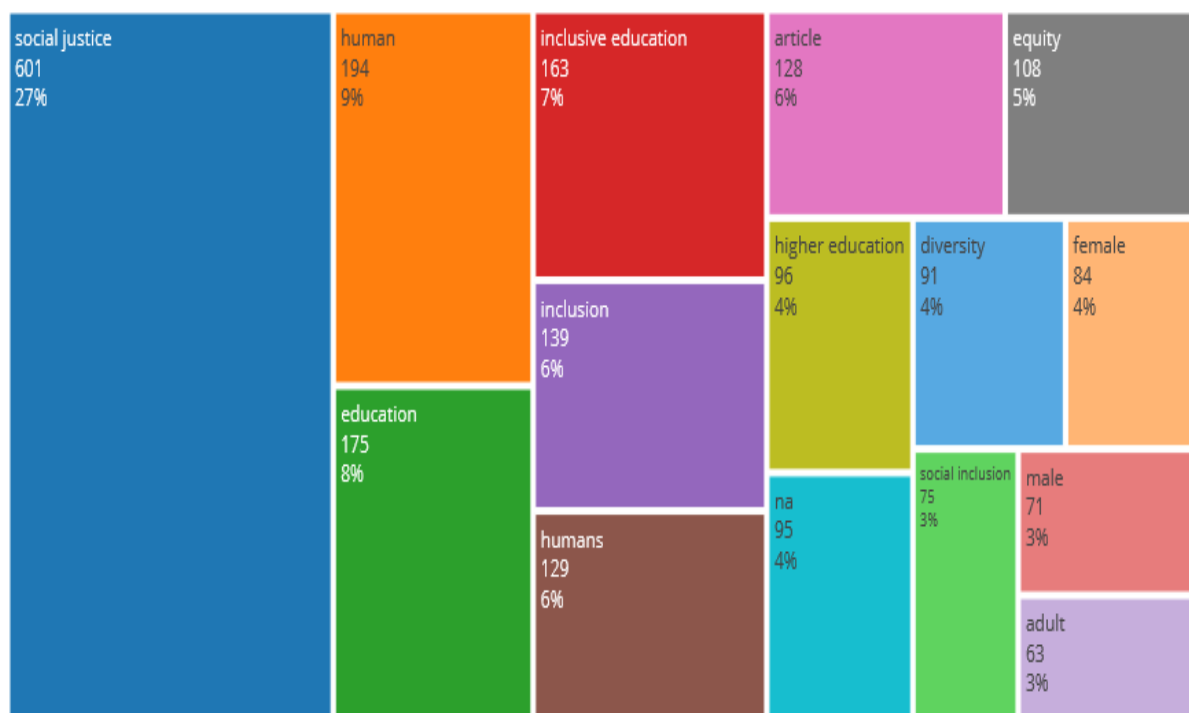
Figure 9: Most Frequent Words



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

In addition to core discipline-specific concepts, general index and metadata terms further characterize the textual composition of the dataset. Descriptors such as "human" (194 occurrences) and "humans" (129 occurrences) emphasize the person-centered and sociological focus of these investigations, while procedural index terms like "article" (128 occurrences) reflect standard database indexing practices. Together, these high-frequency keywords demonstrate a strong conceptual alignment centered around educational equity, human rights, and systemic social justice.

Figure 11: WordCloud



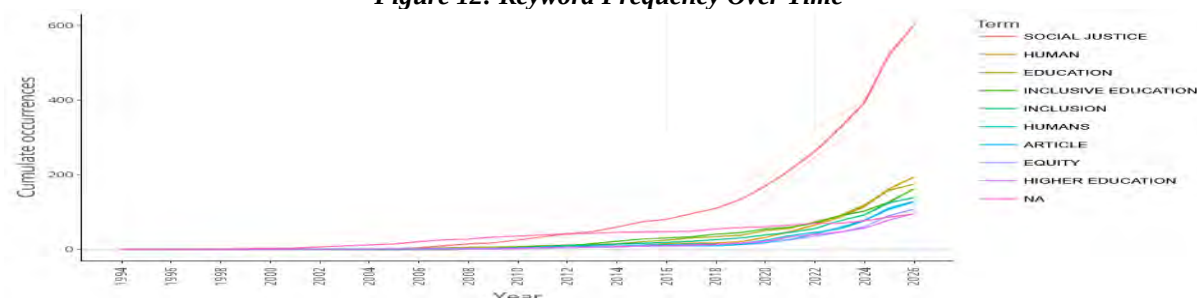
Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

Surrounding these core blocks, smaller comparative partitions map institutional settings and contextual descriptors within the TreeMap structure. The distinct presence of "higher education" (96 occurrences) forms a specific sectoral block dedicated to post-secondary equity and institutional policy. Meanwhile, broader demographic and database metadata terms such as "human" (194 occurrences), "humans" (129 occurrences), and "article" (128 occurrences) fill out the structural matrix, completing a hierarchical layout that visually balances macro-level social theory with specific educational implementations.

