



Volume 6 Nomor 1 (2025) Pages 101-115

Edubase : Journal of Basic Education

Email Journal : edubase.bbc@gmail.com

Web Journal: <https://jurnal.uibbc.ac.id/index.php/edubase/index>



Ethnoscience-Based Instructional Materials for Natural and Social Sciences in Elementary Schools: A Bibliometric Analysis

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Received: 2025-02-25; **Revised:** 2025-03-25; **Accepted:** 2025-03-27

Abstract

Research on ethnoscience-based instructional materials in Natural and Social Sciences (IPAS) education has grown in recent years. However, a significant gap remains in bibliometric analysis and systematic mapping, limiting the understanding of research trends, collaboration patterns, and key themes in this field. **Objective:** This study aims to conduct a bibliometric analysis of ethnoscience-based IPAS instructional materials to identify publication trends, researcher networks, and thematic focuses. **Novelty:** Unlike previous studies focusing on classroom implementation, this research offers the first bibliometric mapping of ethnoscience in IPAS materials. **Methods:** This study used a systematic literature review and bibliometric analysis of Scopus-indexed publications (2020–2025). Data was analyzed using VOSviewer 1.6.20, Biblioshiny, and Microsoft Excel to identify trends and key research themes. **Results:** The findings reveal that Indonesia and China are the top contributors, with dominant themes including curriculum development and student engagement. Research collaboration remains limited, with only 16.73% of studies involving international partnerships. Additionally, challenges include the lack of a standardized framework for implementing ethnoscience in elementary curricula. **Conclusion:** This study highlights the need for cross-disciplinary collaboration between educators, researchers, and policymakers to enhance the application of ethnoscience in elementary school. Strengthening international partnerships will further support the development of culturally responsive and scientifically robust instructional materials.

Keywords: Ethnoscience, Instructional Materials, Natural and Social Sciences, Elementary School, Bibliometric Analysis.

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INTRODUCTION

Primary education plays an important role in developing students' scientific literacy, particularly through the Natural and Social Sciences (IPAS) subject in the Indonesian curriculum (Surul & Septiliana, 2023). However, conventional approaches often overlook cultural and local aspects that can enhance students' connection to the subject matter (Mokmin et al., 2024). To address this issue, ethnoscience-based instructional materials integrate local wisdom into science education, allowing students to understand theoretical concepts while relating them to everyday life (Walter, 2024). This approach aligns with the Indonesian Curriculum policy, which emphasizes the integration of local content in learning (Septiana & Winangun, 2023). In contrast, science education in Europe focuses more on STEM (Science, Technology, Engineering, and Mathematics) with technology-driven approaches and laboratory experiments (Wu et al., 2022). This difference illustrates how each country tailors its curriculum based on its specific needs and policies. Therefore, adapting the curriculum to align with students' social and cultural contexts is essential for enhancing the relevance and effectiveness of education.

As 21st-century education increasingly emphasizes context-based scientific literacy, the integration of ethnoscience into IPAS instructional materials in elementary school has become even more significant. Several studies indicate that ethnoscience can improve students' conceptual understanding of science and their engagement in learning (Sarkingobir & Bello, 2024). Additionally, this approach contributes to fostering students' awareness of local wisdom and strengthening their cultural identity (Yetti et al., 2024). However, existing research remains limited in scope and implementation. Most studies focus on specific regions without providing a comprehensive overview of the challenges and opportunities in integrating ethnoscience into IPAS instructional materials. Until now, no study has comprehensively mapped the global collaboration patterns in ethnoscience research or analyzed the longitudinal trends of keywords in this field (Puspita et al., 2024).

The approach employed in this study offers a novel perspective compared to previous research, which has primarily focused on the practical implementation of ethnoscience-based instructional materials in classrooms (Khery et al., 2025). By utilizing bibliometric analysis, this study not only explores the effectiveness of instructional materials but also identifies publication patterns related to the integration of ethnoscience in IPAS education. This approach enables researchers to examine emerging research trends, assess the distribution of frequently discussed topics, and understand the evolution of this field over time. Consequently, this study contributes not only to pedagogical aspects but also to the broader development of ethnoscience-based educational theories and policies. Indonesian curriculum mandates the integration of local wisdom into learning; however, found that many teachers still struggle to access suitable ethnoscience-based instructional materials (Arianingrum et al., 2024). Without ethnoscience in learning, students may see science as irrelevant to their culture, leading to decreased interest and understanding (Khotimah et al., 2022).

