ar-Riyadhiyat
JOURNAL OF MATHEMATICS EDUCATION
Vol. 6, No. 2, January 2026, pp. 79-90
ISSN: 2775-8990 DOI: https://doi.org/10.47766/arriyadhiyyat.v6i2.6544

Systematic Literature Review: Ethnomathematics Research Trends Using Bibliometrix R Studio Biblioshiny (2005-2025)

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Article Info

Article history:

Received July 17, 2025
Revised December 10, 2025
Accepted January 5, 2026

Keywords:

Bibliometrix
Biblioshiny
Ethnomathematics
Literature Review
R Studio

ABSTRACT

This study aims to analyze the trend of scientific publications on the theme of ethnomathematics indexed by Scopus during the period 2005-2025. The analysis is conducted as a basis for identifying future research directions and opportunities. The method used is Systematic Literature Review (SLR) with the help of bibliometric analysis using R Studio through the biblioshiny interface. Data was collected automatically through the Scopus API with the keyword "ethnomathematics", which resulted in 670 documents from journals, books, book chapters and others. Furthermore, publication patterns, author collaboration, journal distribution, and thematic trends were analyzed. Data visualization through biblioshiny provides a comprehensive picture of research dynamics, which can be used as a strategic reference for the development of further studies in this field. Trends in the topics of equations, ethnomathematics, mathematics education, and curricul from the derivatives of this theme are also still largely unexamined so it is important that there is novelty related to further research on the theme of ethnomathematics.

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INTRODUCTION

Mathematics has long been positioned as a universal language, yet its meanings are always lived and interpreted within particular cultural landscapes. In everyday contexts, mathematical reasoning emerges not merely as symbolic manipulation, but as a practical tool embedded in social practices and local knowledge systems (Giriansyah et al., 2023; Rahimah, 2023). The transformation of abstract mathematical concepts into tangible experiences is therefore essential, especially when students encounter difficulties in relating formal symbols to their lived realities. Contextualization through cultural artifacts and local environments has been shown to support conceptual understanding and deepen students' engagement with mathematical ideas (Payadnya & Jayantika, 2022; Permana, 2023).

Within this perspective, ethnomathematics has developed as a significant field that explores the dynamic relationship between mathematics and culture. Studies highlight how mathematical practices are embedded in specific cultural frameworks, reflecting the ways communities construct, interpret, and transmit

quantitative and spatial knowledge (Owusu-Darko, 2021; Rawani & Fitra, 2022; Wulandari et al., 2024). By positioning culture as a legitimate epistemological source, ethnomathematics bridges formal schooling and local wisdom, enriching mathematics education with culturally responsive approaches (Zaini et al., 2023; Putu et al., 2023).

Empirical evidence indicates that integrating ethnomathematical elements into curricula can enhance students' motivation, participation, and contextual understanding (Usman & Wijaya, 2024; Kurniawati et al., 2025). Learning materials grounded in local culture, including realistic and problem-based designs, have demonstrated positive contributions to meaningful mathematical learning (Lestari & Mulyawati, 2024; Andriani et al., 2022). Nevertheless, challenges persist. Teachers frequently report limited pedagogical preparation and uncertainty in translating cultural knowledge into structured mathematical instruction (Sunzuma & Maharaj, 2019). Variations in implementation are also influenced by teachers' professional backgrounds and contextual constraints (Rafsanjani et al., 2024; Zuhri et al., 2023; Fitiradhy et al., 2023).

The rapid expansion of digital technologies further reshapes the landscape of mathematics education. Recent studies suggest that technology-enhanced ethnomathematics can generate interactive and multimodal learning environments aligned with contemporary educational demands (Lu'luilmaknun & Novitasari, 2024; Amreta, 2024). The integration of digital platforms with culturally grounded content opens new possibilities for innovative instructional strategies, extending ethnomathematics beyond traditional artifact exploration toward technologically mediated pedagogy (Turmuzi et al., 2023; Yuliana et al., 2022).

Despite the growing body of empirical studies, theoretical consolidation remains limited. Foundational work emphasizes the need for robust conceptual frameworks that clarify how ethnomathematics interacts with modeling, pedagogy, and students' cognitive development (Rosa & Orey, 2013). More recent scholarship calls for structured analytical models to deepen understanding of these interactions and to position ethnomathematics within broader educational theories (Piter et al., 2025; Fredy et al., 2020; Prahmana et al., 2023). Moreover, comprehensive reviews of the field reveal the necessity of systematically mapping publication trends, thematic evolution, and collaborative networks in order to identify underexplored research areas (Febriyanti et al., 2024; Fonseca, 2010; Ida, 2023).

