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Dr. S.K. Bhatia**



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Bi-Annual Journal

Would like to appeal to the learned readers to send us their views, counter views, suggestions, comments, and observations etc. via “Letters to Editor” (which will be published in the next Issue) on the articles published in this Journal so that an academic discussion may start and our efforts may become more participative and thereby more meaningful and interesting.

Editor-in-Chief

The Themes for the next Issue January-2027

Section I.

1. Valuing professionalism and training in Teacher Education courses.
2. Changes in perspectives on areas of research in Teacher Education.
3. Perspectives on how learning in Curriculum and Pedagogy are demonstrated in Teacher Certification Programs.
4. Perspectives on effective Evaluation Practices in Teacher Education Programs.
5. Innovations and Innovative practices in Teacher Education Programs.
6. Diversity and Inclusion: Different International perspectives.
7. Ensuring access and equity in high quality Teacher Education programs.
8. ICT-related Innovations and practices in Teacher Education Programs.
9. Policy Perspectives in Teacher and School Education.
10. Reports on related conferences, seminars and workshops, including International offerings.
11. The Prolonged Online Mode of Teaching-learning - Challenges, Innovative experiments, Findings.
12. Tailored Interventions in Learner-centered Education.
13. Blended Learning as an outcome of Online Learning.
14. Scope of starting B. Ed for Vocational Teachers (B.Ed.Voc.)
15. Artificial Intelligence in Teacher Education: Preparing Future Teachers for AI-Enabled Classrooms.
16. Teacher Education: Implications of Contemporary Wars and Their Global Impacts.

Section II. Innovative Experiments in Schools:

1. Teachers' Professional Growth
2. Optimising Students' Achievement
3. Holistic Learning
4. Experiments in the area of Experiential Learning.
5. Objective Evaluative Strategies During the Prolonged Closure of schools.
6. Solving School Problems through Action Research
7. Measuring Students' all-round Achievements through Ensemble assessments.
8. Literacy and Numeracy Challenges and their Remedies in schools
9. Integrating the inputs of Arts, Music and Play during the classroom teaching-learning processes
10. Starting Job-linked Courses in Schools at the Secondary Level
11. School Education: Implications of Contemporary Wars and Their Global Impacts.

Thanks and Regards
Editor-in-Chief
Dr. S.K. Bhatia

Editorial



The circulation and readership of the *Journal of Teacher Education and Teaching* have been steadily increasing year after year, owing to the continued support, encouragement, and goodwill of our valued readers, contributors, and academic well-wishers. The journal has emerged as a vibrant platform for intellectual exchange, scholarly reflection, and professional discourse in the field of education.

The esteemed authors who contribute to this journal derive inspiration for their writings from a wide range of sources. Their scholarly pursuits are often shaped by self-motivation, reflective thinking, academic inquiry, and lived experiences rooted in diverse hereditary, social, cultural, environmental, and institutional contexts. The process of knowledge creation is further enriched by their engagement with contemporary educational challenges and evolving pedagogical realities.

At times, extraordinary global and societal events—such as epidemics, pandemics, wars, social transformations, and technological advancements—also become powerful catalysts for academic reflection and research. Such developments encourage scholars and practitioners to critically examine their impact on educational systems, professional practices, and human development, while exploring innovative ways to preserve, strengthen, and advance their respective domains of contribution.

In addition, several contributors take guidance from the themes and suggested topics published in the introductory pages of the journal. We warmly welcome all relevant research papers, reflective articles, and scholarly contributions. Every submission undergoes a rigorous review process, and we make sincere efforts to accommodate those manuscripts that receive strong recommendations from our learned reviewers and editorial experts.

It is heartening to note that many scholars read the editorial carefully and thoughtfully engage with the suggestions offered therein. In the previous editorial, contributors were encouraged to submit articles and research papers exploring the constructive, responsible, and innovative applications of Artificial Intelligence (AI) across diverse domains. It is gratifying that several authors responded to this call and contributed papers addressing various dimensions of AI. Their work highlights the importance of using AI not merely as a tool operated at the press of a button, but as a resource that requires informed, critical, and purposeful engagement in the pursuit of knowledge. The authors also emphasize that AI, when used judiciously, can help save time, reduce stress, and enhance productivity.

The other contributions in this issue are equally relevant and need-based, addressing contemporary concerns and enriching the existing body of knowledge in their respective fields. Collectively, the papers in this issue make meaningful contributions to educational discourse and research.