This study is a pioneering research that integrates bibliometric analysis with ethnoscience studies in the development of IPAS teaching materials for elementary schools, offering a new perspective on culturally based curriculum design. Previous studies have predominantly employed a qualitative case study approach such as Prabowo et al., (2024); Lestari (2025); Dhoka et al., (2024); Fitriani et al., (2024), whereas this research presents a quantitative trend analysis based on bibliometric data. The use of software such as VOSviewer 1.6.20 and Biblioshiny in this analysis provides a methodological advantage in mapping key aspects of ethnoscience research. Through the visualization of researcher collaboration networks, keyword analysis, and identification of the most active institutions in this field, this study presents a comprehensive overview of the dynamics of ethnoscience research in

education. With a systematic and data-driven approach, this study aims to establish a strong academic foundation for the development of instructional materials that integrate local wisdom.

Furthermore, it serves as a valuable reference for academics and education practitioners in designing more contextually relevant and culturally responsive teaching strategies (Lau & Shea, 2024), thereby enhancing the effectiveness of IPAS learning in elementary school. This study has several limitations, including restricted database coverage limited to Scopus, potential language bias due to the use of English-only articles, and constraints in conducting an in-depth qualitative analysis. However, it still contributes by providing the first comprehensive map integrating bibliometric and thematic analysis in the development of ethnoscience teaching materials at the elementary school level.

Although numerous studies have explored the benefits of ethnoscience in IPAS education, several research gaps remain unaddressed. First, studies on ethnoscience-based IPAS instructional materials are still sporadic and lack systematic mapping. Second, there is a limited number of studies that explicitly employ bibliometric analysis to examine related literature, making it difficult to understand global trends as well as the challenges and opportunities in developing ethnoscience-based instructional materials. Third, previous research has yet to investigate the long-term impact of ethnoscience integration in IPAS education at the elementary school level, particularly in terms of learning effectiveness and the sustainability of educational innovations. Therefore, this study seeks to bridge these gaps by providing a comprehensive scientific mapping of the field.

The ethnoscience approach in education is not only supported by various empirical studies but also grounded in strong theoretical foundations. Vygotsky's constructivist theory, as cited in Shibina & Vidyapeetham (2022), emphasizes that learning rooted in social and cultural contexts is more meaningful for students. In this context, ethnoscience allows students to understand scientific concepts by linking them to cultural practices they have been familiar with since childhood. For instance, in agrarian communities, students can grasp concepts such as ecosystems, the water cycle, and photosynthesis through traditional farming practices observed in their surroundings (Ryplova et al., 2023). Thus, ethnoscience-based learning facilitates more effective knowledge transfer, as the material taught is directly relevant to students' daily lives (Ardianti & Raida, 2022).

Furthermore, Bronfenbrenner's ecological systems theory, as cited in Panahandehpour et al., (2023), reinforces the significance of social and cultural environments in shaping students' learning experiences. From this perspective, education cannot be separated from external factors such as family, community, and local culture, all of which influence how students think and perceive the world. Thus, the integration of ethnoscience in IPAS learning is not merely a pedagogical innovation but also a strategic approach to strengthening the connection between schools and communities (Fitria et al., 2025). By positioning local culture as a learning resource, students not only develop a stronger academic understanding but also learn to appreciate their own cultural heritage. This approach enhances scientific literacy while fostering students' critical thinking, reflective skills, and sense of ownership over the cultural values that surround them.

Based on the identified research urgency and gaps, this study aims to address the following research questions: 1) How has research on ethnoscience-based IPAS instructional materials evolved in scientific publications, and what are the key themes? 2) What are the collaboration patterns among researchers? 3) What are the main challenges in researching ethnoscience-based IPAS instructional materials in elementary school? In line with these research questions, the objectives of this study are to: 1) Analyze the development of research on ethnoscience-based IPAS instructional materials in scientific publications and identify key themes, 2) Examine researcher collaboration patterns, and 3) Explain the main challenges in implementing ethnoscience-based IPAS instructional materials in elementary school.

This study is expected to contribute both academically and practically. From an academic perspective, it will enrich the body of knowledge on the integration of ethnoscience in primary education, particularly in IPAS instruction. The bibliometric literature mapping can serve as a reference for other researchers in developing similar studies while helping to determine future research directions. From a practical standpoint, the findings can provide valuable insights for educators and curriculum developers in designing more contextualized and culturally relevant IPAS instructional materials. Consequently, the implementation of ethnoscience-based instructional materials in elementary school can become more systematic and have a positive impact on enhancing students' understanding and interest in science.

METHODS

This study employs a systematic literature review method with a bibliometric approach to explore literature related to ethnoscience-based instructional materials in elementary school from 2020 to 2025. The data analyzed is sourced from a leading academic database, Scopus, following systematic bibliometric analysis procedures. The bibliometric approach enables a quantitative analysis of scientific literature, including citation patterns, researcher collaboration, geographical distribution, and keyword trends. Additionally, this method aims to map research developments using software tools such as OpenRefine, VOSviewer type 1.6.20, Biblioshiny, and Microsoft Excel. The bibliometric analysis PRISMA steps are illustrated in Figure 1 .

