

Where is Vocational Education Heading? Unpacking Two Decades of Global Knowledge Dynamics and Policy Relevance

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ABSTRACT

Purpose – As digital disruption and global inequalities reshape the future of work; vocational education is increasingly recognized as essential for skills development and social mobility. However, the field remains marked by thematic fragmentation—between traditional foci such as curriculum and pedagogy and emerging priorities like digitalization, equity, and learner well-being—and significant geographical imbalance, with research output dominated by a few high-income countries. This study maps the intellectual and policy landscape of vocational education research (2000–2024) to clarify its alignment with urgent global challenges.

Method – A total of 11,781 Scopus-indexed articles was analyzed using bibliometric tools in R, including keyword co-occurrence, thematic mapping, and international collaboration network analysis to reveal dominant clusters and neglected themes.

Findings – Research in vocational education is anchored in curriculum and employability, yet digital skills, gender inclusion, and mental health remain underexplored. Publication is concentrated in Australia, the US, Germany, and China, reinforcing North–South disparities and limiting global integration. While interest in innovation is rising, persistent conceptual fragmentation still hinders policy impact.

Research Implications – Policymakers should move beyond rhetoric to embed digital skills, equity, and well-being in policy and curricula. Future research needs to address underrepresented issues and regions, foster cross-country collaboration, and better translate evidence into practice. The focus on English-language, Scopus-indexed articles may exclude some regional scholarship.

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Introduction

Where is vocational education heading? This question is no longer rhetorical—it is a critical inquiry into the intellectual, political, and practical pathways shaping one of the most consequential educational domains of the 21st century. Vocational education and training (VET) has long been heralded as a mechanism for employability, productivity, and economic equity. Yet, as the world hurtles through successive waves of industrial disruption and policy reform, the core knowledge structures, theoretical paradigms, and foundational concepts—that is, the *epistemic foundations*—of vocational education remain surprisingly under-mapped, and its future direction dangerously under-theorized (Chen & Li, 2025; Yasdin & Muksin, 2024).

Over the last two decades, VET systems have been tasked with solving some of the world's most pressing crises—from youth unemployment to skills mismatches, from the marginalization of low-income learners to the fragmentation of labor markets (Müller, 2024; Paudel et al., 2025). However, research in this field has failed to converge into a cohesive global discourse. What has emerged instead is an ever-growing constellation of isolated studies, characterized by fragmentation on at least three fronts: thematically, methodologically, and geographically.

Thematically, research tends to focus narrowly on select issues such as blended learning models, digital skills, or student well-being, but these strands often develop in silos rather than as part of an integrated framework (Panday et al., 2025). Methodologically, studies employ diverse approaches—from tracer studies mapping employability outcomes (Ababio et al., 2024), to large-scale bibliometric analyses capturing publication trends (Sundar & Gurupandi, 2025)—making it challenging to compare results across contexts. Geographically, scholarship is dominated by research in particular regions, while perspectives from other parts of the world remain underrepresented (Ababio et al., 2024). As a result, the field remains scattered across disciplines, regions, and epistemologies, with little sense of trajectory or thematic consensus (Zhang et al., 2025). Policymakers are thus often left navigating blind spots, and practitioners are working without a compass.

There is no shortage of ambition in vocational education. In China, for example, massive investments in VET have fueled upward economic mobility and catalyzed industrial transformation (Chen & Li, 2025). In Indonesia, policy interventions have become highly politicized, shifting with ideological tides rather than evidence-based continuity (Yasdin & Muksin, 2024). And in Nepal, persistent misalignment between vocational curricula and labor market realities continues to render reform efforts only partially effective (Paudel et al., 2025). These national snapshots, while instructive, reflect a broader pattern: the research base of vocational education is expanding—but without coherence.

The urgency of this fragmentation becomes even more acute when we consider the emotional and psychological dimensions of VET learners. Studies consistently show that students in vocational tracks face stigma, lower self-worth, and limited aspirations, particularly when vocational education is perceived as a second-choice pathway (Wicht et al., 2024; Wang et al., 2024). While some empirical studies suggest that interventions based on positive psychology can be transformative—indicating that emotional well-being and motivation are not peripheral, but central to vocational success—evidence in this area remains emergent and context-dependent (Wang & Zhang, 2025; Zhang et al., 2025).

Simultaneously, the pedagogical discourse is being reshaped by creativity, aesthetics, and learner agency. In a context where technical competencies alone are no longer sufficient, concepts like creative self-efficacy (Mahfud et al., 2024), thematic immersion (Øgård et al., 2025), and digital fluency (Lee et al., 2024) are rapidly gaining currency. Yet again, the literature is siloed—making it difficult to track whether these shifts are global trends, local innovations, or momentary pedagogical fashions.

This study seeks to intervene in this intellectual fragmentation by undertaking a comprehensive bibliometric mapping and policy-oriented synthesis of vocational education research over the past 24 years. Utilizing the R programming environment—specifically the bibliometrix and biblioshiny packages—this study systematically analyzes what has been studied, by whom, where, and with what effect (Shen et al., 2025; Genchi et al., 2025; Zuo & Tian, 2025). In contrast to previous bibliometric reviews that have focused primarily on mapping publication trends or identifying prolific authors and countries, this study offers an added value by integrating thematic evolution analysis and policy relevance, thereby revealing not only the structure of the research field but also its alignment with emerging educational priorities and gaps in policy implementation. Rather than merely visualizing publication data, the analysis is designed to uncover latent structures, thematic evolutions, and influential scholarly networks that drive vocational education discourses across global contexts.

The power of bibliometric analysis lies not just in quantification, but in pattern recognition and agenda setting. It reveals blind spots, amplifies neglected voices, and surfaces new intellectual frontiers. In Shakespearean studies, for example, bibliometric review uncovered the evolution of global cultural adaptation across four methodological epochs (Li & Li, 2025). In the field of digital competence in education, such analysis revealed how scattered micro-level studies can coalesce into a cohesive scholarly movement (Ferri et al., 2025). These methods, when applied to VET, offer the same promise: the opportunity to trace not only what we know, but also what we have refused to know.