Although individual bibliometric and literature reviews have examined specific dimensions of ethnomathematics, a long-term mapping of global research trends covering two decades remains limited. Understanding how themes such as curriculum integration, mathematical problem solving, primary education, and technology-based learning have evolved over time is crucial for identifying research gaps and guiding future investigations. Therefore, this study conducts a systematic literature review combined with bibliometric analysis using the Bibliometrix package in R Studio (Biblioshiny interface) to analyze Scopus-indexed publications on ethnomathematics from 2005 to 2025. By mapping publication growth, thematic structures, author collaborations, and emerging research fronts, this study aims to provide a comprehensive overview of ethnomathematics research trends and to formulate strategic directions for future scholarly contributions in mathematics education.

METHOD

This study employed a Systematic Literature Review (SLR) combined with bibliometric analysis to map the development of ethnomathematics research from 2005 to 2025. The bibliometric approach enables the systematic exploration of large-scale scientific publications through quantitative techniques, allowing researchers to identify publication patterns, thematic evolution, collaboration networks, and emerging research fronts (Donthu et al., 2021). The analysis was conducted using the Bibliometrix package in R Studio, operated through the Biblioshiny interface, which provides an interactive environment for comprehensive bibliometric visualization and interpretation (Büyükkidik, 2022).

Data Collection

Data were retrieved from the Scopus database using an API key to ensure systematic and reproducible extraction. The keyword used in the search query was "ethnomathematics," and the publication period was limited to 2005–2025. All document types indexed in Scopus, including journal articles, conference proceedings, book chapters, and books, were included to capture a broad representation of scholarly output in the field. The search results were exported in BibTeX format to ensure compatibility with Bibliometrix.

Data Analysis Procedures

The bibliometric analysis followed several structured stages. First, publication data were collected from Scopus and exported in BibTeX format. Second, R Studio was used to run the Bibliometrix package, and the BibTeX file was imported into the Biblioshiny interface. Third, descriptive bibliometric indicators were

generated, including annual publication growth, most productive authors, institutional affiliations, country contributions, and source journals. Subsequently, advanced analyses were conducted to examine collaboration networks between countries and authors, keyword co-occurrence patterns, thematic evolution, word frequency distribution (word cloud), treemap visualization, and thematic mapping. These analyses enabled the identification of motor themes, emerging themes, declining themes, and underdeveloped but relevant research areas. Visualization outputs were interpreted to reveal dominant research clusters and potential gaps that require further scholarly attention.

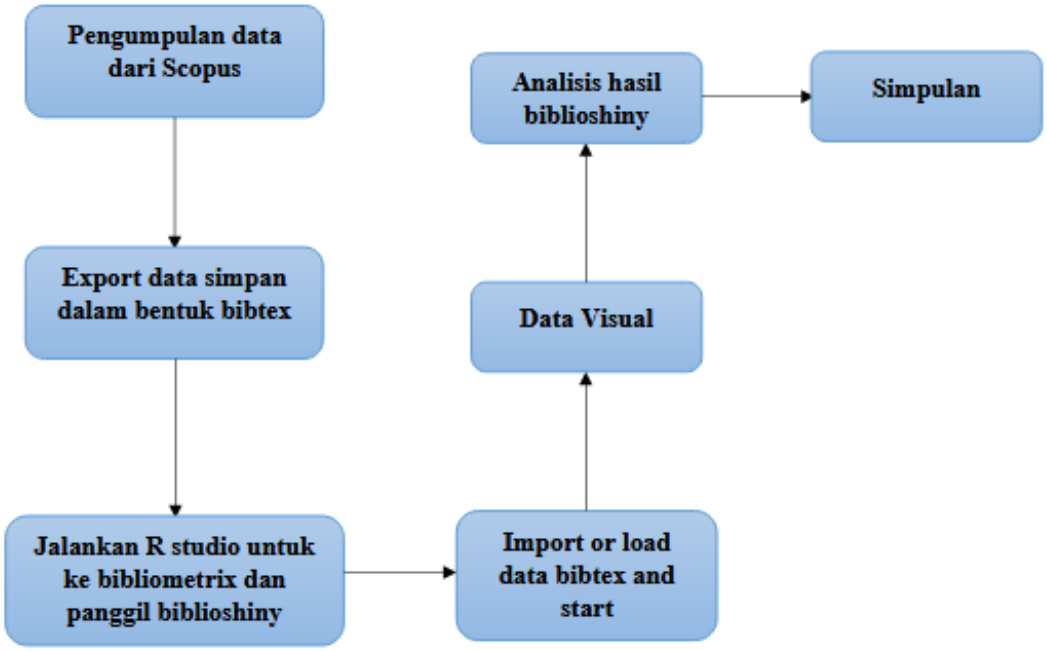


Figure 1. Stages of Literature Review Activities

Figure 1 illustrates the sequential stages of the literature review process, beginning with Scopus data collection, data export in BibTeX format, processing in R Studio through Bibliometrix and Biblioshiny, visualization of bibliometric outputs, and concluding with interpretative analysis and research conclusions