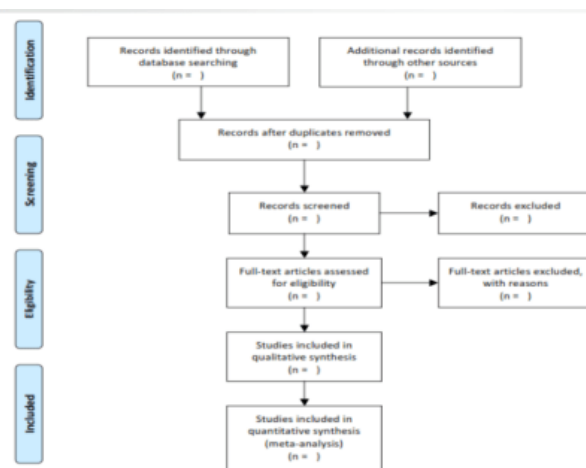


Figure 1. Bibliometric Analysis PRISMA Steps

This study uses search queries in the Scopus database as the main tool, with specifically designed keywords to find publications relevant to the research topic, specifically instructional materials, IPAS, and ethnoscience at the elementary school level. Additionally, synonyms for these terms were identified, as shown in Table 1.

Table 1. Synonyms of Keywords

Teaching Materials	“Teaching materials” OR “Instrument materials” OR “Educational resources” OR “Learning materials” OR “Teaching resources” OR “Didactic materials” OR “Pedagogical tools” OR “Curriculum materials” OR “Study aids” OR “Learning aids” OR “Training materials” OR “instructional materials”
Natural And Social Sciences	“Natural and Social Sciences” OR “Interdisciplinary Sciences” OR “Holistic Sciences” OR “Comprehensive Sciences”
Ethnoscience	“Ethnoscience” OR “Traditional Knowledge” OR “Local Knowledge System” OR “Indigenous Knowledge”

Elementary School	“elementary school” OR “Primary school” OR “Grade school” OR “Grammar school” OR “Junior school” OR “Infant and junior school” OR “Lower school” OR “Basic school” OR “Foundation school”
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Table 2. Inclusion Criteria Components

Indicator	Criteria
Year of Publication	2020-2025
Publications	Indexed in Scopus
Subject Area	Social Science
Publication Stage	Final
Source Tyoe	Journal
Language	English

This study encompasses all scientific publications related to ethnoscience-based science teaching materials indexed in Scopus. Out of a total of 725 identified documents, 275 passed the selection process and met the inclusion criteria after screening. The validation of the analysis results was conducted through in-depth discussions (peer-debriefing). Additionally, to ensure consistency in the data categorization process, a reliability test was performed using Cohen’s Kappa with criteria such as, citation count, impact factor of the journal source, and h-index or scientific productivity index.

RESULTS AND DISCUSSION

The Scopus-indexed publications on ethnoscience-based IPAS instructional materials in elementary schools from 2020 to 2025 are presented in Table 3.

Table 3. Main Information About Data

Main Information About Data	
Timespan	2020:2025
Sources (Journals, Books, etc)	168
Documents	275
Annual Growth Rate %	-41.29
Document Average Age	2.81
Average citations per doc	5.091
References	13739
Document Contents	
Keywords Plus (ID)	176
Author's Keywords (DE)	1075
AUTHORS	
Authors	882
Authors of single-authored docs	39
Authors Collaboration	
Single-authored docs	39
Co-Authors per Doc	3.29
International co-authorships %	16.73
Document Types	
article	275

The consistency results in the data categorization process were validated through a reliability test using Cohen’s Kappa, which yielded a value of $\kappa = 0.89$. This result reflects a very high level of agreement among researchers in the coding process of various academic indicators, such as citation count, which indicates how frequently an article is referenced in

other research; Impact Factor, which represents the influence level of a publication within the scientific community; and H-index, which is used to measure a researcher's productivity and scientific impact based on the number of publications and the citations they receive.

RQ1. How has research on ethnoscience-based IPAS teaching materials developed in scientific publications, and what are the main identified themes?

Based on Table 3, there was an increase in publications from 2020 to 2023, reaching a peak of 79 publications. However, in 2024, there was a decline of 30 articles, resulting in only 49 published articles, with an additional 3 articles published in March 2025. The results from VOSviewer indicate the most frequently researched keywords, as shown in Figure 2.