To date, few bibliometric studies have examined vocational education as a transnational field of research, and fewer still have connected those findings to the actual

mechanics of policy formation and educational practice. This paper addresses that gap by not only mapping the intellectual structure and thematic evolution of vocational education research globally, but also by explicitly linking these bibliometric patterns to challenges and opportunities in policy development and educational implementation. It addresses the following urgent questions: What are the dominant knowledge structures in vocational education research? Where are the epistemic silences? And how can these patterns inform smarter, fairer, and more responsive policies?

By unpacking two decades of global knowledge dynamics, this study contributes a long-overdue map of vocational education's intellectual landscape—a map that is not neutral, but normative; not descriptive, but directive. In doing so, it offers researchers, policymakers, and practitioners a new lens through which to understand what vocational education has been, what it is becoming, and, more importantly, what it could be.

Methods

This study employed a quantitative descriptive design using a bibliometric mapping approach to synthesize two decades of global scholarship on vocational education. The choice of this method was grounded in the objective to not only map the volume and structure of scientific outputs, but to also critically examine the thematic trajectories, intellectual clusters, and policy relevance of research in Technical and Vocational Education and Training (TVET) between 2000 and 2024. Bibliometric analysis has been widely recognized as a powerful technique to understand the growth, scope, and direction of scientific fields, particularly when supported by structured computational tools (Aria & Cuccurullo, 2017; Ferri et al., 2025).

1. Population and Sample

The population of this study comprised all peer-reviewed journal articles published between 2000 and 2024 that thematically focused on vocational education. Using metadata retrieved from the Scopus database, the authors identified 11,781 English-language articles representing scholarly contributions across multiple disciplines. The search was conducted using the following query: *TITLE-ABS-KEY("vocational education" OR "TVET" OR "technical and vocational education and training") AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMIT-TO(DOCTYPE, "ar")) AND (LIMIT-TO(LANGUAGE, "English"))*. This search string ensured the inclusion of articles explicitly addressing vocational education or TVET, limited to journal articles in English published from 2000 to 2024.

These documents were published in 3,489 distinct sources and cited a total of 402,023 references, offering a comprehensive basis for thematic and network-based bibliometric analysis.

The large number of articles retrieved is not incidental. It reflects the exponential growth of research in vocational education, marked by an annual growth rate of 8.25%, and driven by increasing global urgency to align workforce development with socioeconomic transformation (Chen & Li, 2025; Yasdin & Muksin, 2024). This volume also evidences the diversity of academic contributions and the multidimensional nature of vocational education discourse, encompassing psychological, pedagogical, technological, and policy perspectives.

2. Data Collection and Cleaning

All metadata were exported in BibTeX format from Scopus and processed using the R programming language, specifically the bibliometrix package and its web-based interface biblioshiny (Aria & Cuccurullo, 2017). The raw data were meticulously cleaned to resolve inconsistencies in author names, affiliations, and keywords. Duplicate entries and incomplete records were excluded to ensure the analytical integrity of the dataset. References and keywords were standardized to enable accurate co-word analysis and network modeling.

3. Data Analysis Technique

The analysis proceeded in three stages:

- 1) **Descriptive Analysis:** This initial phase identified publication trends, prolific authors, high-impact sources, and citation behaviors over time. The average citation per document (13.6) and average article age (8.7 years) were used to assess the maturity and influence of the field.
- 2) **Conceptual and Thematic Mapping:** Keyword co-occurrence and co-word analysis were applied to uncover dominant themes and conceptual evolution. This technique enabled the identification of both stable research cores (e.g., vocational pedagogy, skill mismatch) and emerging frontiers (e.g., 4IR, psychological resilience).
- 3) **Structural Analysis and Cluster Detection:** Using Multiple Correspondence Analysis (MCA) and clustering algorithms embedded in bibliometrix, the study mapped the intellectual structure of the field, grouping authors, themes, and sources into coherent knowledge clusters (Liang et al., 2025; Genchi et al., 2025). These clusters were later interpreted against the backdrop of global policy shifts and regional implementation patterns.

4. Justification for Bibliometric Approach

Bibliometric analysis, particularly when applied through the rigor of open-source and transparent tools like R, offers a reproducible and scalable method for educational synthesis. It avoids the limitations of narrative review, which is often constrained by subjectivity and selection bias (Zuo & Tian, 2025; Jaheer Mukthar et al., 2025). More importantly, when framed within a policy-oriented lens, bibliometrics can illuminate whose voices dominate the discourse, what knowledge is systematically overlooked, and

how global priorities in vocational education are shaped—or neglected—over time (Kabiri et al., 2025; Batz et al., 2025).

By blending algorithmic precision with policy-critical interpretation, this study transforms bibliometric mapping from a descriptive tool into a reflective and normative method—one capable of guiding not only future research, but also the strategic directions of vocational education policy across diverse contexts. For example, rather than merely reporting which thematic clusters are most prominent, this study critically interprets the dominance of topics such as digital skills or employability in the literature as evidence of policy priorities, while simultaneously highlighting underexplored areas (such as learner well-being or equity) that represent critical gaps in research and practice. Such interpretive analysis allows bibliometric findings to inform not only what is known, but also what still needs to be addressed by policymakers and researchers.

Result

1. Yearly and Cumulative Publication Trends (2000 – 2024)

All metadata were exported in BibTeX format from Scopus and processed using the R programming language, specifically the bibliometrix package and its web-based interface biblioshiny (Aria & Cuccurullo, 2017). The dataset was cleaned to resolve inconsistencies in author names, affiliations, and keywords. Duplicate entries and incomplete records were excluded to ensure analytical integrity. References and keywords were standardized to enable accurate co-word analysis and network modeling.

Figure 1 presents the yearly and cumulative publication trends in vocational education research from 2000 to 2024. The number of annual publications increased from 188 articles in 2000 to 1,261 articles in 2024. The cumulative total reached 11,781 articles published across this period. The chart indicates a steady and accelerating rise in both yearly and cumulative publication counts, with an average annual growth rate of 8.25%. These articles were published in 3,489 distinct sources and cited a total of 402,023 references.

A notable increase in annual publications is observed after 2020, with the yearly total consistently exceeding 800 articles per year during this period. This pattern reflects a general expansion in scholarly attention to vocational education over the last two decades.

