Data and Metadata. 2025; 4:434
doi: 10.56294/dm2025434

REVIEW

Bridging Cultures in the Classroom: A Systematic Literature Review of Ethnoscience Research in Indonesian Elementary Science Education

Tendiendo puentes entre culturas en el aula: Una revisión bibliográfica sistemática de la investigación etnocientífica en la enseñanza elemental de las ciencias en Indonesia

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Cite as: Muyassaroh I, Saputri AE, Saefudin A, Darmayanti M, Mufliva R, Ginting LCB, et al. Bridging Cultures in the Classroom: A Systematic Literature Review of Ethnoscience Research in Indonesian Elementary Science Education. Data and Metadata. 2025; 4:434. https://doi.org/10.56294/dm2025434

Submitted: 10-02-2024 **Revised:** 02-06-2024 **Accepted:** 23-10-2024 **Published:** 01-01-2025

Editor: Adrián Alejandro Vitón-Castillo

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ABSTRACT

Ethnoscience plays a crucial role in integrating cultural knowledge into science education, especially in multicultural contexts like Indonesia. This study aims to provide a comprehensive examination of the current state of ethnoscience research within the realm of elementary science education in Indonesia. By employing a systematic literature review, this research analyzes a corpus of 70 articles published between 2014 and 2023, sourced from prominent databases such as Scopus and Indonesia's Ministry of Education and Culture's accredited national journal database (SINTA). Through content analysis, the study delves into the thematic content, methodologies, and findings of the reviewed literature. The synthesis of these diverse sources offers a nuanced understanding of the landscape of ethnoscience research in Indonesian elementary science education. Additionally, this review identifies existing gaps and provides insights into potential directions for future research, contributing to the ongoing discourse on integrating cultural knowledge in science education within diverse educational settings. This research is of significant value to educators, policymakers, and researchers aiming to enhance the cultural relevance and effectiveness of science education in elementary schools.

Keywords: Ethnoscience; Elementary Schools; Indonesia; Science Education.

RESUMEN

La etnociencia desempeña un papel crucial en la integración del conocimiento cultural en la enseñanza de las ciencias, especialmente en contextos multiculturales como el de Indonesia. Este estudio tiene como objetivo proporcionar un examen exhaustivo del estado actual de la investigación en etnociencia en el ámbito de la educación científica elemental en Indonesia. Mediante el empleo de una revisión sistemática de la literatura, esta investigación analiza un corpus de 70 artículos publicados entre 2014 y 2023, procedentes de bases de datos prominentes como Scopus y la base de datos de revistas nacionales acreditadas del Ministerio de Educación y Cultura de Indonesia (SINTA). A través del análisis de contenido, el estudio profundiza en el contenido temático, las metodologías y las conclusiones de la bibliografía revisada. La síntesis de estas diversas fuentes ofrece una comprensión matizada del panorama de la investigación en etnociencia en la enseñanza elemental de las ciencias en Indonesia. Además, esta revisión identifica las lagunas existentes y proporciona ideas sobre posibles direcciones para futuras investigaciones, contribuyendo al discurso en curso sobre la integración de los conocimientos culturales en la enseñanza de las ciencias en diversos contextos educativos. Esta investigación tiene un valor significativo para los educadores, los responsables políticos y

los investigadores que aspiran a mejorar la pertinencia cultural y la eficacia de la enseñanza de las ciencias en las escuelas primarias.

Palabras clave: Etnociencia; Escuelas Primarias; Indonesia; Enseñanza de las Ciencias.

INTRODUCTION

Ethnoscience is a field of study that deals with the local knowledge systems of diverse civilizations and populations.[1,2] This knowledge is expressed through their language, customs, culture, morals, and technology, and incorporates elements of scientific knowledge.[3,4] Ethnoscience integration in the classroom is strongly encouraged in Indonesia. Since the KTSP curriculum, the 2013 curriculum, and the current Merdeka curriculum were introduced, there has been a persistent emphasis on integrating learning through the investigation of local culture and knowledge.[5,6,7] This is particularly important since Indonesia is the one of world's largest multicultural countries with 1 340 ethnic groups each with their own unique culture.[8] This diversity significantly impacts education in Indonesia as culture and education are closely intertwined. The cultural and indigenous knowledge systems of communities serve as the foundation of ethnoscience, which offers a fascinating lens through which to look at the dynamics of science education in various cultural contexts.