RESULTS AND DISCUSSION

General Bibliometric Overview

The bibliometric extraction produced 670 Scopus-indexed documents published between 2005 and 2025, distributed across 227 sources and authored by 1,386 researchers. The dataset shows an annual growth rate of 15.55%, indicating a sustained and accelerating scholarly interest in ethnomathematics over the last two decades. The average citations per document (5.149) and the mean document age (5.35 years) suggest that the field is relatively dynamic, with continuous publication turnover and emerging thematic shifts.

Figure 2. Overall information of the processed data

The presence of 1,256 author keywords reflects a high level of conceptual diversity, signaling that ethnomathematics research is not confined to a single pedagogical strand but intersects with curriculum studies, mathematical modeling, cultural studies, and educational technology. International co-authorship accounts for 15.82% of publications, while the average of 2.93 co-authors per document indicates moderate collaborative engagement within the field.

Publication Trends and Source Distribution

The annual publication trajectory demonstrates fluctuating yet overall upward growth, with a significant peak in 2024. Minor fluctuations in the most recent year may be attributed to metadata indexing limitations rather than an actual decline in research productivity.

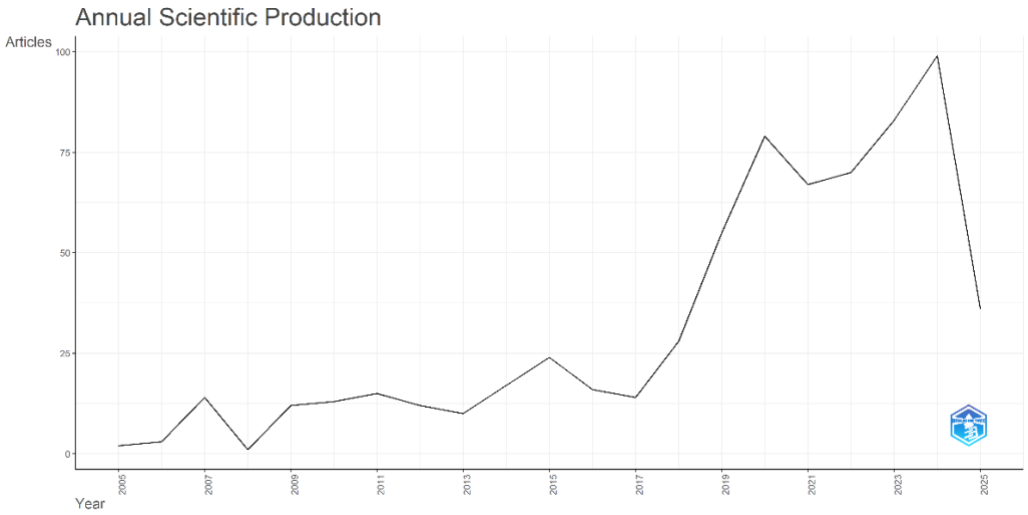
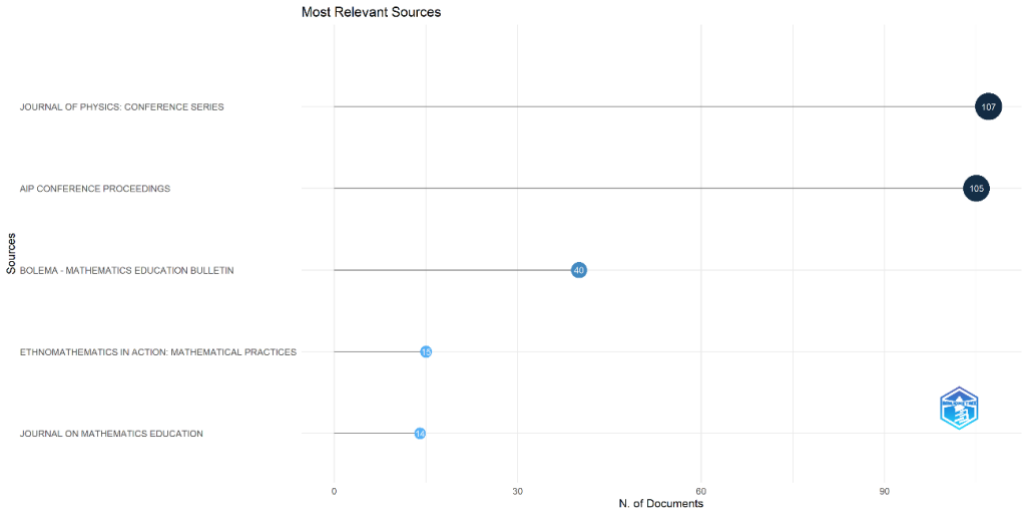