7.4. Longitudinal Word Frequency and Evolutionary Trajectories

The longitudinal trajectory of word frequencies from 1994 to 2026 demonstrates an extraordinary post-2015 conceptual expansion, transitioning from a nascent baseline into exponential cumulative growth. Overarching theoretical descriptors experienced unprecedented surging volume, led by "SOCIAL JUSTICE," which expanded from a single occurrence in 2003 to 74 in 2015, ultimately climbing to 601 occurrences by 2026. Parallel evolutionary trends are evident across core operational concepts, as "INCLUSIVE EDUCATION" grew from 28 occurrences in 2015 to 163 in 2026, while "EDUCATION" (21 to 175) and "INCLUSION" (17 to 139) followed identical steep trajectories.

Figure 12: Keyword Frequency Over Time



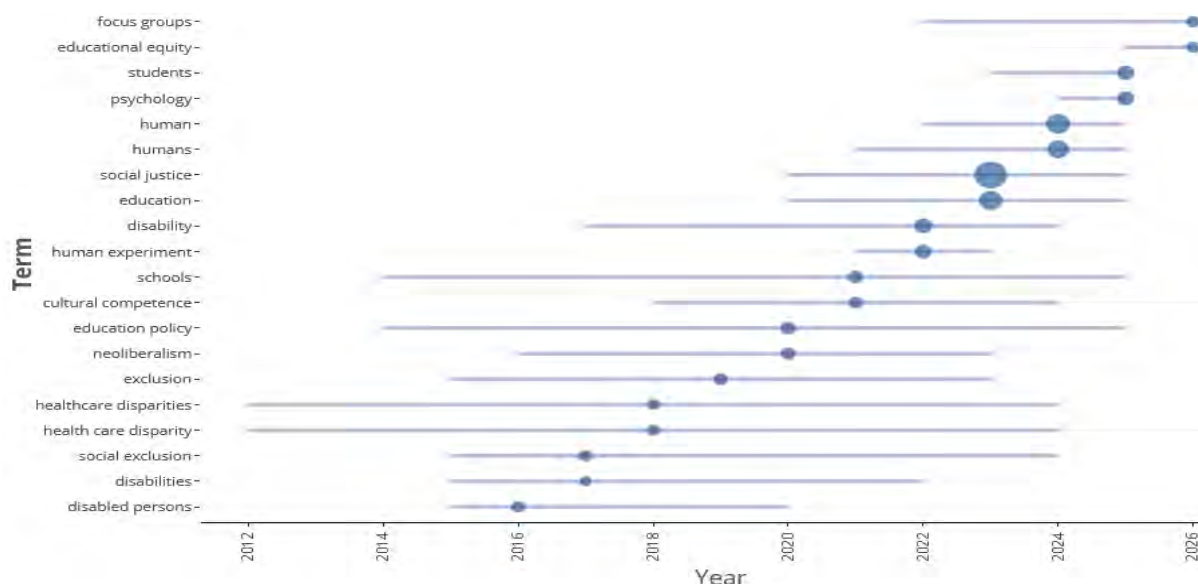
Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

Institutional and demographic keywords reflect a corresponding structural acceleration over the past decade. "HIGHER EDUCATION" expanded from 9 occurrences in 2015 to 96 by 2026, illustrating a growing research focus on post-secondary institutional equity. Concurrently, human-centered and systemic policy descriptors such as "EQUITY" (9 to 108), "HUMAN" (12 to 194), and "HUMANS" (12 to 129) experienced multi-fold growth, capturing the broadening socio-humanitarian scope of the discipline. This dynamic keyword evolution confirms that research on educational equity has matured from isolated, low-frequency discussions into a dominant, highly integrated global research agenda.