Ethnoscience research has grown and benefited academia at all levels of education for the past fifty years.[9]

Science education's long-standing interest in incorporating local communities' cultural practices is beginning to garner renewed attention and examination.[10] Numerous ethnoscience studies have been conducted due to the importance of cultural integration in science education.[11,12] These studies seek to understand, create or design products, apply, and assess the effects of ethnoscience on the learning process. The number of publications on ethnoscience has increased significantly, which has made an urgent need for a comprehensive review of the field.[13] By highlighting patterns and potential gaps in the body of knowledge, a systematic literature review can enhance a field of study and assist researchers in defining the objectives of their next investigations. Examining ethnoscience's use in elementary students' science learning is crucial, as it is one of the learning methodologies that are most frequently advised for use in the classroom.[14] Therefore, a comprehensive understanding of ethnoscience may be possible based on the purposes, methods, samples, topics, results, recommendations, and location. Similarly, this analysis would provide insights into the findings of ethnoscience research. A thematic review of ethnoscience would also shed insight into possible studies for further investigation.

Systematic Literature Review (SLR) studies on ethnoscience have been conducted in several areas, including ethnoscience-based learning to enhance students' cognitive outcomes,[15] ethnoscience as the Merdeka Curriculum policy implementation,[7] ethnoscience research using bibliometrics,[14] and ethnoscience in science learning.[5,16,17] All of this research focuses on science learning at various levels of education. There isn't any research that has directly addressed it at the elementary school level, particularly in Indonesia. Therefore, different from previous research, this research focuses on the study of ethnoscience in the context of science education for Indonesian elementary students. Using the particular context of Indonesia as a focal point, this systematic literature review embarks on a comprehensive exploration of ethnoscience research in elementary students' science learning.

This study provided answers to the following queries: (1) what research purposes are most frequently employed in an ethnoscience study? (2) what products are most developed in ethnoscience-integrated product design? (3) what models are mostly integrated in ethnoscience science learning? (4) what variables are influenced by ethnoscience? (5) what research methods are most often used in ethnoscience research? (6) what grade levels are mostly used as participants in ethnoscience research in elementary students' science learning? (7) which provinces have ethnoscience research been widely carried out? (8) what ethnoscience objects are mostly discussed? (9) what science materials in elementary schools have been studied? (9) which journals and publishers publish the most papers about ethnoscience? (10) what are the trends in ethnoscience research in elementary students' science learning? Categorizing ethnoscience studies is ascetically necessary for future research. Researchers can effectively design such studies by using this review to discover research opportunities and gaps. Henceforth, this research recommends that researchers, teachers, and curriculum developers trace the predispositions of ethnoscience studies and use them according to their capacity.

METHOD

This research is categorized as a qualitative study as it uses a content analysis approach with a systematic literature review technique to examine the research regarding ethnoscience in science education at the elementary school level in Indonesia. A systematic literature review is a type of secondary research that integrates findings from multiple primary studies to address specific research inquiries.[18] The major advances

in knowledge are expected to be based on previous studies to probe the breadth and depth of existing academic works to discover gaps. The groundwork for new theories can be developed by summarizing and analyzing specific bodies of literature.[19]

This study used the review process adopted according to Pahlevan-Sharif et al.[20], which included the following steps: (1) formulating research questions; (2) determining the criteria for article review (table.1); (3) searching for articles in various databases (Google Scholar and Scopus) using publish or perish by typing the keywords "ethnoscience and" "elementary school"; (4) article coding using Paper Classification Form (PCF); (5) identifying patterns across all articles; and (6) synthesizing. The collected data is analyzed using descriptive statistics such as presenting data in the form of percentages, tables, graphs, and diagrams. The 70 articles analyzed in this study contain the findings of empirical research on ethnoscience in elementary school students' science learning in Indonesia. The whole article's criteria can be seen in table 1.