Scholars must have taken note of the tragic loss of human lives and the widespread destruction of infrastructure resulting from ongoing armed conflicts in different parts of the world. While the immediate consequences are borne by the regions directly affected, the repercussions extend far beyond national borders, influencing social, economic, and educational systems across the globe. Education, unfortunately, has not remained untouched by these disturbances. The disruption of educational activities in conflict-affected regions has posed serious challenges for students, teachers, and educational institutions. Many students pursuing higher education abroad have experienced uncertainty, psychological distress, and interruptions in their academic programmes. In several instances, students have had to return to their home countries as educational institutions in conflict-prone areas suspended their operations or faced severe disruptions. The emotional

and mental stress experienced by learners during such crises cannot be overlooked, as it often affects their academic progress, well-being, and future aspirations.

The indirect effects of conflict are equally significant. Disruptions in transportation, trade, communication networks, and the supply of essential commodities create challenges that impact societies worldwide. Educational institutions often face difficulties in maintaining normal operations due to economic instability, resource constraints, and uncertainties arising from such situations. Consequently, the smooth conduct of teaching, learning, research, academic exchanges, and international collaborations may be adversely affected. These developments raise an important question: Can education play a meaningful role in fostering peace and reducing the likelihood and consequences of conflict? Education has long been recognized as a powerful instrument for promoting mutual understanding, dialogue, empathy, respect for diversity, and responsible citizenship. Teacher education, in particular, has a crucial role in preparing educators who can nurture the values of peace, social harmony, and global citizenship among future generations.

In this context, we invite scholars, researchers, and practitioners to contribute articles and research papers that examine the relationship between education, peace-building, conflict resolution, global citizenship, and social cohesion. Contributions that explore the role of educational institutions, curricula, teachers, and communities in mitigating the adverse effects of conflict and promoting sustainable peace will be especially welcome. Such scholarly engagement can enrich educational discourse and contribute meaningfully to addressing one of the most pressing challenges of our times.

Scholarly contributions on themes related to artificial intelligence and the educational implications of armed conflicts are particularly welcome. The journal encourages authors to pursue topics that align with their interests, expertise, and research priorities in the field of teacher and school education. Recognizing the diversity of scholarly perspectives and areas of specialization, the journal welcomes submissions on a broad range of themes. In addition to the suggestive topics listed in the opening pages of this issue, authors are invited to submit manuscripts on any topic that contributes to the existing body of knowledge and advances the theory, policy, or practice of teacher and school education.

While the journal continues to receive a substantial number of articles and research papers in the area of teacher education, contributions from schools remain limited. Yet, school education constitutes an equally important focus of the journal, and a dedicated section is reserved exclusively for articles, reports, and papers arising from school-based experiences and innovations.

The journal welcomes contributions on a wide range of school education themes, including the development and implementation of innovative teaching-learning strategies, need-based curriculum design, the effective application of national education policies, the development and use of assessment and evaluation techniques, and reports on significant academic, co-curricular, and community-oriented initiatives undertaken by schools. Such contributions can provide valuable insights into educational practice and enrich the dialogue between theory and practice.

To strengthen this important component of the journal, our administrative team will actively reach out to schools and encourage teachers, school leaders, and practitioners to share their experiences, innovations, and best practices with the wider educational community.

It is our sincere hope that the collective efforts of researchers, teacher educators, teachers, and schools will continue to enrich educational discourse and contribute meaningfully to the advancement of teacher and school education.

Dr. S. K. Bhatia
Editor-in-Chief

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RESEARCH ARTICLES

Global Trajectories, Local Gaps: A Bibliometric Analysis of STEM Education Research

Vemma Mae G. Olivar

Abstract

This bibliometric analysis systematically maps the intellectual and social structures of STEM Education research between 2015 and 2024. An initial retrieval of 2,919 documents from the Scopus database was systematically screened according to PRISMA 2020 guidelines (Page et al., 2021), yielding a Final Inclusion Set of 300 highly relevant records. Using the bibliometrix R-package (Aria & Cuccurullo, 2017), the study identified exponential growth (Annual Growth Rate: 17.11%), a thematic convergence between technological and socio-critical foci, and persistent geographical concentration. Findings reveal that research output is largely dominated by the United States and Western nations, with limited international collaboration (13.84%). A sub-analysis showed the Philippines contributed approximately 2.67% (8 documents) to the Final Inclusion Set, with output emphasizing curriculum implementation and workforce alignment, in contrast to the global focus on equity and computational thinking. The thematic clusters identified—disciplinary core, socio-critical focus, technological integration, teacher professional development, and policy and curriculum reform—reflect an evolving field that is becoming more interdisciplinary and equity-driven. This study highlights both the maturing structure of STEM Education research and the urgent need for inclusive, context-sensitive international collaborations, particularly from underrepresented regions such as Southeast Asia.