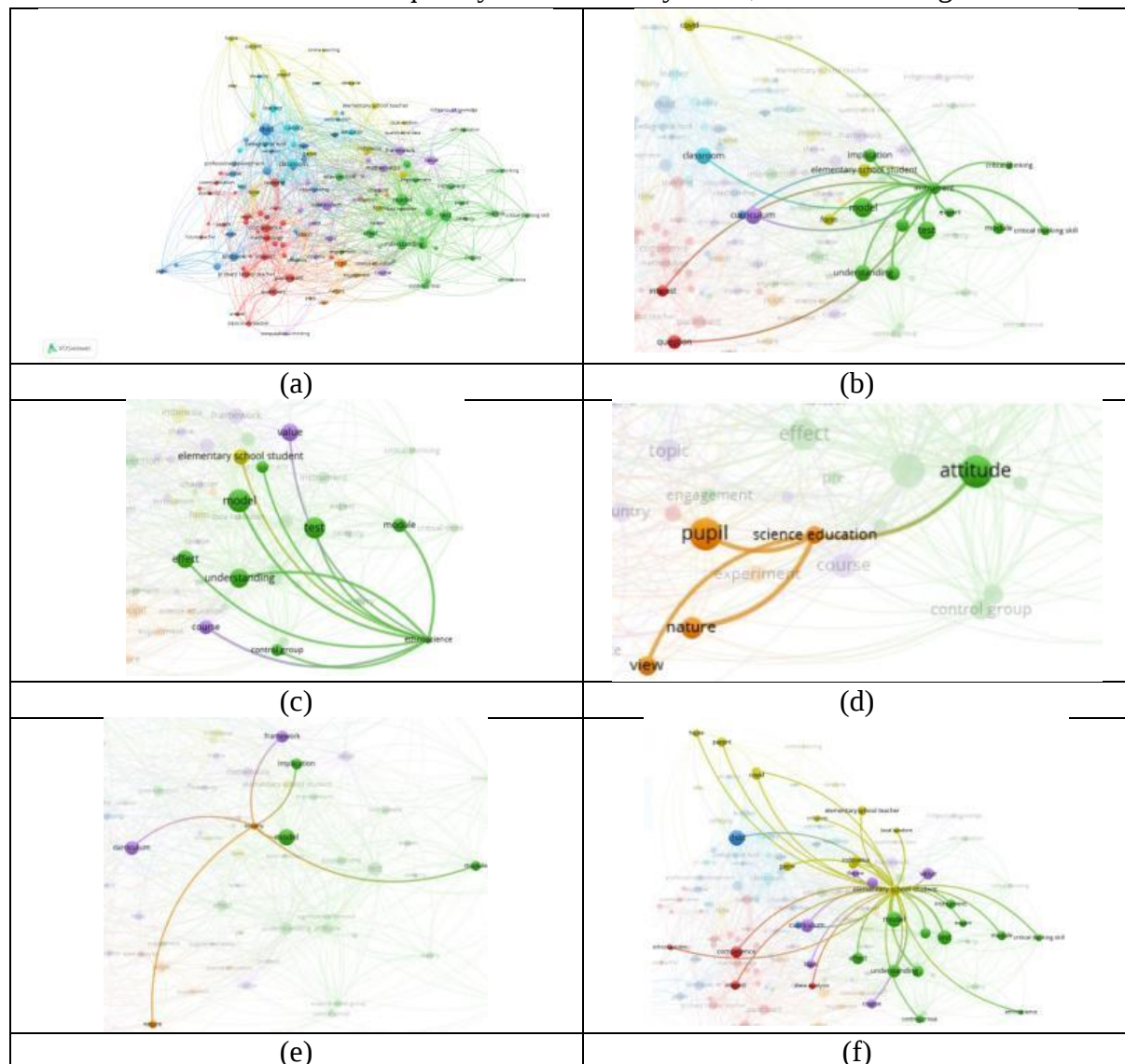


Figure 2. VOSviewer results for all keywords (a); Instrument (b); Ethnoscience (c); Science Education (d); Society (e); Elementary School Student (f)

The analysis results indicate that teaching materials directly related to ethnoscience have not yet been identified in previous studies. Although many studies have explored various aspects of science education, the explicit connection between ethnoscience and the development of teaching materials remains highly limited. In the literature review conducted, keyword cluster analysis in Figure 2 (a, b, c, d, e, f) reveals that terms such as test, model, and understanding frequently appear in related research. This suggests a tendency for science

education research to focus more on the development and evaluation of instructional models rather than their practical implementation in classrooms. Consequently, while ethnoscience is gaining attention in the academic sphere, research on how this concept can be effectively applied in teaching materials remains a scientific gap that requires further exploration.