Table 1. Criteria for Integrating Ethnoscience Review Articles

Category	Criteria
Type of Publication	article published in Scopus and national journal accredited by Indonesian ministry of education and culture (SINTA)
Keywords	ethnoscience, elementary school
Year Publication	2014-2023
Aspect	ethnoscience in elementary students' science learning
Subject Study	elementary students
Type study	empirical, primary research

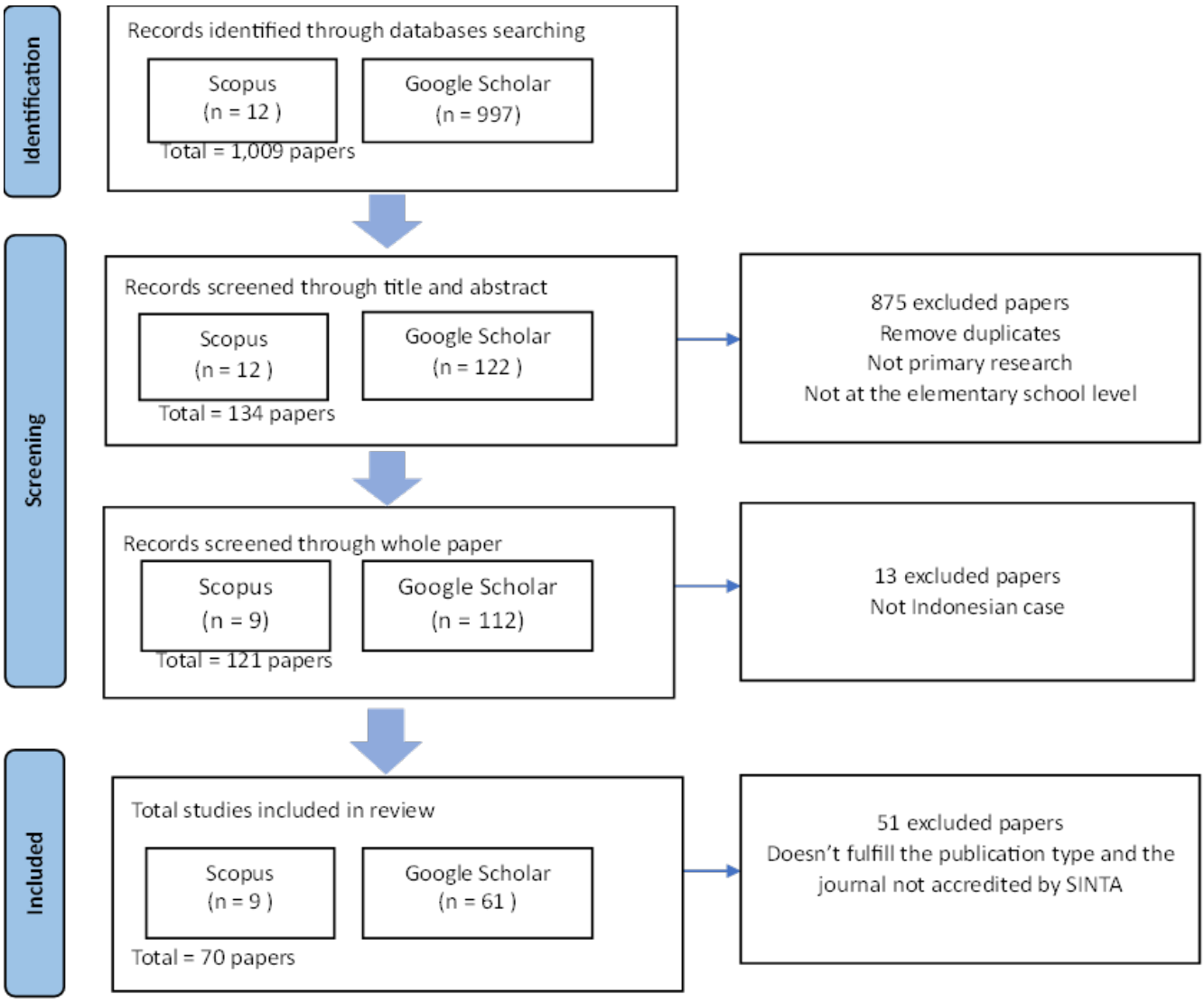

Figure 1. The Database Search Flow Diagram using PRISMA

RESULTS AND DISCUSSION

The search results identified 70 papers which were then analyzed following the formulation of the research questions. The results of the existing article analysis will be discussed in this section regarding the research purpose, products developed on ethnoscience integrated product design, integrated ethnoscience learning models, variables influenced by ethnoscience, research method, participants, research location, ethnoscience objects, learning materials, and research trend in ethnoscience in elementary science learning.

Research Purposes

One of the research queries addressed by this study is what research purposes are most frequently employed in an ethnoscience study. Table 2 displays four different purposes in ethnoscience research and the number of publications.