Keywords: Bibliometrics, STEM Education, STEM Research, Scopus Database, Philippines, Computational Thinking, Research Gap

Introduction

Globally, STEM education—encompassing Science, Technology, Engineering, and Mathematics—serves as a cornerstone of innovation, economic growth, and technological advancement. Since the coinage of the acronym by the U.S. National Science Foundation in the early 2000s, STEM education has transitioned from a policy buzzword to a legitimate interdisciplinary research field with its own theoretical frameworks, pedagogical debates, and empirical traditions (Sanders, 2009). The field's expansion from 2015 to 2024 demonstrates a significant shift toward integrating equity, gender inclusion, and computational literacy as essential themes, reflecting broader societal concerns about who benefits from STEM opportunities and how future-ready competencies should be defined (Wing, 2006; Bybee, 2013).

Despite this global acceleration, deep structural disparities persist in STEM education research production and dissemination. Research output continues to be dominated by high-resource, English-speaking countries, particularly the United States, the United Kingdom, and Australia, creating a systemic bias in what questions are asked, which populations are studied, and what findings are amplified in international journals (Freeman et al., 2015; Marginson et al., 2013). This geographic concentration risks producing a body of knowledge that, while technically rigorous, fails to reflect the educational realities and needs of the Global South.

Vemma Mae G. Olivar, Science and Mathematics Department, Pangasinan State University–Bayambang Campus, Bayambang, Pangasinan, 2425 Philippines

The Philippines presents a particularly instructive case. As a developing nation with a large and youthful population, the Philippines has made significant curricular strides through its K to 12 reform program, which formally integrated STEM tracks at the senior high school level (Department of Education, Philippines, 2022). Yet national STEM research output remains modest in international databases, often concentrated on local curriculum implementation rather than theoretical advancement or engagement with global pedagogical debates. This mismatch between curricular ambition and research capacity represents a structural challenge with implications not only for the Philippines but for similarly positioned nations across Southeast Asia.

This study addresses this imbalance through a bibliometric lens. Bibliometrics—the quantitative analysis of scholarly publications—offers a powerful, objective methodology for mapping the intellectual and social structures of a research field without the selection biases inherent in traditional narrative reviews (Donthu et al., 2021). By applying bibliometric methods to the Scopus database, this study situates Philippine STEM scholarship within the broader global research trajectory, identifying where the local output aligns with, diverges from, or is absent from global conversations. The overarching aim is to provide actionable insights for researchers, policymakers, and funding agencies committed to building a more globally representative and contextually nuanced STEM education research landscape.

Key Advances

This study advances the field of STEM education research in several interconnected ways. First, it provides a comprehensive bibliometric mapping of global STEM education development from 2015 to 2024—a period that encompasses rapid technological disruption, intensified equity discourses post-Black Lives Matter, and the unprecedented disruption of schooling by the COVID-19 pandemic. Each of these forces has left discernible marks on the thematic priorities of the field, and this study makes those shifts visible through systematic data analysis.

A key empirical contribution is the identification of a clear thematic convergence among five major clusters: (1) disciplinary core, (2) socio-critical perspectives, (3) technological integration, (4) teacher professional development, and (5) policy and curriculum reform. This structured thematic landscape signals a shift toward a more interdisciplinary and future-oriented framework in which computational thinking, data literacy, and equity are no longer peripheral concerns but central axes of scholarly inquiry (Bybee, 2013; Paucar-Curasma et al., 2023).

The study further documents the emergence of computational thinking as the fastest-growing research cluster, with a median publication year post-2020, reflecting the growing importance of digital and data-driven competencies across educational systems worldwide (Abadi, 2024; Wing, 2006). The keyword co-occurrence network generated through VOSviewer (van Eck & Waltman, 2010) visually confirms this emergence, placing computational thinking nodes at the intersection of disciplinary and socio-critical clusters—suggesting that the field increasingly views digital literacy as both a technical and an equity issue.