Figure 3. Number of articles per year and order of publication

The most productive sources include Journal of Physics: Conference Series (107 documents), AIP Conference Proceedings (105 documents), and BOLEMA: Mathematics Education Bulletin (40 documents). The prominence of conference proceedings suggests that ethnomathematics continues to expand through academic forums that encourage rapid dissemination of innovative teaching practices and exploratory studies.



Country Contribution and Institutional Dominance

Country-level analysis indicates that Indonesia dominates the field, contributing 528 documents, followed by Brazil (194) and the United States (77). This dominance reflects Indonesia's rich cultural diversity, which provides extensive empirical material for ethnomathematical exploration. At the institutional level, Universitas Pendidikan Indonesia emerges as the most productive affiliation.

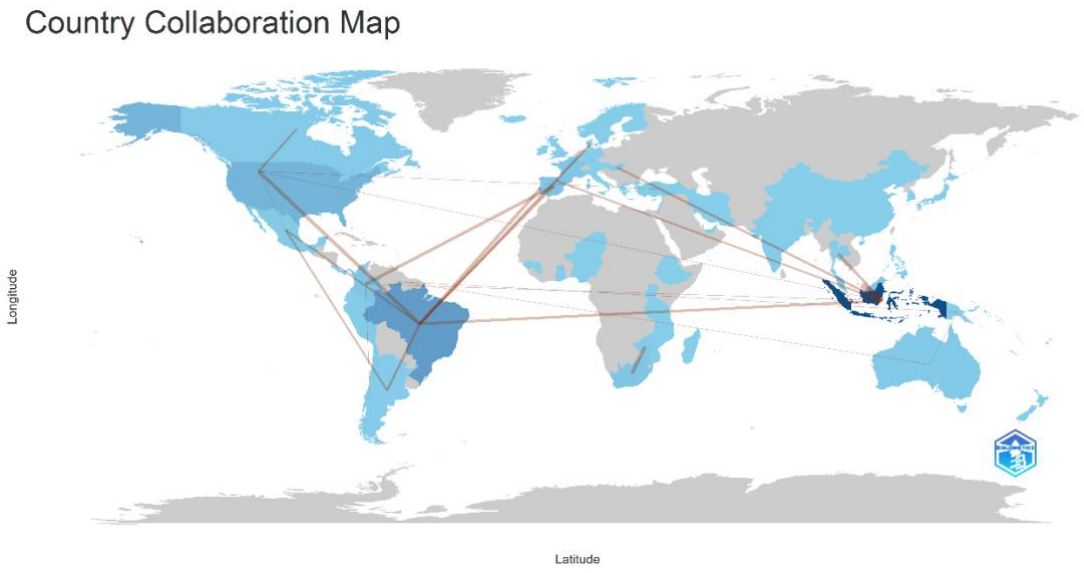
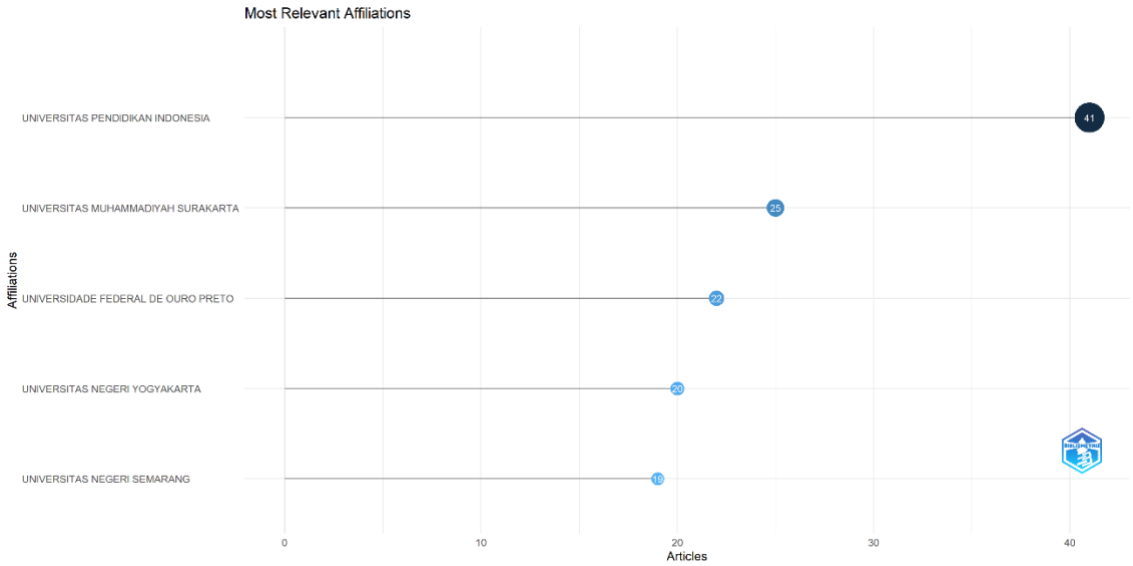