Table 2. Frequencies of the Research Purpose

Purpose	Percentage
Identifying scientific concepts in local culture and their application in elementary students' science learning	16 %
Designing ethnoscience based products (material, evaluation tool, learning media etc.)	29 %
Knowing the effect of different teaching strategies in ethnoscience.	24 %
Analyzing the relationship between ethnoscience and different variables (concept understanding, scientific literacy, critical and creative thinking, etc.)	31 %

The most frequent research objective was to analyze the relationship between ethnoscience and various variables. This indicates a significant interest in exploring how ethnoscience influences factors such as scientific literacy,[21] science process skills,[22] students' learning activities,[23] learning outcomes,[24,25,26] and conceptual understanding of science[27] in elementary education.

Another common research focus was the design of ethnoscience-based products, underscoring the potential of ethnoscience in creating educational materials and tools that cater to specific cultural contexts. These products include a digital pocketbook,[28] teaching materials,[29,30,31] traditional games,[32] augmented reality,[33] student worksheets,[34] ethno-vlogs on the *Sisingan* and *Gembyung* dances,[35] an *ethno*-edutainment digital module[36] learning tolos,[37] posters,[38] and a thematic integrated book.[39]

Knowing the effect of different teaching strategies in ethnoscience occupied the middle ground, indicating a growing interest in exploring effective ways to use ethnoscience in the classroom specifically by integrating them with diverse learning models such as course review horay,[22] contextual learning,[23] problem-based,[21,40,41] thematic learning,[42] guided inquiry,[43,44] discovery learning,[26,45] project-based learning,[27] 5E cycle learning model,[42] etc.

Identifying scientific concepts within local cultures and their application in elementary science education has been the least frequently explored research purpose. However, it remains a vital foundation for integrating ethnoscience into science curricula. Several studies highlight various ethnoscience concepts, such as the traditional *Barodak wedding procession*,[46] the *Padusan* and *Kungkum* traditions,[47] traditional salt farming practices,[48] *Sate Bandeng* traditional cuisine,[49] the *Sako Seng* tradition,[50] *Aru* culture,[51] traditional alcohol production,[4] the *Sedekah Bumi* tradition,[52] funeral processes,[53] brick-making,[54] traditional knife-making,[55] the potential of the *Madura* coastline,[56] and local resources in *Banyuma*s district.[57] The entire object of ethnoscience explored can be seen in table 5.

Overall, the table suggests that researchers are actively exploring various aspects of ethnoscience in the context of elementary science education in Indonesia. There is a particular focus on understanding the impact of ethnoscience on various student learning outcomes and developing practical applications for educational purposes.

Products Developed on Ethnoscience Integrated Product-Design

As shown in table 2, a total of 29 % studies have been identified with the aim of developing products that integrate ethnoscience content. The distribution of these products in design-based ethnoscience research is illustrated in figure 2.

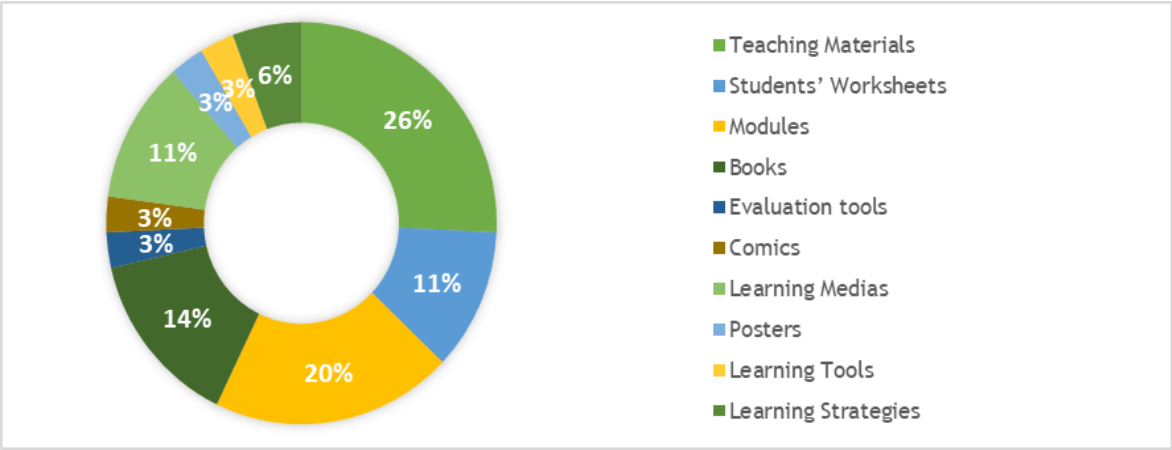

Figure 2. The distribution of products developed in design-based ethnoscience research