7.5. Emerging Frontiers and Thematic Evolution

An analysis of thematic evolution and trend topics reveals a clear shift in the field's intellectual focus, transitioning from structural analyses of marginalization toward systemic equity and methodological refinement. Earlier research phases concentrated on foundational sociopolitical and institutional challenges, characterized by topics such as disabled persons, social exclusion, healthcare disparities, neoliberalism, and education policy. These established themes mapped the institutional and socioeconomic dimensions of structural inequality, providing a critical baseline that examined how systemic policy frameworks and schooling environments impact vulnerable populations.

Figure 13: Trending Topics



Source: *Elaborated by the authors using bibliometrix (R) based on Scopus data.*

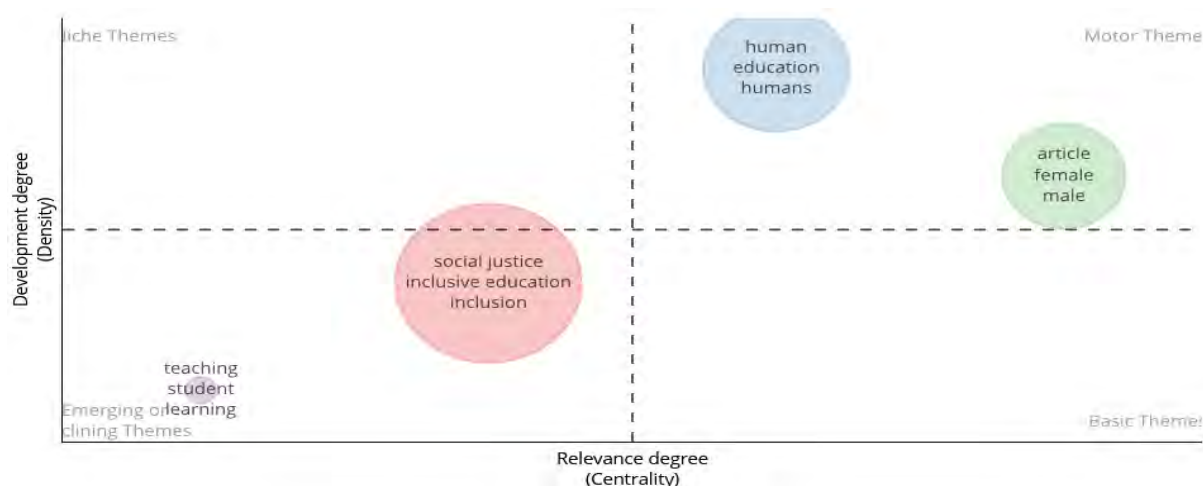
In contrast, recent evolutionary trajectories highlight cutting-edge frontiers centered on actionable pedagogical strategies and empirical methodologies. The most recent period is defined by a dramatic surge in core overarching concepts—most notably social justice, education, and broad human-centered frameworks—alongside newly emerging research fronts such as educational equity, psychology, students, and focus groups. This ongoing thematic shift underscores a maturing scholarly field that increasingly blends macro-level normative theory with localized, empirical, and psychological investigations to foster inclusive practices in contemporary educational settings.

8. Network Approach

The strategic mapping analysis provides a nuanced evaluation of thematic coherence, network centrality, and conceptual development across the research corpus. Dominating the strategic map is **Cluster 1 ("Social Justice")**, which functions as the primary motor theme driving the field's intellectual architecture. Anchored by the principal node "social justice" (601

occurrences), this cluster exhibits exceptionally high Callon centrality and density metrics, reflecting both strong internal cohesion and pervasive external connectivity across the broader network. Highly frequent co-occurring keywords within this core cluster include "inclusive education" (163 occurrences), "inclusion" (139 occurrences), "equity" (108 occurrences), and "higher education" (96 occurrences), confirming that theoretical frameworks of social justice are structurally integrated into research on educational access and institutional reform.

Figure 14: Thematic Map



Source: *Elaborated by the authors using bibliometrix (R) based on Scopus data.*

Furthermore, the thematic composition of Cluster 1 demonstrates how broad equity frameworks are operationalized across institutional levels and specialized sub-disciplines. The systematic inclusion of key nodes such as "diversity" (91 occurrences), "social inclusion" (75 occurrences), "disability" (54 occurrences), "teacher education" (45 occurrences), and "intersectionality" (37 occurrences) captures a multifaceted and intersectional research agenda. This network topology underscores that scholarly inquiry within this cluster continuously bridges macro-level theories of social justice with meso- and micro-level applications—positioning teacher preparation, post-secondary policy, and inclusive pedagogical practices as critical drivers of systemic educational equity.