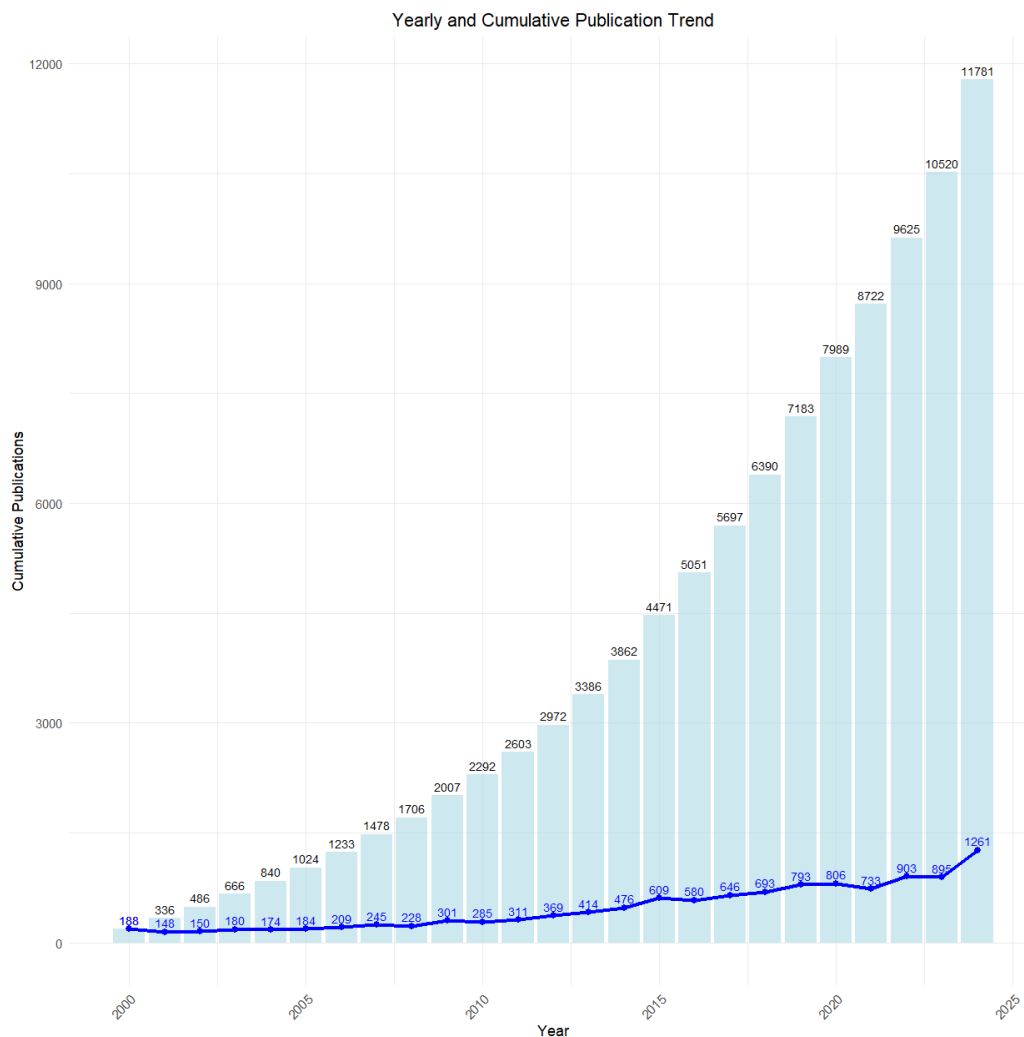


Figure1. Yearly and Cumulative Publication Trend in Vocational Education (2000–2024)

2. Mapping the Landscape: Scientific Production, Citation Impact, and Structural Patterns in Vocational Education Research (2000 – 2024)

Understanding the depth and breadth of a knowledge domain begins with mapping its scientific productivity and intellectual influence. This section synthesizes key bibliometric indicators—including document counts, citation averages, author collaboration, and source concentration—to illuminate the structural profile of vocational education research from 2000 to 2024.

2.1. Scope and Value of Publication

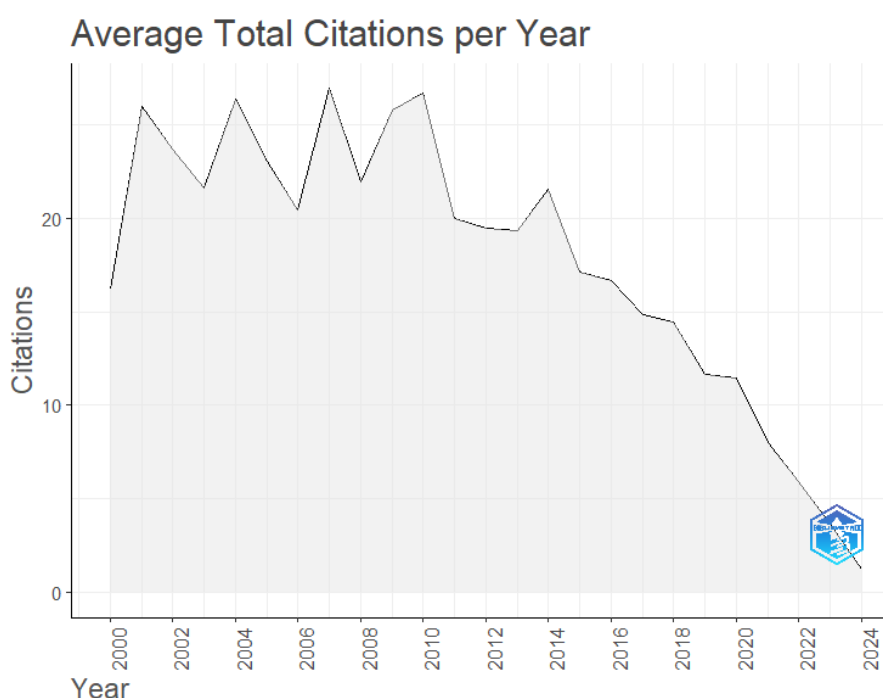
The dataset analyzed comprises 11,781 articles retrieved from Scopus-indexed sources, published over a 25-year timespan across 3,489 distinct journals and book series. As shown in the summary below, these publications cite over 400,000 references, with each article receiving on average 13.6 total citations, and 1.41 citations per year—metrics indicative of sustained scholarly engagement over time. To provide a snapshot of the dataset's breadth, Table 1 outlines the primary descriptive statistics drawn from the bibliometric metadata.