Figure 4. Distribution of author affiliations and author countries

Collaboration mapping reveals that Indonesia–Malaysia partnerships demonstrate the strongest international linkage intensity. Although international collaboration is present, a substantial portion of publications remains domestically concentrated, suggesting opportunities for broader transnational research partnerships.



Keyword Analysis and Emerging Research Opportunities

Word cloud visualization highlights frequently occurring terms such as "student," "physics," "mathematics learning," and "mathematical concepts," indicating a strong pedagogical orientation in the field.

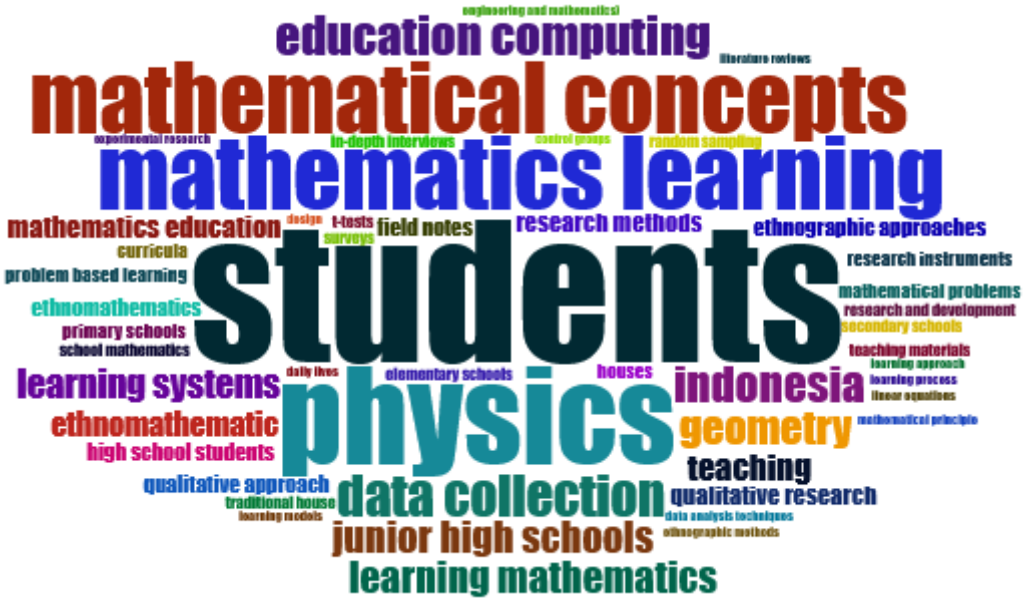
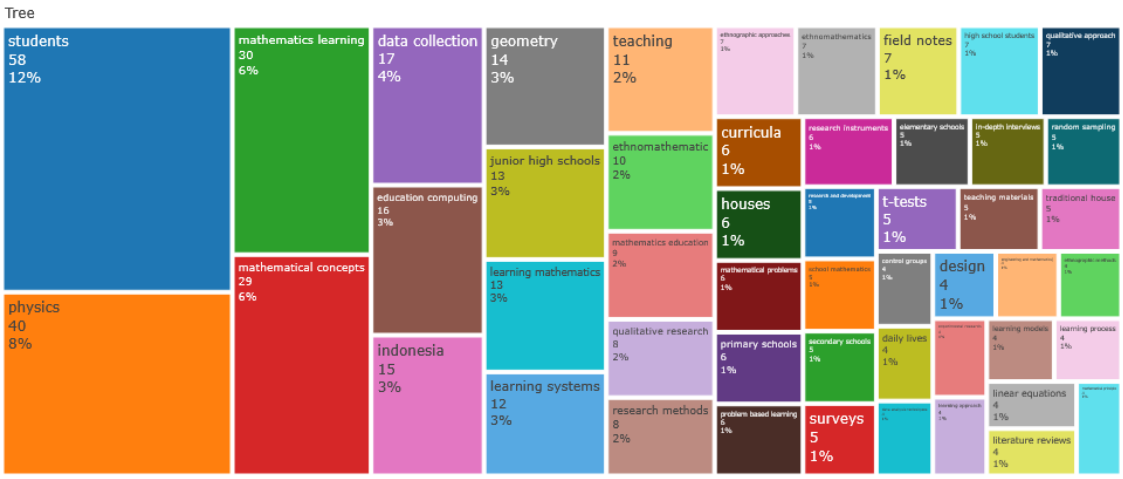


Figure 5. World cloud and treemap views based on

Treemap analysis identifies several underrepresented but promising themes, including "curricula," "mathematical problems," "primary school," "problem-based learning," and "traditional house," each representing approximately 1% of the dataset. These low-density clusters suggest areas where theoretical refinement and empirical expansion are needed.