9. Countries' Collaboration World Map

An analysis of the country collaboration network reveals a highly interconnected global research system structured around key Anglo-American, European, and Asia-Pacific hub nations. At the core of this network is the **United States**, which exhibits the highest overall connectivity and collaboration frequency, featuring particularly strong bilateral partnerships with **Canada** (14 joint linkages) and the **United Kingdom** (14 joint linkages). The United States further acts as a critical bridge between North America, Europe, Asia, and the Global South through significant collaboration ties with Turkey (6), China (6), Australia (5), and South Africa (5).

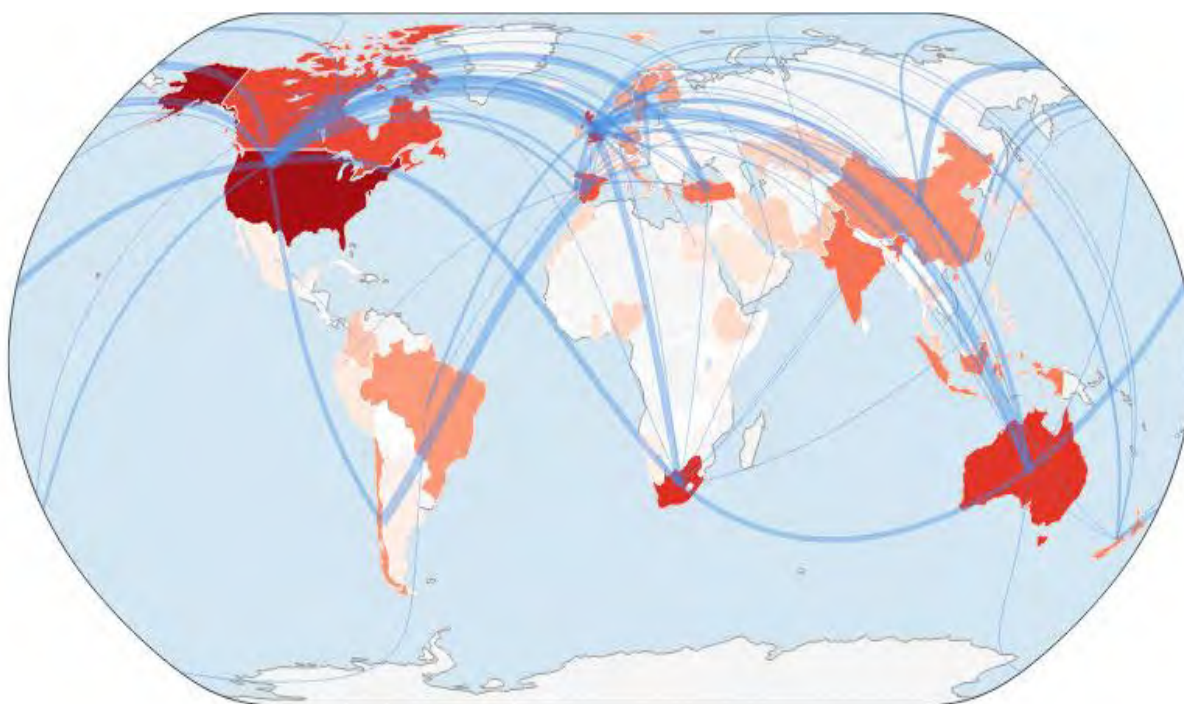
The **United Kingdom** serves as a vital European and transatlantic nexus, maintaining prominent collaboration ties with **Australia** (8 linkages), **South Africa** (6 linkages), **Germany** (5 linkages), and **Norway** (5 linkages). In parallel, **Spain** forms a crucial linguistic and regional bridge to Latin America, anchored by a primary international collaboration vector with **Chile** (8 linkages), alongside stable European connections to Portugal (3) and intra-regional partners. Regional hubs also demonstrate well-defined collaboration clusters across the network:

- **Asia-Pacific & Oceania:** **Australia** maintains strong ties with China (4), South Africa (4), the Netherlands (3), New Zealand (2), and Malaysia (2). Concurrently, **China**

bridges East Asia with Europe, Africa, and North America via linkages with Finland (2), Germany (2), Norway (2), Malaysia (2), and South Africa (2).