Table 1. Core Bibliometric Indicators

Indicator	Value
Timespan	2000 – 2024
Total Documents	11,781
Distinct Sources	3,489
Total References	402,023
Average Article Age	8.7 years
Average Citations per Document	13.6
Average Citations per Year per Doc	1.41
Document Type	Article Only

2.2. Annual Growth and The Citation Lifestyle

In addition to the overall increase in publication volume, the dataset reveals trends in citation patterns over time. As shown in Figure 2, the average total citations per article per year were highest for articles published in the early 2000s, frequently exceeding 20 citations per year. Over the subsequent years, a gradual decline in average citations per article is observed, with the most recent publications (2020–2024) receiving fewer citations on average. This pattern reflects the typical citation lifecycle in scientific publishing, where older articles accumulate more citations over time, while more recent publications have had less time to be cited. The yearly counts of articles and their average citations demonstrate both the continued expansion of research activity and the temporal dynamics of scholarly attention within vocational education studies.

**Figure 2.** Average Total Citations per Year (2000 – 2024)

2.3. Author Productivity and Collaboration Patterns

Equally important is the question of who drives the field. In this dataset, author LI J and PILZ M emerge as the most prolific contributors with 39 articles each. Yet when authorship is adjusted for collaboration—known as fractionalized counting—PILZ M leads with 17.7 articles, highlighting his role in collaborative, multi-authored scholarship. Table 2 lists the top contributors in terms of both raw and fractionalized article counts.

Table 2. Most Productive Authors by Raw and Fractionalized Count

Author	Article	Fractionalized Count
PLIZ M	39	17.7
LI J	39	11.8
SMITH E	22	14.7
ZHANG Y	36	13.2
WINCH C	22	13.7

2.4. Citation Structure and Landmark Works

Table 3 presents the most cited articles in the dataset. The top-ranked publication is by Lee Ventola (2014), which has received 871 total citations and an average of 72.6 citations per year. Other highly cited works include Guzmán (2001) with 785 citations, Shattuck (2012) with 719 citations, Anderson (2010) with 599 citations, and Piepoli (2014) with 471 citations. These articles represent publications with the greatest citation impact in the dataset, with citation rates per year ranging from 31.4 to 72.6.

Table 3. Most Cited Articles in the Dataset

Rank	Author (Year)	Journal	Total Citations	Citations/Year
1	Lee Ventola (2014)	P T	871	72.6
2	Guzmán (2001)	BMJ	785	31.4
3	Shattuck (2012)	Pediatrics	719	51.4
4	Anderson (2010)	Patient Educ. Couns.	599	37.4
5	Piepoli (2014)	Eur. J. Prev. Cardiol.	471	39.2

2.5. Source Distribution and Journal Centrality

Vocational education research is concentrated in a limited number of core journals. The Journal of Vocational Education and Training is the leading publication outlet with 483 articles, followed by the Journal of Technical Education and Training (260 articles), and the International Journal for Research in Vocational Education and Training (149 articles). The distribution of research output among these and other journals is presented in Table 4. This pattern indicates that a significant proportion of vocational education research is published in a small number of central, field-specific journals.

Table 4. Most Relevant Publication Sources

Rank	Source	Articles
1	Journal of Vocational Education and Training	483
2	Journal of Technical Education and Training	260
3	International Journal for Research in Vocational Education and Training	149
4	International Journal of Training Research	141
5	International Journal of Environmental Research and Public Health	119

2.6. The Cited Article Per Year in Vocational Education Research (2000 – 2024)

Figure 3 displays the top cited article for each publication year from 2000 to 2024 in the vocational education research dataset. Each year, one article stands out as the most highly cited, with notable peaks in several years. The highest citation count occurred in 2014, with the article “Social media and health care professionals: Benefits, risks, and best practices” reaching 871 citations. Other top-cited articles by year include “Postsecondary education and employment among youth with an autism spectrum disorder” (2012) with 719 citations, “Patient empowerment: Myths and misconceptions” (2010), and “An Ethics Framework for a Learning Health Care System” (2013).

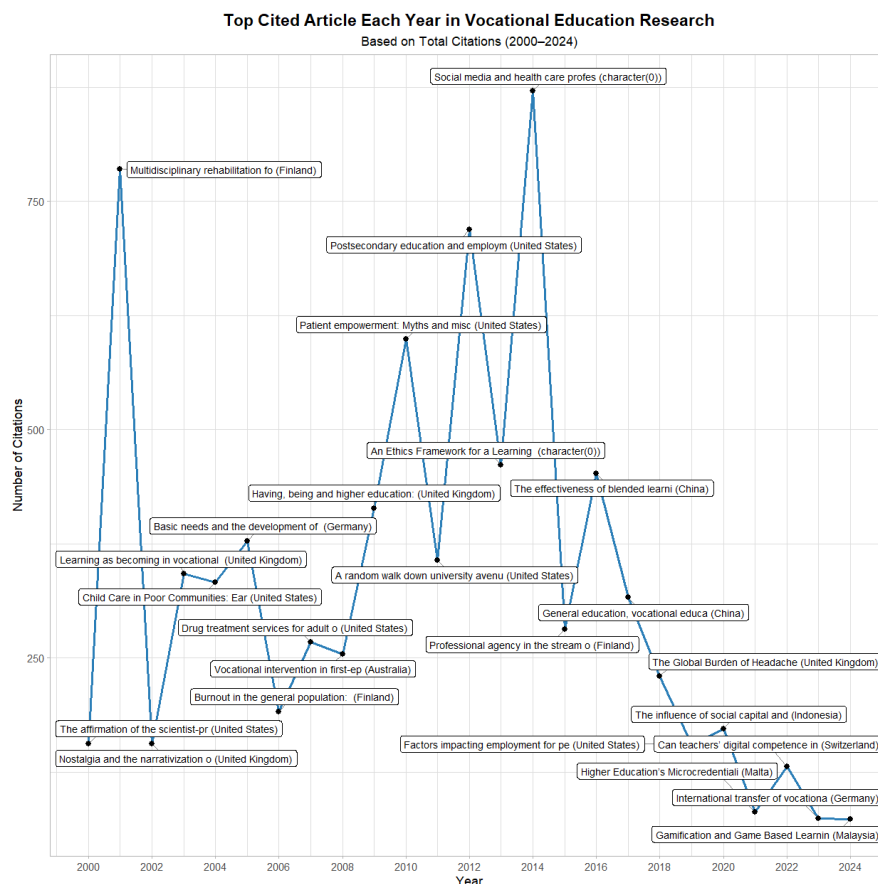


Figure 3. Top-cited article for each year (2000–2024) in vocational education research.