As depicted in figure 2, the range of products developed offers valuable insights into the tangible outcomes of design-based ethnoscience research. The variety of products reflects a broad strategy for incorporating ethnoscience into educational settings. The figure shows that teaching materials constitute the largest share of these products (26 %), followed by modules (20 %), books (14 %), student worksheets (11 %), learning media (11 %), learning strategies (6 %), evaluation tools (3 %), comics (3 %), posters (3 %), and learning tools (1 %). The dominance of teaching materials (26 %) among the developed ethnoscience-based products emphasizes the critical role of educational resources in promoting ethnoscience knowledge. This suggests a commitment to improving the quality and accessibility of ethnoscience-related content, with the potential to enhance teaching methods and student learning experiences. Modules, which represent 20 % of the distribution, also stand out as a key product category. This aligns with the findings of Jannah et al.[16], who found that modules are the most commonly created ethnoscience products globally. Modules offer a structured and comprehensive approach to integrating ethnoscience into science instruction, providing educators with a valuable tool for curriculum development.

The diversity of products, including books, student worksheets, learning media, and more, highlights the versatility of design-based ethnoscience research. This diversity caters to different learning styles and preferences, ensuring a more inclusive and engaging educational experience for students. It also reflects the recognition that ethnoscience knowledge can be effectively conveyed through various mediums. While the current distribution provides a snapshot of the existing products, it also raises questions about the potential gaps and areas for further exploration. Future research could delve into the effectiveness of these products in enhancing students' understanding of ethnoscience, evaluate their impact on inclusive education, and investigate the challenges faced in their implementation across different cultural contexts.

Integrated Ethnoscience Learning Models

Ethnoscience can be applied either on its own or integrated with more advanced science learning models. The direct application of ethnoscience in elementary science education has been shown to significantly enhance students' scientific literacy, creative thinking, science process skills, and conceptual understanding.[50,58,59] The various learning models that have been integrated with ethnoscience in research on elementary science education can be seen in figure 3.

Figure 3 highlights a key aspect of ethnoscience research which integrates into advanced science learning models, with guided inquiry and problem-based learning models being the most prominent. The guided inquiry approach has proven to be particularly effective for teaching science in elementary schools.[60,61] Numerous studies emphasize the positive effects of integrating ethnoscience into science learning strategies, resulting in improvements in scientific literacy, conceptual understanding, critical thinking, science process skills, and overall learning outcomes.[21,22,27,40,62]

Ethnoscience can be integrated into education through a variety of methods, often in conjunction with student-centered learning models. For instance, guided inquiry learning based on ethnoscience has been shown to significantly enhance students' mastery of scientific literacy.[44] This model teaches students how to acquire knowledge through scientific methods,[43] encouraging them to think and act scientifically, thereby strengthening their knowledge, skills, and scientific attitudes.[63] Another approach involves integrating ethnoscience with contextual collaborative learning, also known as context-based learning. This method emphasizes learning from real-life situations and student collaboration, making scientific concepts more accessible and relatable.[17,62] Ethnoscience can also be combined with problem-based and project-based learning, where the problems discussed are rooted in students' socio-cultural contexts and everyday experiences.[21] Through this integration,

students deepen their understanding of scientific concepts, connect prior knowledge with new information, and broaden their overall comprehension of science.[21,27,64] These findings offer valuable insights for educators and curriculum developers seeking effective ways to enhance elementary science education by incorporating ethnoscience into advanced learning models. They also provide a foundation for future research to explore new learning models that have not yet been fully investigated.