Furthermore, the dominance of keywords such as test, model, and understanding in cluster analysis indicates that current research approaches are primarily centered on theoretical development and testing the effectiveness of teaching materials, yet they have not given sufficient attention to real-world classroom implementation. Many studies examine the effectiveness of specific instructional models by assessing students' understanding through a series of tests and evaluations, but few have integrated local cultural values into ethnoscience-based teaching materials. However, this culturally grounded approach holds great potential in enriching students' learning experiences, particularly by strengthening the connection between modern science and their everyday lives. Therefore, future research should focus more on how ethnoscience can be incorporated into concrete learning materials rather than merely being tested in theoretical models or controlled experiments.

The implications of these findings are crucial for the advancement of science education, particularly at the elementary school level. If research continues to prioritize model development without real-world implementation, there is a risk that the innovations produced will remain confined within academic discourse and will be difficult to adopt broadly in educational systems. Therefore, greater efforts are needed to develop teaching materials that directly integrate ethnoscience, not just as an abstract concept but as a curricular component that teachers and students can utilize in daily learning. By incorporating ethnoscience into science education, learning will not only become more contextual and relevant but will also foster students' awareness of the relationship between science and local culture, thereby creating a more inclusive and meaningful educational experience.

By analyzing the patterns of keyword occurrences, it can be concluded that research on ethnoscience-based IPAS teaching materials still holds great potential for further development. The dominance of keywords such as module, test, understanding, and effect indicates that this field remains widely open, particularly in designing teaching materials based on local culture and wisdom. The ethnoscience approach has significant potential to enhance the relevance of learning to students' daily lives (Marpaung et al., 2024), fostering a deeper conceptual understanding and increasing student engagement in the learning process (Wong & Liem, 2022). Therefore, further research is needed to design teaching materials that are not only ethnoscience-based but also significantly improve students' learning outcomes through contextual, interactive, and culture-exploratory approaches.

The ethnoscience approach in teaching material development plays a crucial role in improving the quality of IPAS education in elementary schools. The analysis results show that research on teaching materials still focuses on aspects such as test, model, understanding, and effect, which mainly assess the effectiveness of learning methods. Meanwhile, research on ethnoscience is more focused on models and the effects of integrating culturally-based knowledge into students' understanding. This indicates that there is still a research gap that needs to be explored further, particularly in developing teaching materials that not only enhance cognitive understanding but also connect science with real-life experiences based on local wisdom. By integrating ethnoscience, elementary school learning can become more contextual, engaging, and meaningful for students.

Furthermore, research in the field of science education shows that aspects such as attitude, students' perceptions of science (view), and their relationship with the surrounding environment (nature) are key focal points. This suggests that science education is not only about conceptual understanding but also about how students develop critical thinking skills and scientific attitudes. In this regard, ethnoscience can serve as a bridge between modern scientific

knowledge and local culture, allowing students to see the direct connection between their daily lives and the science concepts they learn. For example, students living in coastal areas can learn about buoyancy and ocean currents through the traditional boat-making culture, while those in agricultural regions can understand the water cycle and photosynthesis through local farming practices.

Additionally, the analysis reveals that in research related to society, frequently appearing keywords include curriculum, module, and implication, indicating that the relationship between education and society is mostly studied in the context of curriculum and learning model implementation. In other words, research on the role of ethnoscience in the curriculum has not yet been deeply explored. However, integrating culture into learning can help students understand that science is not separate from their lives but rather an integral part of social and cultural practices passed down through generations (Roeser et al., 2023). Therefore, the development of ethnoscience-based teaching material modules should become a focus in educational innovation (Rosita et al., 2024), ensuring that learning is more inclusive and aligned with students' cultural backgrounds.

Thus, the development of ethnoscience-based IPAS teaching materials in elementary schools still holds vast opportunities for further exploration. The dominance of keywords such as module, test, understanding, and effect indicates that research on teaching materials remains focused on their effectiveness and impact on students' comprehension. Therefore, further research is necessary to explore how ethnoscience can be adapted into curriculum-appropriate teaching materials while also enhancing students' learning outcomes and critical thinking skills. With this approach, education will not only focus on the transfer of scientific knowledge but also on preserving cultural values and shaping students' identities as members of a society with rich intellectual heritage that should be valued and developed.

RQ2. How is the pattern of collaboration among researchers?

The analysis of the five most-cited articles reveals the pattern of collaboration among researchers in the study of ethnoscience and the development of teaching materials in elementary schools. According to Figure 3, the top five corresponding authors' countries are Indonesia, China, Spain, the United Kingdom, and Sweden. The dominance of these countries indicates that research in this field has a broad international scope, with significant contributions from various academic institutions. Indonesia's presence in this list highlights that ethnoscience studies have gained considerable attention domestically, aligning with the need to develop teaching materials based on local wisdom in the elementary education system. Additionally, the involvement of developed countries such as the United Kingdom and Sweden suggests a multidisciplinary approach in this research, where collaboration between education, culture, and science is a primary focus.