At the same time, this study uncovers a persistent global imbalance in research production. The dominance of Western nations, combined with an international co-authorship rate of only 13.84%, raises important questions about whose knowledge counts and which educational contexts are rendered invisible in the international literature (Marginson et al., 2013). By providing a contextualized analysis of the Philippines—showing

its minimal contribution (2.67%) and its strong orientation toward curriculum implementation rather than broader theoretical and technological discourses—the study identifies a critical research translation gap. This gap refers to the disconnect between the rich policy activity occurring at the local level and the absence of that activity in globally indexed, peer-reviewed scholarship. Closing this gap is presented not merely as a bibliometric concern but as an ethical imperative for a truly global STEM education research community.

Methodological Section

Data Source and Search Strategy

This bibliometric analysis employed data retrieved from the Scopus database, selected for its comprehensive coverage of peer-reviewed, internationally indexed journals and its compatibility with bibliometric software tools. The search covered the period from January 2015 to December 2024. An initial retrieval of 2,919 records was obtained using a structured Boolean search combining core terms: ('STEM education' OR 'science education' OR 'engineering education') AND ('equity' OR 'computational thinking' OR 'computing'). The search was limited to English-language documents indexed as articles, reviews, or conference papers.

Screening and PRISMA Protocol

Following the PRISMA 2020 guidelines (Page et al., 2021), the retrieved records underwent a systematic screening process. After removing duplicates ($n = 412$), the remaining 2,507 records were screened at the title and abstract level for disciplinary relevance. Documents that did not directly address STEM education as a primary theme were excluded ($n = 1,296$), yielding 1,211 records for full-text eligibility assessment. A further review for document type (excluding editorials, letters, and book reviews) and thematic focus resulted in a Final Inclusion Set of 300 publications used for full bibliometric analysis. The complete screening flow is depicted in Figure 1.

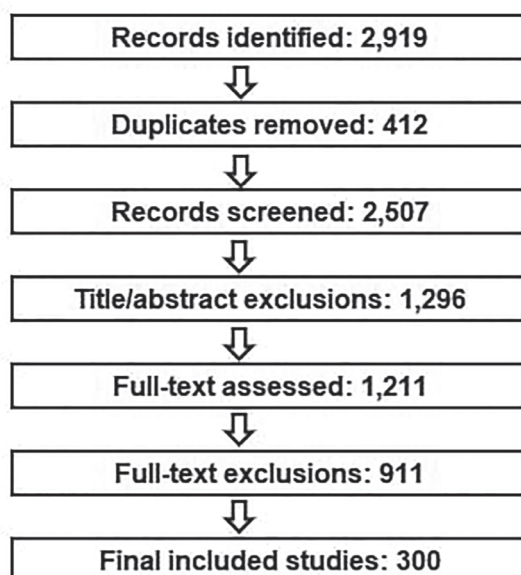


Figure 1: PRISMA 2020 flow diagram of the literature screening and selection process identification.

It is important to note that this screening process was designed to maximize relevance to the research questions rather than to produce a comprehensive census of all STEM education publications. The Final Inclusion Set is therefore best understood as a high-relevance sample rather than an exhaustive population, a methodological choice aligned with recent best practices in bibliometric review (Donthu et al., 2021).

Analytical Tools

The bibliometrix R-package (version 4.0; Aria & Cuccurullo, 2017) and its web interface, Biblioshiny, were used for performance, conceptual, and social structure analyses. Performance analysis examined publication growth rates, author productivity, and institutional contributions. Conceptual structure analysis employed keyword co-occurrence mapping and co-citation analysis to identify thematic clusters. Social structure analysis examined co-authorship networks to assess international collaboration patterns. Visualization of keyword co-occurrence networks was performed using VOSviewer (van Eck & Waltman, 2010), which uses a force-directed algorithm to cluster semantically related keywords into color-coded thematic groups.

Sub-Analysis: Philippine Contribution

To ensure contextual depth, a specific sub-analysis was conducted. Philippine-affiliated studies were isolated by filtering the Final Inclusion Set ($n = 300$) using affiliation keywords including ‘Philippines’, ‘Filipino’, ‘Philippine’, and major Philippine university names. This sub-analysis quantified the nation’s output, identified institutional contributors, and characterized the distinct thematic focus of Philippine STEM research, enabling a direct comparative analysis with dominant global trends. This approach aligns with recommendations for country-specific bibliometric profiling within larger global analyses (Mahtari & Suyidno, 2024).