- **African & Global South Integration:** South Africa emerges as the principal scholarly gateway for the African continent, demonstrating strong intra-African partnerships with Namibia (3), Botswana (1), Malawi (1), Kenya (1), Nigeria (1), and Morocco (1), alongside extensive cross-continental ties to the UK, USA, Canada, and Australia.
- **European Union Network:** Strong intra-European cohesion is driven by intra-regional sub-clusters across **Sweden** (partnered with Portugal, Norway, Denmark, Croatia, New Zealand), **Germany** (partnered with Austria, Netherlands, Portugal), and **Portugal** (partnered with Croatia, Czech Republic, Denmark).

Figure 15: World map of countries collaboration



Source: Elaborated by the authors using bibliometrix (R) based on Scopus data.

10. Structural Position of Morocco within the Global South Collaboration Network

Within the African collaboration architecture, Morocco occupies a strategically vital position as a North African gateway bridging Arab-Mediterranean epistemic communities with Sub-Saharan scientific networks. Although currently represented by an emerging co-authorship link with South Africa (1 linkage), Morocco's structural presence illustrates the gradual insertion of Maghreb scholars into global social justice and public policy research. In recent years, national public policy reforms in Morocco—notably the implementation of the New Development Model (NMD) and territorial decentralization strategies—have intensified scholarly focus on territorial equity, inclusive education, and regional social justice. Integrating Moroccan institutional nodes into broader African and Euro-Mediterranean collaboration corridors remains essential for reducing core-periphery asymmetries, fostering South-South research synergies, and generating contextualized empirical knowledge on social cohesion across Northern Africa.

11. Discussion

11.1. Methodological and Structural Limitations

The empirical findings demonstrate that global scientific collaboration in social justice, health equity, and inclusive education is structured as a complex, hierarchical network dominated by well-established transatlantic and Anglo-American core nodes. The pronounced centrality of the United States and the United Kingdom reflects their enduring capacity to attract international research talent and lead major global research consortia focused on educational equity and public policy reform. This structural concentration reinforces the preferential attachment dynamics documented in network theory, where central nodes continuously strengthen their position within the global knowledge economy, shaping normative definitions of inclusive pedagogy and social welfare.

At the same time, the data highlight the critical role of multidimensional proximity in shaping cross-border research links on social inclusion. The strong collaboration vector observed between Spain and Chile illustrates how linguistic, cultural, and historical affinities can bridge geographic distances, creating robust channels for knowledge exchange surrounding educational rights and vulnerable populations in Ibero-America. Similarly, the tight coupling between the United States and Canada underscores the compounding effect of geographic contiguity combined with institutional alignment, facilitating seamless joint scientific production on spatial justice and institutional governance.

The emergence of regional collaboration anchors, most notably South Africa within the African continent and Australia across the Asia-Pacific, points to a gradual diversification of global science in inclusive education and public policy. South Africa acts as an essential bridge connecting sub-Saharan African research institutions with core scientific systems in Western Europe and North America. This dual positioning enables regional knowledge synthesis on rural education, digital equity, and post-colonial social justice while maintaining integration with high-impact global research networks.

Despite these positive trends toward multi-polarity, structural peripheralization remains a defining challenge for many developing research systems seeking to advance local equity agendas. Numerous nations in the dataset exhibit sparse, highly dependent collaboration links, frequently relying on a single core partner for international visibility. This structural asymmetry limits peripheral nations' capacity to direct global research agendas toward local socio-economic priorities such as regional educational disparities, indigenous rights, and territorial governance, perpetuating systemic inequalities in scientific capacity.

11.2. Actionable Policy Recommendations and Governance Mechanisms

A comprehensive interpretation of these empirical findings requires acknowledging several key methodological and data limitations. First, while merging Web of Science Core Collection and Scopus provides an extensive cross-database snapshot, bibliometric indexing inherently favors English-language journals, introducing a systemic publication bias that underestimates non-English scholarly output from Latin America, Francophone Africa, and Asia (Mongeon & Paul-Hus, 2016). Second, reliance on institutional affiliation metadata captures formal co-authorship networks but misses informal academic exchanges, grassroots policy consultations, and non-indexed regional policy reports that significantly shape social justice discourse in the Global South. Third, using equal-count country attribution across multi-authored publications may overstate the relative research capacity of peripheral institutions in large multi-partner consortia where lead authorship remains concentrated in Western centers.