Labels

Recent years (2021–2024) feature articles focused on digital innovation, such as “Gamification and Game Based Learning for Vocational Education and Training: A Systematic Review” in 2024, as well as research on microcredentialing, teacher digital competence, and international transfer of vocational education systems. Earlier years in the dataset include highly cited works related to psychological and sociological foundations, such as “Basic needs and the development of intrinsic motivation” (2005) and “Burnout in the general population” (2006).

The geographic distribution of the top-cited articles includes contributions from the United States, United Kingdom, Finland, Germany, China, Malaysia, and Indonesia, indicating a range of international scholarly influence over time.

3. Geographical Distribution of Research Output

Figure 4 shows the global distribution of vocational education research publications by country. The highest number of publications is contributed by Australia (1,010), followed by the United States (987), Germany (651), China (633), and the Netherlands (590). Other countries with substantial research output include the United Kingdom (1,047, combining institutional variants), Sweden (239), Switzerland (282), and Indonesia (324). South Africa leads among Sub-Saharan African countries with 226 publications, while many other countries in Africa and Latin America report fewer than ten publications each.

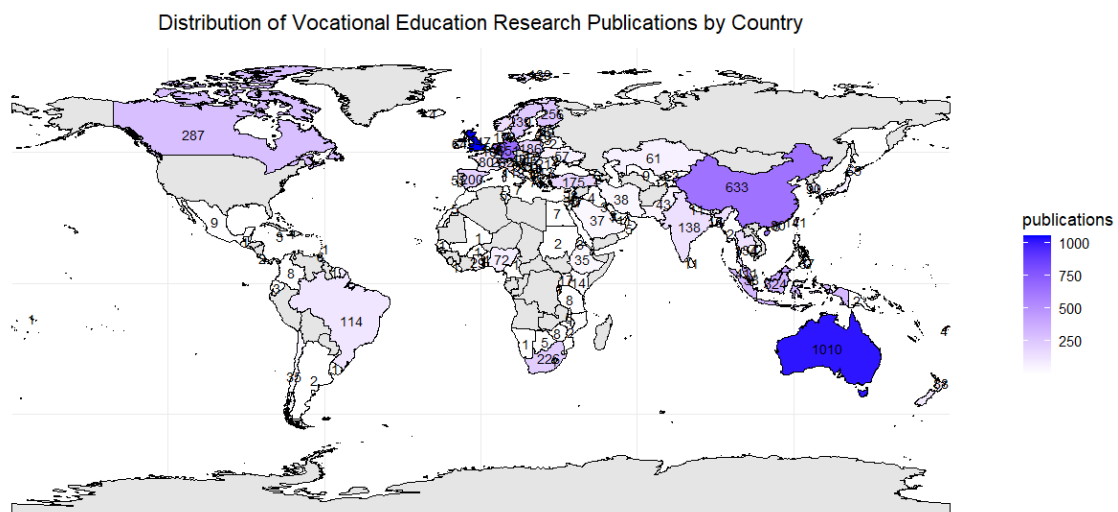


Figure 4. Distribution of Vocational Education Research Publications by Country (2000–2024)

The map indicates that vocational education research output is concentrated in a relatively small number of high-income countries, particularly in Western Europe, North America, Australia, and East Asia. In contrast, there are notable regions with low publication counts, especially in parts of Sub-Saharan Africa, Latin America, and Central Asia. This pattern highlights a strong global asymmetry in the distribution of scholarly output related to vocational education.

4. Keyword Co-occurrence and Thematic Landscape

Figure 5 presents the keyword co-occurrence network in vocational education research. The most prominent keywords—reflected by their larger size and central placement—are "education", "vocational", "training", "learning", and "development". These terms indicate that the main focus of the literature is on educational processes, skill formation, and workforce preparation.

Several additional keywords appear in close proximity to the central terms, including "professional", "teaching", "students", "curriculum", "policy", "assessment", and "skills". Health-related terms such as "health", "nursing", and "rehabilitation" also feature in the network, suggesting a substantial body of research at the intersection of vocational education and healthcare.

Peripheral keywords in the network include "digital", "technology", "innovation", "gender", "equity", and "mental health", which appear with lower frequency. This pattern indicates that while topics such as digital transformation, inclusion, and well-being are present in the literature, they have not yet become central or dominant themes.

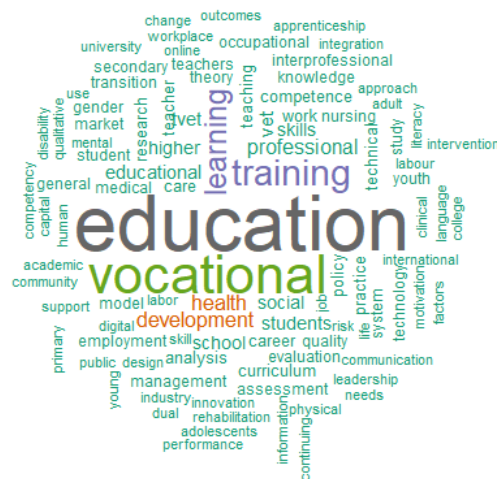


Figure 5. Word Cloud of Author Keywords in Vocational Education Research (2000–2024)

Overall, the co-occurrence network visualizes the conceptual structure of the field, with a strong emphasis on pedagogical, institutional, and workforce-related topics, alongside emerging but less prominent areas related to digitalization, inclusion, and learner well-being.

5. Evolution of Keyword Emphasis in Vocational Education Research (2000 – 2024)

Analysis of the 20 most recurrent keywords from 2000 to 2024 reveals significant thematic and methodological shifts in vocational education research. These trends are visualized in Figure 6 (Keyword Topic Trends) and summarized numerically in Table 5 (Frequency of Selected Keywords at Benchmark Years). The frequency of the keyword "vocational education" has steadily increased, rising from 116 mentions in 2000 to 476 in

2024, reflecting the growing importance of this domain in both research and policy agendas.