Research and Discussion

Performance Indicators and Growth Trajectory

STEM education research demonstrates exponential expansion over the study period, with an Annual Growth Rate (AGR) of 17.11%. Publication output rose from 147 documents in 2015 to 609 in 2024, reflecting a more than fourfold increase over a decade. This growth rate substantially exceeds the estimated average AGR of 8–10% for educational research broadly (Mahtari & Suyidno, 2024), indicating that STEM education has attracted disproportionate scholarly attention, likely driven by sustained policy investment in STEM workforce development across OECD nations (Freeman et al., 2015).

The growth trajectory is not uniform. A notable acceleration is observed from 2019 onward, which may reflect the combined effects of the COVID-19 pandemic—which forced a rapid pivot to technology-mediated STEM instruction and generated a surge in related research—and the broader societal reckoning with equity and diversity following high-profile social justice movements (Nasir & Hand, 2006; Equity-Oriented STEM Literacy Framework for K-12 STEM Literacy, 2021). The field’s rapid growth reflects institutional recognition of its interdisciplinary and policy relevance, with STEM education research now appearing regularly in journals spanning education, computer science, psychology, and public policy.

In terms of authorship, the most prolific individual contributors are based in the United States, with notable clusters in Australian and UK institutions. The h-index of the most cited authors in the dataset reaches into

the mid-20s, reflecting the growing influence of a small cohort of highly productive scholars who serve as nodes in broader collaboration networks. This concentration of influence raises important questions about intellectual diversity and the extent to which seminal frameworks developed in Western contexts travel across cultural and institutional boundaries.

Conceptual Evolution and Thematic Focus

Table 1 presents the major thematic clusters derived from keyword co-occurrence analysis. Five distinct but interconnected clusters were identified, each reflecting a different dimension of the field's intellectual preoccupations. The 'Frequency' column refers to total co-occurrence counts in Scopus keywords, while the 'Year of Emergence/Median' was calculated by identifying the median publication year for each cluster's constituent keywords.

The Disciplinary Core cluster—anchored by 'science education', 'STEM education', and 'engineering education'—remains the foundational stratum of the field. These keywords appear with the highest absolute frequency, confirming that the field retains strong disciplinary anchors even as it broadens thematically. The Socio-Critical Focus cluster, including equity, gender, diversity, and social justice, has shown sustained growth throughout the study period. This cluster reflects a broader turn in educational research toward questions of who is included in, and who is excluded from, STEM learning opportunities (Nasir & Hand, 2006; Paucar-Curasma et al., 2023). The sustained presence of these keywords across the decade-long study window indicates that equity concerns are not a passing trend but a structural feature of contemporary STEM education scholarship.

The most dynamic growth is observed in the Technological Integration cluster, particularly around computational thinking, computer science education, and programming. The median publication year for this cluster (2020) places its emergence firmly in the post-pandemic era, when the digitization of education accelerated dramatically (Abadi, 2024). Wing's (2006) influential framing of computational thinking as a

Table 1 Thematic Clusters from Keyword Co-occurrence Analysis

Thematic Cluster	Core Keywords (Frequency)	Year of Emergence/Median
Disciplinary Core	science education (544), stem education (520), engineering education (426)	Foundational
Socio-Critical Focus	equity (297), gender (269), diversity (188), social justice (52)	Sustained/Increasing
Technological Integration	education computing (440), computer science education (428), computational thinking (67), programming (21)	Recent Surge (Median, 2020)
Teacher Professional Dev.	teacher training (183), professional learning (94), pedagogical content knowledge (61)	Ongoing (Median, 2018)
Policy & Curriculum	curriculum reform (109), K-12 policy (88), workforce alignment (74)	Emerging (Median, 2019)

fundamental literacy has been operationalized across numerous empirical studies in this cluster, producing a rapidly growing body of evidence on how CT skills can be integrated across STEM disciplines. The intersection of this cluster with the Socio-Critical cluster is particularly noteworthy: a growing subset of studies examines computational thinking through an equity lens, asking not merely whether CT improves learning outcomes but whether CT-integrated STEM education reduces or reproduces existing disparities (Pauca-Curasma et al., 2023).