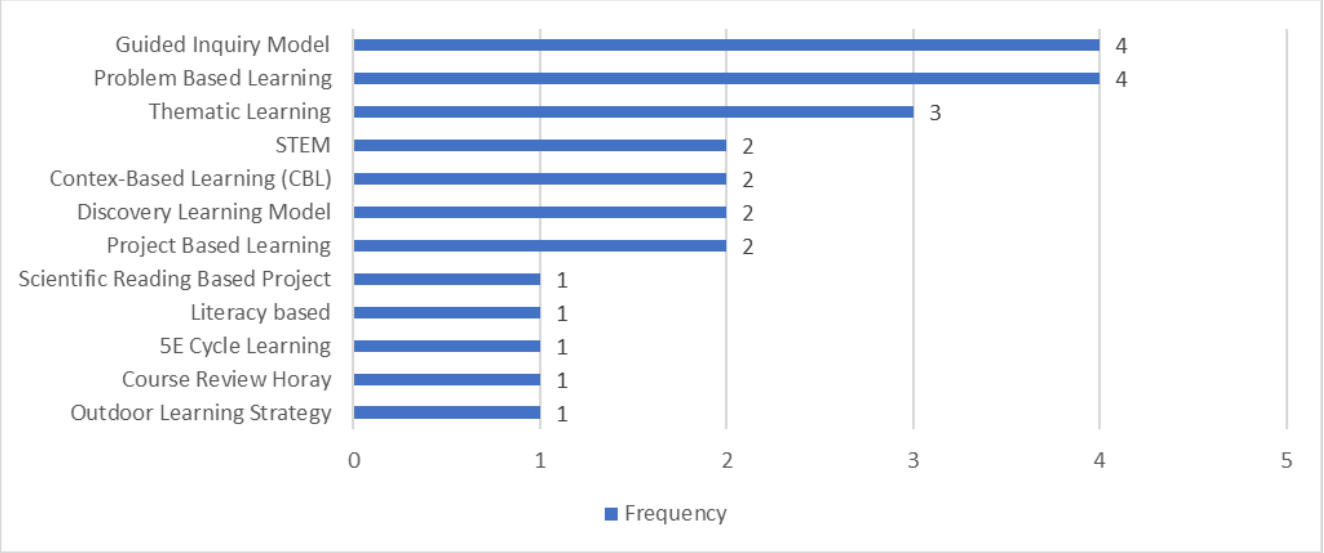

Figure 3. Integrated Models in Ethnoscience

Variables Influenced by Ethnoscience

The increasing number of ethnoscience studies in Indonesia, as reflected in the growing body of research, highlights a rising recognition of its crucial role in education, particularly in fostering an understanding of local culture. This surge indicates a deeper awareness of the educational advantages that ethnoscience offers. The relationships between various variables within ethnoscience research further underscore its impact on education. As noted by Sari et al.[17], the application of ethnoscience has been shown to positively influence students' proficiency in natural sciences, particularly in developing essential 21st-century skills. The variables impacted by ethnoscience learning are detailed in figure 4.