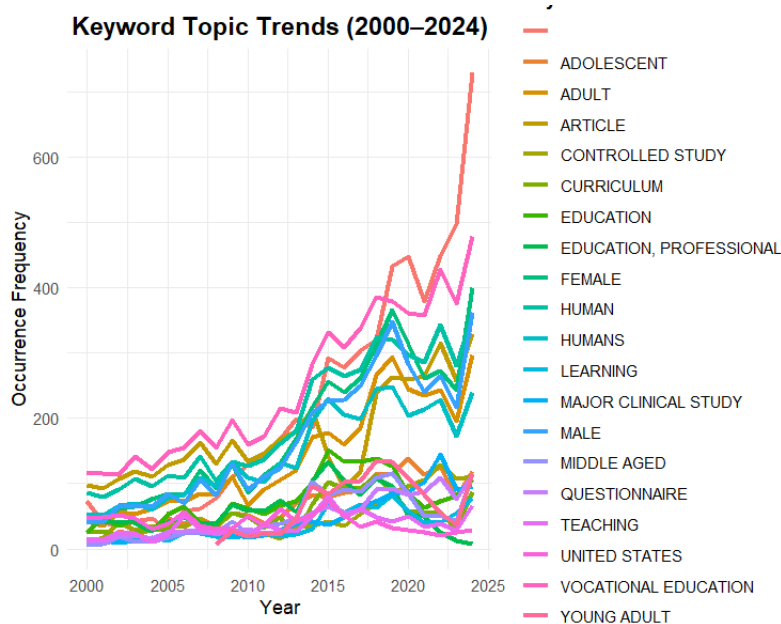


Figure 6. Keyword Topic Trends (2000 – 2024)

Alongside this, gender-related keywords such as "female" and "male" also show a notable increase, especially after 2015, each reaching 400 mentions by 2024. This pattern highlights heightened scholarly attention to gender perspectives and inclusivity in vocational education.

From a methodological standpoint, the keyword "controlled study" exhibits a marked rise—from just 9 occurrences in 2000 to 110 in 2024—indicating an increasing prevalence of experimental and quasi-experimental research designs. Similarly, the keyword "questionnaire" demonstrates a steady increase over time, underscoring the frequent use of survey-based methods in the field.

Table 5. Frequency of Selected Keywords at Benchmark Years

Keyword	2000	2005	2010	2015	2020	2024
Vocational Education	116	148	160	332	360	476
Article	98	129	133	141	259	329
Female	44	84	86	256	313	400
Male	41	84	90	227	313	400
Controlled Study	9	33	22	41	95	110
Education	25	54	62	152	85	107
Education, Professional	40	41	58	134	50	8
Questionnaire	10	26	30	65	82	114

Conversely, certain themes show a declining trajectory. The keyword "education, professional" peaks earlier but drops sharply to only 8 mentions by 2024, as shown in

Table 5, possibly indicating a shift toward more contemporary or specialized concepts. The general keyword "education" also plateaus and slightly declines after 2015, with more specialized terms such as "curriculum," "teaching," and "learning outcomes" gaining relative prominence.

In summary, Figure 6 and Table 5 together illustrate a conceptual evolution characterized by the rising prominence of vocational, gender, and empirical research themes, alongside a decline in broader or less specialized descriptors. These longitudinal patterns reflect ongoing maturation and thematic realignment within the field of vocational education research.

6. Thematic Evolution and Conceptual Structure in Vocational Education Research

To examine the underlying intellectual structure and thematic organization of vocational education research, conceptual analysis was conducted using keyword co-occurrence clustering and thematic mapping.

6.1. Conceptual Structure Mapping

The conceptual structure map (Figure 7) partitions the network of co-occurring keywords into three main clusters using Walktrap community detection. The first cluster (red) centers around keywords such as "education," "curriculum," "learning," and "organization and management." The second cluster (green) includes demographic and methodological terms such as "female," "male," "young adult," "controlled study," and "questionnaire." The third cluster (blue) is anchored by "vocational education," "human," "article," and "student."

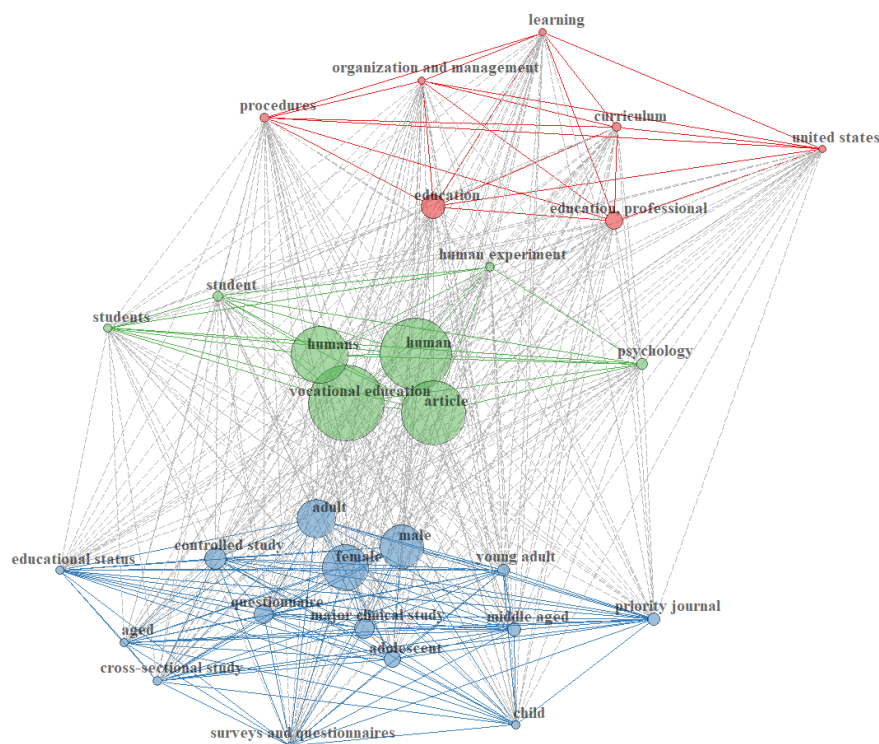


Figure 7. Conceptual Structure Map

Table 6 lists the top nodes by betweenness centrality and Page Rank within this network, with "vocational education," "human," and "article" showing the highest centrality scores.