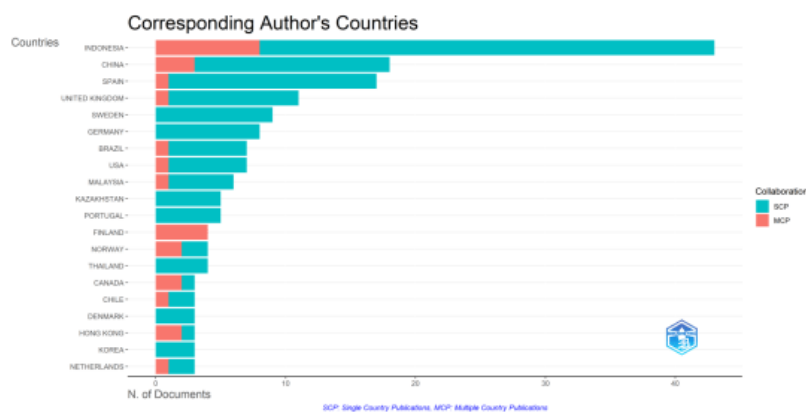


Figure 3. The Top Five Corresponding Authors' Countries

Alongside international collaboration, the list of the most relevant affiliators in Figure 4, which includes Universitas Pendidikan Indonesia, Universitas Sebelas Maret, The Education University of Hong Kong, Universidad Complutense De Madrid, and Universiti Pendidikan Sultan Idris, indicates that higher education institutions from various parts of the world actively contribute to this research. The presence of two Indonesian universities in this list suggests that ethnoscience studies have become a major focus in educational research in Indonesia. Universitas Pendidikan Indonesia and Universitas Sebelas Maret are known for their strengths in research on education based on culture and local wisdom, positioning them as key research centers in the development of ethnoscience-based teaching materials. Meanwhile, universities from Hong Kong, Spain, and Malaysia reflect a global approach to this study, demonstrating how ethnoscience concepts can be adapted in different educational contexts worldwide.

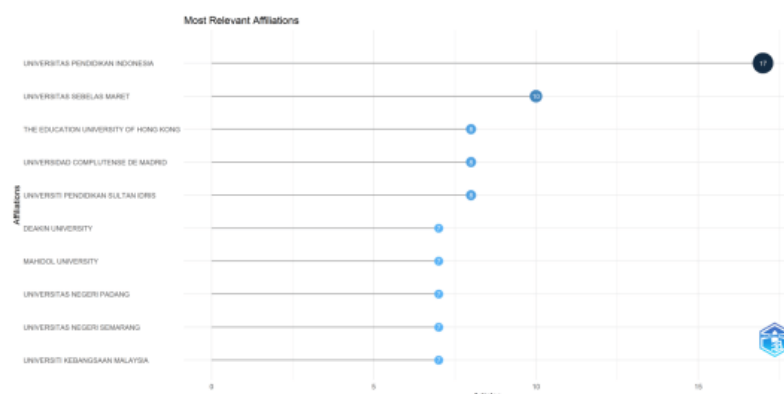


Figure 4. The Most Relevant Affiliators

Collaboration among researchers from various countries and institutions reflects a progressive shift in educational research, emphasizing cross-cultural and multidisciplinary approaches. Ethnoscience studies, by nature, require a holistic perspective that integrates scientific knowledge with cultural heritage, making global collaboration an essential component in refining its application across diverse educational systems. The involvement of multiple nations fosters a dynamic exchange of ideas, enabling researchers to explore how indigenous knowledge systems, traditional ecological practices, and local wisdom can be effectively incorporated into modern curricula.

While some countries focus on theoretical frameworks, others prioritize empirical studies, leading to a comprehensive understanding of ethnoscience's role in primary education. In this context, Indonesia, China, Spain, the United Kingdom, and Sweden have emerged as

key contributors, each bringing unique perspectives shaped by their historical, socio-cultural, and pedagogical landscapes. The contrast in research priorities Indonesia's emphasis on cultural-based teaching materials, Europe's focus on pedagogical effectiveness, and China's integration of technological advancements demonstrates that ethnoscience is not a static concept but an evolving field that adapts to different educational demands.

Indonesia holds a strategic position in ethnoscience research due to its rich and diverse cultural heritage (Khery et al., 2025), making it an ideal environment for integrating local wisdom with modern scientific concepts. The ethnoscience approach in the Indonesian curriculum is not only designed to connect scientific concepts with everyday cultural practices to make learning more contextual and meaningful for students (Suprpto et al., 2021) but also reflects a historical effort to revitalize local traditions amid globalization, aligning with the continuously evolving national education policies. However, despite its strong potential, the main challenge in its implementation lies in standardizing teaching materials that reflect cultural diversity while maintaining alignment with national curriculum policies. To address this, research collaboration with international institutions has become increasingly crucial, especially with countries facing similar challenges in multicultural education.