Trend Topics and Thematic Evolution

Trend topic analysis demonstrates that “ethnomathematics” itself became highly prominent between 2021 and 2024, indicating renewed scholarly attention. The theme “mathematics education” shows sustained relevance from 2019 to 2024.

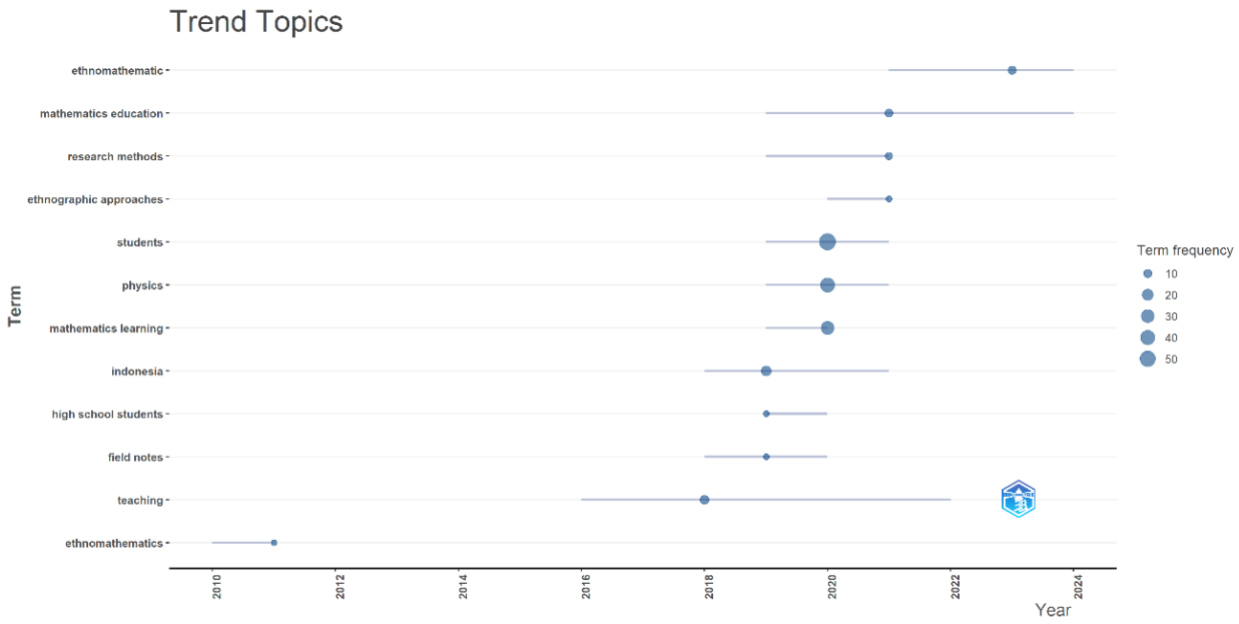


Figure 6. Display of trend topics against the ethnomathematics theme

The thematic map categorizes research clusters into four quadrants based on centrality and density. Core themes such as ethnomathematics, mathematics education, and curricula appear as important but not yet fully developed domains, suggesting the need for deeper theoretical consolidation.