Table 6. Top Nodes by Centrality in Conceptual Keyword Network

Vertex	Cluster	Betweenness Centrality	Page Rank
Vocational Education	3	32.67	0.0784
Human	3	34.70	0.0778
Article	3	26.29	0.0680
Female	2	7.16	0.0695
Male	2	6.53	0.0669
Education	1	3.95	0.0321
Learning	1	0.50	0.0137

6.2. Thematic Mapping of Research Fronts

Thematic mapping (Figure 8) positions major research themes within four quadrants based on centrality and density metrics. Motor themes—such as "learning," "professional education," and "curriculum"—occupy the top-right quadrant, indicating well-developed and central research areas. Niche themes, which are internally strong but less central, are found in the top-left quadrant. Emerging or declining themes, such as "education, professional," appear in the bottom-left quadrant, characterized by lower centrality and density. Basic themes, including "vocational education" and "article," are plotted in the bottom-right quadrant, reflecting their foundational yet underdeveloped status in thematic depth.

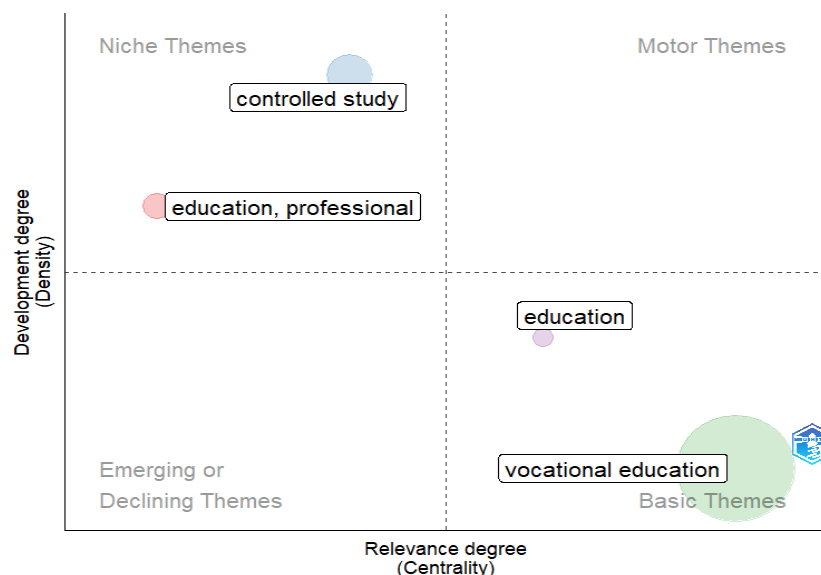


Figure 8. Thematic Map

These visualizations and network metrics collectively indicate the presence of both core and emerging areas in vocational education research, as well as the structural relationships between different thematic clusters.

7. Interpreting Degree Centrality and Community Membership in Global TVET Research

To analyze the structure of international collaboration in vocational education research, a country co-occurrence network was constructed based on author affiliations. Figure 9 visualizes the top 50 countries in this network, with node size representing degree centrality (the number of direct collaborative links each country has). Countries such as the United States, United Kingdom, Australia, Germany, France, and China appear as the largest nodes, indicating the highest number of collaborative ties within the network.

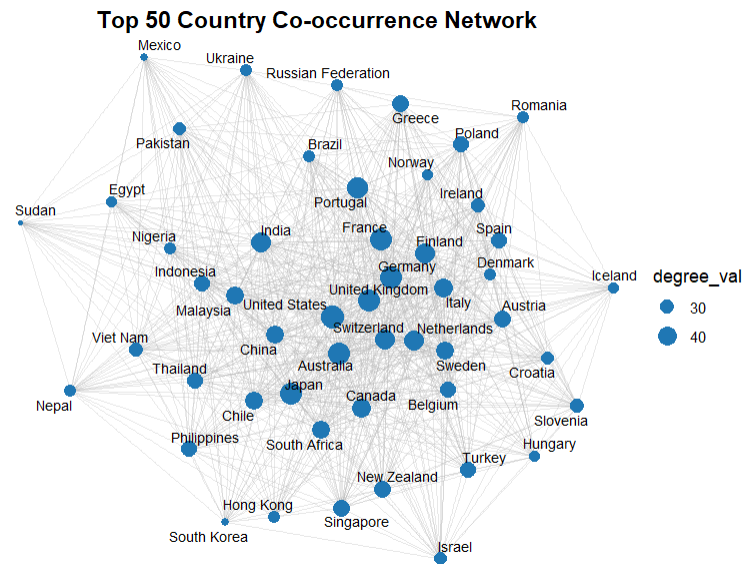


Figure 9. Top 50 Country Co-occurrence Network Based on Degree Centrality

Figure 10 applies Louvain community detection to the same network, partitioning countries into two main communities, each with distinct internal collaboration patterns. Community 1 is comprised of countries with high connectivity, including the United States, United Kingdom, Australia, China, and several Asian and African countries. Community 2 mainly consists of continental European nations, such as Germany, France, the Netherlands, Portugal, and Nordic countries.

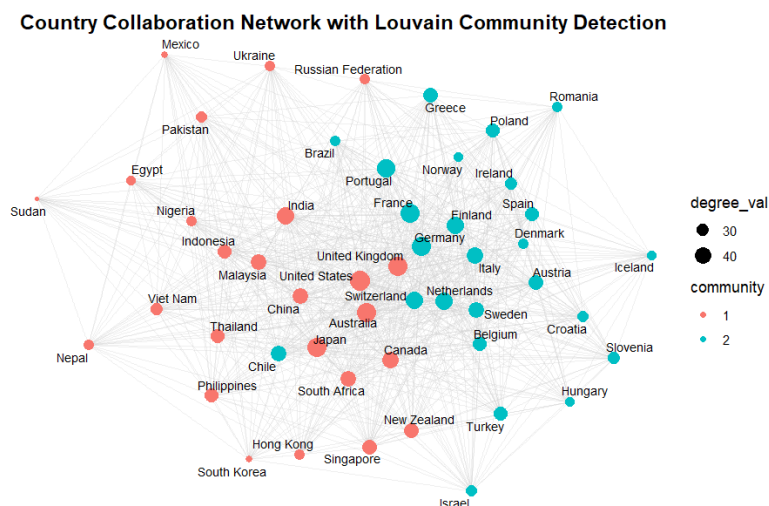


Figure 10. Country Collaboration Network with Louvain Community Detection

Table 7 provides degree centrality scores for the countries with the most collaborative links. The United States has the highest degree centrality, followed closely by the United Kingdom, Australia, Germany, and France. These results indicate a non-homogeneous structure, with international vocational education research collaboration organized into two primary clusters, each led by countries with high network connectivity.