Teacher Professional Development and Policy and Curriculum Reform constitute the fourth and fifth clusters respectively. Their presence underscores that STEM education research has increasingly moved upstream, attending not only to student learning outcomes but to the systemic conditions—teacher preparation, curriculum design, and policy architecture—that shape those outcomes. This represents a maturation of the field from a primarily learner-centered to a systems-oriented research agenda, consistent with the broader ‘educational reform’ paradigm that has dominated educational policy discourse since the mid-2010s (Bybee, 2013).

Keyword Co-occurrence Network and VOSviewer Analysis

The VOSviewer-generated network visualization illustrates the conceptual structure of STEM education research based on keyword co-occurrence. The clusters reveal distinct but interconnected thematic areas organized into four color-coded zones. The blue cluster, anchored by ‘science education’, emphasizes disciplinary cores and epistemological perspectives. The green cluster centers on students, gender equity, engineering, and mathematics, highlighting research focused on learner diversity and STEM participation. The red cluster corresponds to studies on education, female representation, and psychology, suggesting an intersection of STEM education with social science and health-related research. Smaller but rapidly growing nodes—including computational thinking, data science, and e-learning—indicate emerging directions that reflect digital and data-driven pedagogical transformations. The spatial proximity of the equity and computational thinking nodes in the visualization is analytically significant: it suggests that these two research streams are converging in ways that may reshape the field’s central research questions over the next decade.

Geographical Distribution and Collaboration Patterns

The global distribution of STEM education publications is markedly unequal. The United States accounts for approximately 36% of all documents in the Final Inclusion Set, followed by China (~14%), Australia (~9%), the United Kingdom (~8%), and Canada (~6%). Together, these five nations account for nearly three-quarters of global STEM education research output, an extraordinary concentration that reflects broader structural inequalities in research infrastructure, funding, and access to internationally indexed journals (Marginson et al., 2013).

The overall international co-authorship rate of 13.84% is relatively low compared to other scientific fields and suggests that STEM education research remains largely national in its collaborative structures (Freeman et al., 2015). This insularity may partly reflect the inherently context-specific nature of educational research, which is often tied to particular curricula, institutional contexts, and policy environments. However, it also limits the generalizability of findings and reduces opportunities for cross-cultural comparative research that could enrich theoretical frameworks. The strongest bilateral collaboration ties in the dataset exist between

USA and China, and between Australia and China—partnerships that reflect broader geopolitical and economic linkages between these nations rather than a genuine Global South–North knowledge partnership.

Notably absent from prominent positions in the collaboration network are nations from Sub-Saharan Africa, Southeast Asia, and South Asia—regions that collectively educate the majority of the world’s school-age population. This absence is not merely a bibliometric curiosity: it represents a structural gap in the knowledge base from which global STEM education policy and practice are derived. If the evidence base is dominated by contexts characterized by high levels of digital infrastructure, well-resourced schools, and stable educational systems, then the policies derived from that evidence may be poorly suited to the majority of contexts in which STEM education must actually be implemented.

Research Contribution from the Philippines

A focused analysis of the Final Inclusion Set ($n = 300$) identified 8 documents associated with Philippine-based affiliations, representing approximately 2.67% of the total scholarly production in this highly focused dataset. Table 2 provides a comparative summary of Philippine research characteristics relative to global trends.

The Philippine documents predominantly address curriculum development, STEM policy evaluation, and teacher training within the K to 12 framework. High-frequency Philippine-specific keywords include ‘K to 12’, ‘curriculum alignment’, and ‘workforce readiness’—terms that reflect the government’s instrumental framing of STEM education as a pipeline to economic productivity rather than as a vehicle for critical citizenship or computational empowerment (Andrada & David, 2020; Anito et al., 2019). While workforce alignment is a legitimate and pressing concern in the Philippine context—given the documented shortage of STEM professionals (Anito et al., 2019)—the exclusive focus on this dimension leaves other important questions underexplored.