11.2. Actionable Policy Recommendations and Governance Mechanisms

Addressing these spatial and structural disparities requires targeted, actionable interventions

from institutional funding agencies, regional research consortia, and international policy organizations. Specifically, global funding bodies such as the Global Research Council (GRC), UNESCO, and Horizon Europe should establish dedicated South-South-North co-funding mechanisms that mandate lead principal investigators from Southern institutions on projects investigating territorial equity and inclusive education. Regional alliances such as the African Union's Scientific, Technical and Research Commission or Euro-Mediterranean university consortia must establish shared digital repositories, co-supervised doctoral programs, and regional citation indexes to amplify non-English scholarly output. Furthermore, academic evaluation committees in core Anglo-American institutions should reform tenure and promotion criteria to explicitly value equitable cross-border co-authorship, knowledge-sharing partnerships, and context-specific policy impacts in peripheral regions over traditional journal impact factors alone.

12. Conclusion

This study has provided a comprehensive macro-structural analysis of international scientific collaboration networks, mapping the relational architecture that governs contemporary cross-border knowledge production. By combining topological network metrics with socio-spatial theory, the investigation has elucidated how geography, history, and institutional capacity interact to shape global research partnerships. The empirical evidence confirms both the persistent dominance of core academic hubs and the gradual emergence of key regional bridges. The theoretical contributions of this research reside in clarifying the dual mechanics of network self-organization and spatial constraint in science systems. While digital connectivity enables global reach, scientific collaboration remains bounded by structural proximities that concentrate high-density ties within specific geopolitical corridors. Conceptualizing global science as an unequal relational graph offers a valuable analytical lens for evaluating how knowledge privileges are sustained or disrupted across spatial scales.

From a policy perspective, the insights generated emphasize the need to move beyond simple co-authorship counts toward evaluating network positionality and partnership quality. Science policy frameworks must design incentives that encourage genuine co-creation and capacity building in peripheral regions, counteracting tendencies toward scientific extraction. Supporting regional research hubs can serve as an effective mechanism for democratizing access to global knowledge networks.

A key scientific requirement for this study involves maintaining explicit alignment between the broad theoretical framework of global science collaboration and the specific empirical dataset analyzed. While macro-structural metrics provide systemic insights into core-periphery network topology, the empirical findings of this research specifically reflect the interdisciplinary domain of social justice, health equity, and inclusive education across 1,387 peer-reviewed articles published between 1994 and 2025. Recognizing this boundary ensures that theoretical claims regarding preferential attachment and spatial proximity are properly contextualized within social science and public policy research, rather than erroneously generalized as universal laws governing all natural or applied science fields.

Evaluating the empirical scope of this study necessitates highlighting several inherent bibliometric boundaries. First, the primary dataset relies on indexed metadata from Web of Science Core Collection and Scopus over the 1994–2025 timeframe, omitting non-indexed regional journals and gray literature that contain crucial local policy discussions on social equity. Second, the structural focus on multi-country author affiliations underrepresents informal collaboration networks, academic exchanges, and non-author research assistance. Third, language indexing restrictions create a persistent Anglo-American geographic bias, which artificially downplays the volume and impact of Francophone, Arabic, and Spanish research outputs from developing research systems.

To advance the empirical and theoretical frontiers of bibliometric network research, future scholarship should address three operationalized research questions: 1. How do structural shocks—such as geopolitical shifts, changes in international research funding, or regional conflicts—alter the resilience and centrality of South-South co-authorship ties in inclusive education research over a 10-year longitudinal period? 2. To what extent do bilateral international research grants accelerate or impede the lead-author autonomy of Southern scholars in multi-regional public policy partnerships? 3. What specific institutional mechanisms best facilitate the translation of bibliometrically central research on territorial equity into actionable regional public policy reforms?

To optimize the integration of Moroccan and North African research institutions into global knowledge networks on social justice and public policy, national science, technology, and innovation (STI) policymakers should implement three strategic interventions:

1. Establish a National South-South Research Integration Fund managed by the Ministry of Higher Education and CNRST, dedicated to co-funding international consortia on territorial governance that require partner institutions from Sub-Saharan Africa and the Euro-Mediterranean region.
2. Expand national indexing platforms and digital repositories to elevate the international visibility of French- and Arabic-language scholarly journals focused on local social welfare, regional equity, and educational reform.
3. Update national university evaluation frameworks to incentivize lead-author publications in international collaborative projects, ensuring that regional scholars maintain agenda-setting authority in research addressing Moroccan and North African territorial development.

In closing, fostering a truly global knowledge ecosystem requires addressing the structural asymmetries that constrain scientific integration across diverse regions. As global challenges become increasingly complex and interdependent, building balanced, inclusive, and spatially equitable research networks is not merely an academic ideal, but a practical imperative for the global scientific community.

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