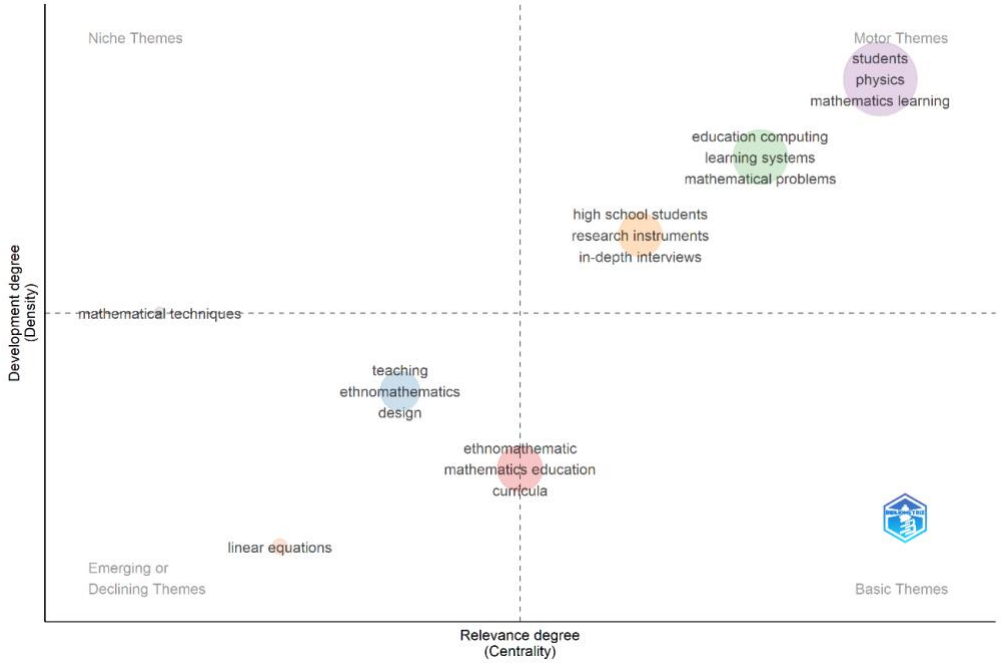


Figure 7. Thematic map of ethnomathematics research

Figure 7 above shows the results of thematic map analysis by grouping them into four quadrants with themes to be developed. seen in quadrant two each empty and there is an intersection between quadrant three and quadrant four. Quadrant four shows that the research themes are important but have not reached a more comprehensive conclusion, so further research is needed, namely ethnomathematics, mathematics education, and curricula. It can be seen in Figure 7 that is positioned in quadrant three related to the derivative themes that are relevant, the smaller the bullets, the less research on the theme of Linear equations. This theme is included in the development of themes that still lack research, so that the existence of innovation or novelty in the future can be very relevant and necessary in the study of ethnomathematics.

Based on the results of a literature review analyzed using bibliometrics, it appears that Indonesia dominates research in the field of ethnomathematics compared to other countries. This dominance is not only evident from the number of publications, but also from the intensity of author collaboration between countries, where Indonesia and Malaysia are recorded as the two countries with the highest level of collaboration in ethnomathematics research.

In terms of affiliation, Universitas Pendidikan Indonesia is the most productive institution in publishing ethnomathematics-themed articles indexed on Scopus. Meanwhile, the journal that has the most publications of ethnomathematics articles is Journal of Physiscs: Conference Series, followed by AIP Conference Proceedings and several other international journals that are also quite productive in the ethnomathematics theme.

Various research activities that have been carried out include: Exploration of ethnomathematics of SIlahisabungan monument (Astuti & Rakhmawati, 2024). Exploration of mathematical concepts in Surakarta truntum batik (Nurcahyo et al., 2024). Meta-analysis of the effectiveness of ethnomathematics-based learning on students' mathematical communication in Indonesia (Turmuzi et al., 2024). Integration of ethnomathematics in thematic learning (Wulandari et al., 2024). Ethnomathematics in the Intermediate Phase: Reflection on morabaraba game as indigenous mathematical knowledge (Meeran et al., 2024)

The integration between realistic mathematics and ethnomathematics presents a more meaningful context for students (Mardiah et al., 2023). Ethnomathematics invitation in mathematics learning in Islamic schools (Waritsman & Lefrida, 2024). Ethnomathematics in the form of traditional house buildings such as flat buildings, space buildings, lines, and angles (Saputra et al., 2022).

Some of these findings show that ethnomathematics-themed research is still very relevant to continue to be developed, especially as an effort to introduce and preserve culture to students. Through this research, students are not only invited to understand mathematical concepts in a cultural context, but can also recognize and appreciate the wealth of Indonesian local culture in accordance with the local wisdom of each region. In the analysis of treemap and word cloud results, it can be seen that there are topics that still have great opportunities for further research in the ethnomathematics theme, such as “Curricula”, “Mathematical

problems", "Primary school", "Problem-based learning", "Traditional house", and others which are classified as 1% of the current papers on Scopus.

Researchers also examined the words that have the top frequency of appearance in the document data inputted into Biblioshiny to analyze the trend of ethnomathematics research using the trend topics display. The results obtained were that the top position of the word "Ethnomathematic" became a trending topic from 2021 to 2024. Then, on the Thematic Map which is positioned in quadrant three related to relevant theme derivatives, the smaller the bullet the smaller the research on the theme of Linear equations. this is a derivative theme that has not been researched so much that it is important that there is novelty related to further research on the theme of ethnomathematics. As for some words such as ethnomathematics, mathematics education, and curricula, it is clear in the Thematic Map data that this topic has not yet reached a perfect conclusion.