Particularly notable is the near-absence of Philippine research engaging with equity, gender inclusion, and computational thinking—the three fastest-growing global research clusters. This absence is especially striking given the Philippines’ strong performance of female students in national science assessments and the unique

Table 2 Comparative Analysis: Philippines vs. Global STEM Education Research Trends		
Dimension	Philippines	Global Trend
Primary Focus	Curriculum policy, K-12 alignment, workforce readiness	Equity, computational thinking, gender inclusion
International Co-authorship	Low (~8% of PHL output)	13.84% overall; US–China–Australia dominant
Computational Thinking	Minimal engagement	Fastest-growing cluster (post-2020)
Theoretical Orientation	Applied/policy-driven	Increasingly interdisciplinary and theory-building
Share of Final Inclusion Set	~2.67% (8 of 300 docs)	USA ~36%; China ~14%; Australia ~9%

cultural and linguistic diversity of its student population, which would seem to offer rich material for equity-oriented STEM research. The gap between what is happening in Philippine classrooms and what is being theorized and published in international journals represents what this study terms a research translation gap: a failure to convert local educational experience into globally relevant scholarly knowledge (Ihalon et al., 2024).

Several structural factors contribute to this gap. Philippine universities face significant constraints in research infrastructure, international journal access, and faculty time for research—pressures that push scholars toward applied, policy-responsive work rather than theoretically ambitious, internationally collaborative research. The concentration of Philippine STEM publications in domestic or regional journals further limits their visibility and citability in global databases. Addressing these structural constraints requires not only individual researcher capacity building but systemic investments in research culture, funding, and international partnership (Mahtari & Suyidno, 2024).

Nevertheless, the Philippine case also reveals important opportunities. The country's K to 12 reform represents a natural experiment in large-scale STEM curriculum reform in a developing context—precisely the kind of case study that global STEM education scholarship desperately needs to enrich its theoretical foundations. Philippine researchers are uniquely positioned to contribute comparative and culturally grounded perspectives on equity, multilingual science education, and community-based STEM learning—perspectives that are largely absent from the current literature dominated by North American and Australian contexts.

Conclusion

This bibliometric study confirms the exponential growth and increasing thematic sophistication of STEM Education research between 2015 and 2024. The Annual Growth Rate of 17.11% and the identification of five distinct thematic clusters—disciplinary core, socio-critical focus, technological integration, teacher professional development, and policy and curriculum reform—together paint a picture of a field that is rapidly maturing, diversifying its intellectual agenda, and becoming more attentive to systemic equity concerns. The emergence of computational thinking as the fastest-growing research cluster, positioned at the intersection of disciplinary and socio-critical concerns, suggests that the field is converging on a vision of STEM education as simultaneously technical, civic, and emancipatory.

Yet the dominance of high-resource, Western nations in research production—and the correspondingly low international co-authorship rate of 13.84%—underscores the urgent need to globalize participation in STEM education scholarship. The finding that the Philippines contributes only approximately 2.67% to the highly relevant global literature set, and does so primarily through a domestically oriented, policy-driven lens, illustrates a significant research translation gap that limits the field's global reach and relevance. For nations like the Philippines, this gap represents both a challenge and an opportunity: the challenge of building research capacity under significant structural constraints, and the opportunity to contribute unique perspectives—on equity, multilingual learning, community-based STEM, and large-scale curriculum reform in developing contexts—that could meaningfully enrich global scholarship.

Future research should pursue several concrete directions. First, international collaboration initiatives should be designed to actively include Southeast Asian and other underrepresented regions, moving beyond the USA–China–Australia triangle that currently dominates bilateral collaboration networks. Second, funding agencies and journal editors should prioritize research conducted in and by scholars from

the Global South, both to address representational inequities and to strengthen the empirical basis for globally applicable STEM education theory. Third, Philippine and similar national research communities should invest in systematic reviews, bibliometric analyses, and cross-national comparative studies that translate local educational experience into internationally indexed scholarship. Finally, the field's growing computational thinking agenda should be pursued with explicit equity commitments, ensuring that the benefits of digital and data literacy are distributed across, rather than concentrated within, already advantaged populations.

In sum, this study offers a dual contribution: a rigorous empirical mapping of global STEM education research structures, and a contextualized critique of the inequalities embedded in those structures. Both contributions point toward the same imperative—building a STEM education research community that is not only intellectually sophisticated but genuinely global, inclusive, and responsive to the full diversity of contexts in which STEM learning is practiced.

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6. **Declaration of Originality.** By submitting this work, I hereby declare and certify that this submission is entirely my own original work, created independently, and that no part of it has been copied, paraphrased, or reproduced from any other source without proper and explicit acknowledgment. Furthermore, I confirm that this work has not been previously published and is not currently under consideration for or submitted to any other publication, journal, or competition.

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