The intensive collaboration between Indonesia and China (Figure 3) may be linked to shared challenges in developing an education system that values cultural diversity, as both countries have heterogeneous populations and a long history of education rooted in local values. Unlike the European model, which is more STEM-oriented, cooperation between Indonesia and China focuses more on contextualizing scientific knowledge to suit the social and cultural needs of each nation (Jauhiainen & Guerra, 2023). In this context, academic collaboration provides opportunities for researchers to conduct comparative analyses, develop case studies, and test various ethnoscience-based pedagogical models in different educational settings. By leveraging increasingly sophisticated bibliometric analysis tools, academics can track publication trends, identify research gaps, and refine methodologies to support the implementation of ethnoscience in education. Therefore, the synergy between national education policies, historical factors, and global partnerships is key to creating a more inclusive and sustainable ethnoscience-based learning system, both in urban and rural educational environments.

Strengthening global academic networks is imperative for advancing ethnoscience-based instructional models, ensuring their relevance and applicability in modern classrooms. Indonesian researchers must actively engage in international symposiums, joint research projects, and knowledge-sharing platforms to foster interdisciplinary discourse and enhance methodological rigor. Collaborative initiatives with institutions like Universitas Pendidikan Indonesia, The Education University of Hong Kong, and Universidad Complutense De Madrid have already demonstrated how multi-institutional partnerships elevate research quality and broaden its impact.

Furthermore, the incorporation of emerging technologies, such as digital ethnoscience resources, augmented reality-based indigenous knowledge learning, and AI-driven adaptive teaching tools, can modernize traditional approaches while maintaining cultural authenticity. By merging conventional and contemporary methodologies, ethnoscience research can reach new frontiers, offering students a contextualized, engaging, and scientifically robust learning

experience. Beyond academic discourse, real-world implementation of research findings remains a critical step in ensuring educational transformation (Bergmann et al., 2021).

The application of ethnoscience in primary education should not be confined to theoretical exploration but must be actively integrated into teacher training programs, curriculum development strategies, and national education policies. However, the discussion has not yet addressed the underlying reasons behind the observed trends, highlighting the need for further analysis to identify the factors influencing these patterns. Understanding these drivers is essential to ensure that ethnoscience-based education not only evolves with technological advancements but also aligns with broader educational objectives and societal needs.

Table 4. The Best Citation

Year	Authors	Affiliations	Journal	Cited by
2022	(Wu et al., 2022)	Department of Digital Content and Technology, National Taichung University of Education, Min-Shen Rd., Taichung, Taiwan; Department of Tourism Management, National Kaohsiung University of Science and Technology, Chien Kung Road, Kaohsiung, Taiwan; Leisure & Recreation Administration Department, Ming Chuan University, De Ming Rd., Gui Shan District, Taoyuan County, Taiwan; Department of Engineering Science and Institute of Education, National Cheng Kung University, University Road, Tainan, Taiwan	International Journal of STEM Education	58
2023	(Jauhiainen & Guerra, 2023)	Department of Geography and Geology, University of Turku, Turku, 20014, Finland; Institute of Ecology and the Earth Sciences, University of Tartu, Tartu, Estonia	Sustainability (Switzerland)	57
2021	(Huang, 2021)	Hunan Urban Construction College, Xiangtan, China	International Journal of Emerging Technologies in Learning	45
2020	(Tsai, 2020)	Department of Applied Foreign Languages, Nan Kai University of Technology, Taiwan	International Journal of Instruction	43
2021	(Leonet et al., 2024)	Department of Educational Sciences, University of the Basque Country, UPV/EHU, Spain; Ikerbasque - Basque Foundation for Science, Spain	Journal of Multilingual and Multicultural Development	38

RQ3. What are the main challenges faced in researching ethnoscience-based IPAS teaching materials in elementary schools?