Table 7. Top 5 Countries by Degree Centrality in Each Community

Rank	Community 1 (Anglophone)	Degree	Community 2 (Continental Europe)	Degree
1	United States	49	Germany	47
2	United Kingdom	48	France	46
3	Australia	48	Portugal	45
4	India	42	Netherlands	43
5	Switzerland	42	Finland	41

Discussion

The bibliometric mapping in this study reveals both consolidation and ongoing fragmentation in vocational education research over the past two decades. The steady rise in publication volume and research diversity signals field maturation and growing relevance for global workforce development (Chen & Li, 2025; Yasdin & Muksin, 2024). Core themes—curriculum, pedagogy, and employability—continue to dominate, reflecting the priority of aligning educational outcomes with labor market needs (Liang et al., 2025). However, significant gaps persist: digitalization, gender equity, and learner well-being remain peripheral in mainstream discourse, consistent with earlier reviews (Ferri et al., 2025; Busse & Maué, 2025).

Geographically, research output highlights a persistent North–South divide. High-income countries—Australia, the United States, Germany, and China—dominate publication volume and citation impact, while much of Sub-Saharan Africa, Latin America, and Asia remain underrepresented (Agyapong et al., 2025; Ababio et al., 2024). This asymmetry reflects deeper barriers in access, infrastructure, and international collaboration. Network analysis shows that, despite increasing global collaboration, activity remains clustered in two main communities: an Anglophone, transnational bloc and a Continental European, policy-aligned bloc, reinforcing existing geopolitical patterns (Wicht et al., 2024; Müller, 2024).

Thematic evolution in keyword usage illustrates both progress and persistent challenges. While there has been a clear uptick in attention to gender, empirical methodologies, and innovative learning models, core issues like mental health, digital competencies, and rural or marginalized learner inclusion have yet to achieve centrality in the literature (Mahfud et al., 2024; Wang & Zhang, 2025). The prominence of

experimental and survey-based studies signals methodological advancement, yet the field still struggles to integrate intersectional and context-sensitive frameworks into mainstream analysis (Panday et al., 2025).

Beyond quantitative growth, this study reveals how research production intersects with global educational priorities. Co-occurrence and thematic evolution analyses show that employability, curriculum, and pedagogy remain conceptual anchors, while concerns like digital literacy and intersectionality have only recently gained traction (Panday et al., 2025; Mahfud et al., 2024). Although digitalization is rapidly diffusing across sectors, there is still a temporal lag in its integration into vocational research and practice (Ferri et al., 2025). The peripheral position of terms such as “mental health,” “equity,” and “gender” highlights persistent gaps in inclusivity and learner support, consistent with Wicht et al. (2024) who note ongoing stigma and exclusion in TVET systems.

Methodologically, the rising frequency of “controlled study” and “questionnaire” reflects greater empirical rigor and increased use of mixed-method and quantitative approaches for program evaluation (Agyapong et al., 2025; Busse & Maué, 2025). However, much of the literature remains clustered in national or regional silos, limiting generalizability and innovation. For example, in Ghana and other Global South contexts, tracer studies and skills assessments often remain disconnected from broader international debates, reinforcing global asymmetry in research influence (Ababio et al., 2024).

Collectively, these patterns call for a research agenda that is not only empirically robust but also transnational and contextually sensitive. Strengthening international collaboration and diversifying funding sources could help address the North–South divide, while a sharper focus on psychological resilience, digital skills, and equitable access will ensure that vocational education research remains relevant amid shifting global demands (Wang & Zhang, 2025; Yasdin & Muksin, 2024).

For policy implementation, these findings underscore the urgent need for vocational education systems to move beyond rhetoric and embed digitalization, equity, and well-being in national frameworks. Table 8 outlines how curriculum, gender, digital skills, and mental health should be addressed through modular curricula, gender-sensitive recruitment, teacher training, and student support (Kabiri et al., 2025; Gianni et al., 2024; Mahfud et al., 2024). Bridging the research–policy gap requires not only relevant evidence but also mechanisms—such as formal policy briefs and research–government liaisons—to ensure insights translate into reform (Batz et al., 2025; Chen et al., 2025).

Looking forward, the field’s future inclusivity and policy relevance will depend on expanding open-access publishing, establishing regional research hubs, and fostering South–South partnerships to rebalance the epistemic landscape (Agyapong et al., 2025; Kabiri et al., 2025). By reframing bibliometric analysis as a tool for diagnostic and

normative guidance, this study calls for a shift from descriptive mapping to strategic intervention—positioning vocational education as a transformative platform for equity, resilience, and adaptive human development in an increasingly uncertain world.

Conclusion

This study offers a comprehensive bibliometric mapping of global vocational education research over the past two decades, revealing notable progress yet persistent fragmentation. Core themes—curriculum development, pedagogy, and employability—have become increasingly central, reflecting the sector's alignment with workforce and economic transformation agendas. However, key issues such as digitalization, gender equity, and learner well-being remain underrepresented, while the dominance of high-income countries in publication and collaboration underscores ongoing global disparities in knowledge production.

The findings underscore that, despite the field's quantitative growth and expanding thematic diversity, true integration across regions, methods, and research priorities remains elusive. Network and cluster analyses show that collaboration and influence are concentrated in a handful of countries and communities, leaving lower-income regions and context-specific challenges relatively marginalized. Methodological advancements—evidenced by the rise of experimental, survey-based, and network analyses—signal growing scientific maturity, yet intersectional and context-sensitive frameworks are still slow to take root.

For policy and practice, these patterns point to the urgent need for more inclusive, responsive, and future-oriented vocational education systems. Policy stakeholders should leverage bibliometric evidence to identify and close persistent gaps—especially in digital skills, mental health, and gender-responsive approaches—by investing in modular curricula, teacher professional development, and targeted support for marginalized learners. Furthermore, fostering open-access publishing, regional research hubs, and South-South partnerships will be essential to democratize knowledge production and support equitable policy innovation worldwide.

In summary, this study not only maps the intellectual and policy landscape of vocational education research but also calls for a strategic shift—from descriptive monitoring to proactive intervention—so that vocational education can fulfill its transformative promise in a rapidly changing and uncertain global context.

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