DISCUSSION

The present study examined the comparative effectiveness of Student Team Achievement Division (STAD) and Team Assisted Instruction (TAI) in improving Grade 10 students' performance in illustrating polynomial functions and writing polynomials in standard form. The findings revealed that both strategies resulted in high levels of academic achievement, with no statistically significant difference between them. This outcome is consistent with prior research indicating that various cooperative learning models often produce comparable gains in mathematics performance when implemented systematically (Azmi, N., 2024; Ridwan & Hadi, 2022; Tshering & Dorji, 2022; Damayanti, S. and Auliya, 2023). Although some studies report contextual advantages of one model over another, the absence of significant differences in this study suggests that the shared cooperative principles embedded in both STAD and TAI may play a more decisive role than their procedural distinctions.

The comparable effectiveness of STAD and TAI can be interpreted through their common theoretical foundations. Both models operationalize positive interdependence and individual accountability, which are central to successful cooperative learning environments (Acharya, 2023; Ridwan & Hadi, 2022; Adelia, R and Sarassanti, Y. 2025). Additionally, opportunities for peer explanation and collaborative problem-solving likely strengthened students' conceptual understanding of algebraic procedures, as supported by Atteh et al. (2020). The scaffolding processes inherent in cooperative group work, whether peer-driven as in STAD or teacher-assisted as in TAI, may have facilitated gradual mastery of polynomial concepts. These mechanisms align with broader findings that cooperative learning enhances deeper mathematical reasoning compared to traditional teacher-centered instruction (Karali & Aydemir, 2018; Tshering & Dorji, 2022; Narita, R., et al. 2022).

Behavioral observations further reinforce the quantitative results. Students under both instructional conditions demonstrated consistently high levels of participation, collaboration, attentiveness, and task persistence. This pattern supports literature emphasizing the strong relationship between student engagement and mathematics achievement (Chiaramonte, 2025; Doménech-Betoret et al., 2019; Azmi, N and Rosdiana, 2022). Participation and academic interaction, in particular, are known to contribute to improved conceptual understanding and problem-solving ability (Ocampo Buitrago et al., 2025). The findings suggest that cooperative structures not only improved academic performance but also fostered positive classroom behaviors that are essential for sustained learning. Thus, engagement appears to function as a mediating variable linking cooperative instructional strategies with improved mathematics outcomes.

The absence of statistically significant differences between STAD and TAI may also be influenced by contextual factors. The study was conducted within a single intact class of 20 students, using a counterbalanced repeated-measures design to ensure instructional consistency. The relatively small sample size may have limited statistical power, potentially reducing the likelihood of detecting subtle differences between strategies. Moreover, both interventions were implemented by the same teacher within a controlled classroom environment, which may have minimized variability attributable to instructional delivery. It is also possible that the algebraic topics selected—illustrating polynomial functions and writing polynomials in standard form—were equally well supported by both cooperative structures, thereby contributing to the similarity of outcomes. Such contextual considerations highlight the importance of interpreting non-significant findings with methodological awareness rather than assuming equivalence without reflection.

Despite these limitations, the study contributes context-sensitive evidence to the literature on cooperative learning in secondary mathematics education. While international research has widely documented the effectiveness of STAD and TAI, localized comparative investigations in Philippine secondary classrooms remain limited. By examining both performance outcomes and observed learning behaviors within the same cohort, this study extends existing scholarship and provides practical insights for mathematics educators. The findings imply that teachers may select either peer-driven (STAD) or teacher-assisted (TAI) cooperative structures depending on classroom needs, resource availability, and student characteristics, without

compromising academic effectiveness. Future research involving larger samples, multiple schools, and pre-test–post-test designs may further clarify conditions under which one model demonstrates superior impact.

CONCLUSION

This bibliometric systematic literature review analyzed 670 Scopus-indexed publications on ethnomathematics from 2005 to 2025 using Bibliometrix (Biblioshiny). The results indicate sustained growth in publication output, strong dominance by Indonesian scholars and institutions, and moderate levels of international collaboration, particularly between Indonesia and Malaysia.

Core themes such as ethnomathematics, mathematics education, and curricula remain central yet theoretically underdeveloped, while derivative themes like linear equations and problem-based learning present substantial opportunities for novelty. Future research should prioritize deeper theoretical consolidation, broader international collaboration, and integration of specific mathematical domains into culturally responsive pedagogical models.

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By providing a comprehensive mapping of publication patterns, thematic structures, and research gaps, this study offers a strategic foundation for advancing ethnomathematics scholarship in the global mathematics education landscape.

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