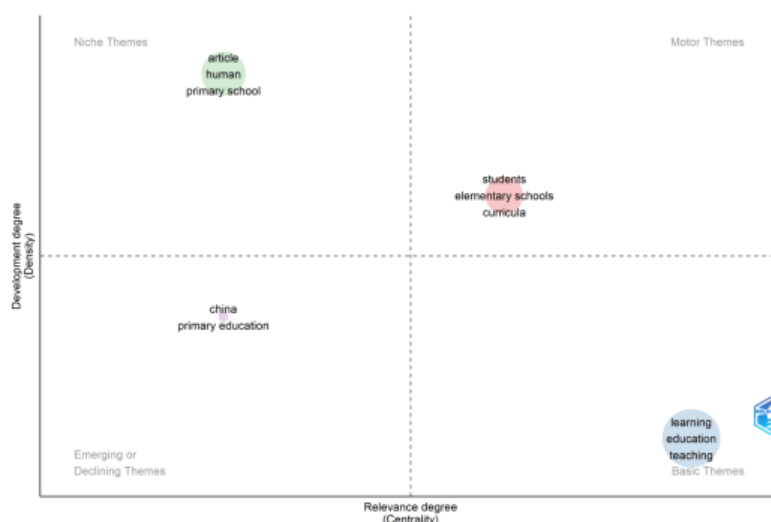


Figure 5. Thematic Map

Based on Figure 5, the key challenges identified through thematic analysis encompass three critical aspects that require further attention. First, there is a lack of an implementation framework for developing ethnoscience-based teaching materials (Quadrant I - 'curriculum'), indicating that while this approach has been widely discussed in the context of primary education, a clearer guideline is still needed to ensure its effective application in learning. Second, research shows that the availability of ready-to-use teaching materials remains highly limited, as reflected in the dominance of the 'module-test' cluster. This suggests that the development of ethnoscience-based teaching materials has focused more on conceptualization and evaluation, while the practical aspects that educators can readily implement are still underdeveloped.

Third, the lack of teacher training is identified as one of the main obstacles to integrating ethnoscience into primary education, as evidenced by the 'teacher training' theme, which appears only three times in the thematic analysis. The low frequency of this theme reflects the limited focus on enhancing teachers' capacity to understand and implement ethnoscience-based learning. However, the success of this approach heavily depends on teachers' preparedness to adapt culturally rooted scientific concepts into more contextual learning experiences for students. Therefore, a more structured strategy is required to establish a clear implementation framework, provide practical teaching materials, and enhance teacher capacity through continuous training, ensuring that ethnoscience can be effectively integrated into the primary school curriculum.

Moreover, the position of ethnoscience-based teaching materials in Quadrant I reinforces the importance of integrating the national curriculum with local wisdom in elementary education. A flexible curriculum that accommodates local cultural values will be more effective in shaping students' character and identity. Within the framework of the current Indonesian curriculum, the ethnoscience concept can serve as an innovative approach in developing project-based teaching materials and environmental exploration (Fitria et al., 2025). This way, students not only acquire academic knowledge but also understand how their cultural

traditions have strong scientific foundations. This integration can also enhance students' awareness of the importance of preserving local culture while fostering a deeper scientific understanding (Garzón-Díaz, 2021).

Considering these aspects, further research on developing ethnoscience-based IPAS teaching materials is essential. The primary focus of this research should not only be on the effectiveness of teaching materials in improving students' learning outcomes but also on designing them to align with the curriculum, students' needs, and the local socio-cultural context. Additionally, appropriate implementation strategies are needed to ensure that ethnoscience-based teaching materials can be optimally used by teachers in the learning process (Rayis et al., 2023). Therefore, collaboration among researchers, educators, and policymakers is crucial to maximize the benefits of the ethnoscience approach in elementary education in Indonesia.

CONCLUSION

This study highlights that the development of ethnoscience-based Natural and Social Sciences (IPAS) teaching materials in elementary schools can significantly improve learning by making scientific concepts more contextual and culturally relevant. Bibliometric analysis reveals notable growth in research trends between 2020 and 2023, with a slight decline in 2024. Dominant keywords such as module, test, understanding, and effect indicate that current research primarily focuses on evaluating the effectiveness of teaching materials and learning models rather than their practical implementation. Additionally, international collaboration among researchers particularly from Indonesia, China, Spain, the United Kingdom, and Sweden demonstrates global interest in integrating ethnoscience into elementary education. However, a key challenge remains the limited studies connecting ethnoscience with curriculum requirements and its direct application in classrooms, creating a gap between theoretical exploration and real-world educational practices. These findings align with the research objectives, emphasizing the need for practical integration strategies and curriculum alignment to enhance ethnoscience-based learning outcomes.

To support the development of systematic and applicable ethnoscience-based teaching materials, further research should explore how this approach can be effectively aligned with national curricula and adapted to local cultural contexts across different regions. Collaboration among academics, educators, and policymakers is essential to ensure that developed teaching materials are not only theoretically sound but also practically implementable in classrooms. Strengthening teacher training programs on ethnoscience-based learning will be a strategic step in enhancing students' conceptual understanding and critical thinking skills. Additionally, future studies should develop and validate ethnoscience modules for specific regions (e.g., coastal vs. agrarian cultures) using design-based research, investigate long-term impacts through quasi-experiments comparing student outcomes in ethnoscience-integrated vs. conventional classrooms, and explore digital tools (e.g., augmented reality) to deliver ethnoscience content in urban schools with limited cultural resources. These steps will ensure that ethnoscience integration in elementary education becomes an innovative solution for improving scientific literacy while strengthening students' cultural identity.

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