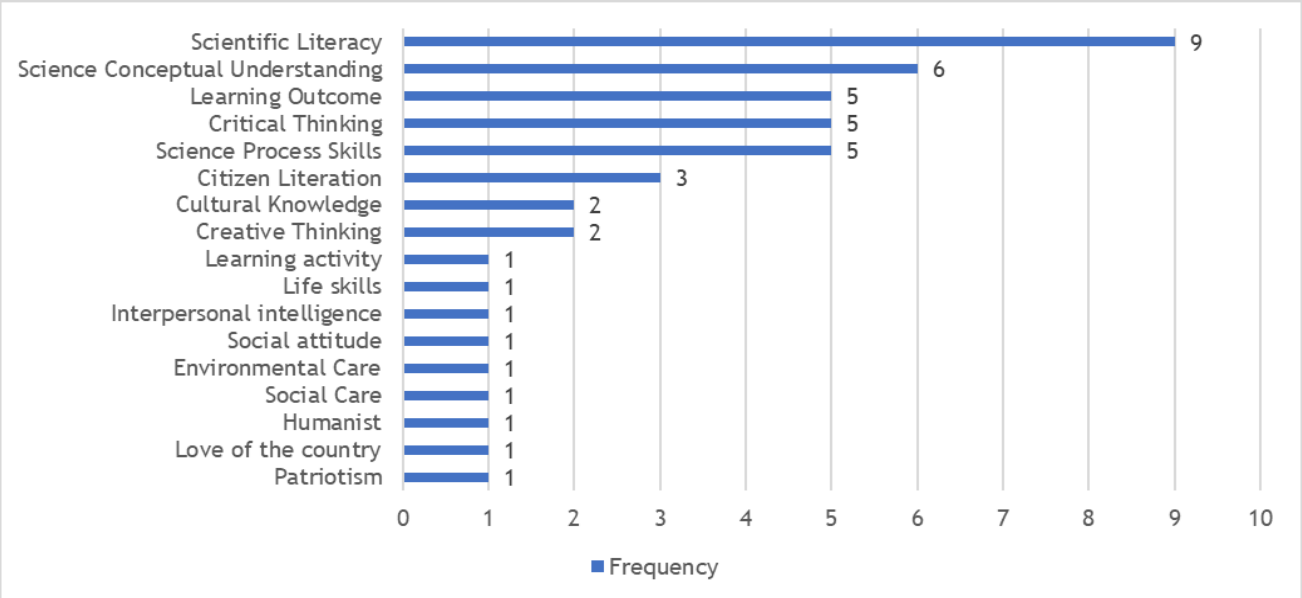

Figure 4. Variables Influenced by Ethnoscience

Figure 4 explores the variables influenced by ethnoscience, with scientific literacy emerging as the most prominent dependent variable. This focus is well-founded, as ethnoscience directly connects with students' ability to understand and explain scientific phenomena. Integrating ethnoscience into learning environments bridges theoretical concepts with students' everyday experiences, fostering a holistic understanding that

enhances both the content and contextual dimensions of scientific literacy.[28] These findings highlight ethnoscience's key role in nurturing scientific literacy and enriching the educational experience.

Scientific literacy, in particular, is closely linked to ethnoscience due to the contextual nature of the subjects studied, which are often rooted in daily life—such as culture, regional cuisine, and local wisdom. This connection extends to the content dimension, blending common and unique scientific facts with competencies that involve applying knowledge and attitudes to make informed decisions about oneself and the surrounding environment. Developing scientific literacy is crucial in preparing future generations to address scientific challenges and make sound decisions. Science conceptual understanding also emerges as a frequently studied dependent variable. Ethnoscience enriches students' understanding by connecting indigenous knowledge with scientific principles, allowing them to relate abstract concepts to real-life situations embedded in their heritage. This promotes inclusivity and enhances learning experiences, helping students grasp science in a more holistic way that transcends cultural boundaries. Other notable variables influenced by ethnoscience include critical and creative thinking. Ethnoscience stimulates critical thinking by encouraging students to engage deeply with their surroundings, fostering curiosity, observation, inquiry, and scientific reasoning. Through ethnoscience-based learning, students become more active participants, leading to improved critical thinking skills. Similarly, creative thinking is nurtured through student-centered learning strategies that encourage innovation and problem-solving. Ethnoscience, with its focus on real-world relevance, enables students to collect information, solve problems, and generate new ideas more efficiently. Additionally, ethnoscience helps cultivate conservation-oriented character traits, instilling values related to everyday practices such as proper waste disposal, water conservation, and energy-saving. This influence on character development stems from the transformative effect of ethnoscience, which reshapes mindsets and fosters positive habits that have a lasting impact on students and their cultural environment.

The chart indicates that ethnoscience primarily influences cognitive aspects such as scientific literacy and conceptual understanding, while also promoting skills like critical thinking and science process skills. Other variables, though less frequently cited, highlight ethnoscience's role in fostering a broader set of skills and values, including cultural knowledge, creative thinking, and environmental care. This distribution suggests that while the focus of ethnoscience research leans toward enhancing scientific and critical skills, it also has the potential to impact a wide array of social and environmental competencies.

Research Method

The distribution of research methodologies employed in ethnoscience studies focused on elementary school science learning is presented in table 3.

Table 3. Frequencies of the Method or Design

Method/Design		Frequency
Quantitative	Quasi-Experimental Research	8
	True- Experimental Research	6
	Pre-Experimental Research	1
Qualitative	Descriptive	8
	Ethnographic research	6
	Phenomenology	4
	Action research	1
	Other (Qualitative but the design is not detailed)	2
Mixed-method		8
Research & Development	ADDIE	8
	4D	8
	Plomp	1
	Nieveen	2
	Not mentioned	1
	Borg & Gall	6

Table 3 offers insights into the diverse approaches employed to investigate and implement ethnoscience practices. The research methods that are often used are quasi-experimental research, qualitative descriptive, mixed method, and research development using ADDIE and 4D models. The quasi-experimental research emphasizes assessing the impact and effectiveness of ethnoscience interventions. On the qualitative front, the variety of methods such as descriptive studies and ethnographic research, underscores the recognition of the need to explore the nuanced and context-rich aspects of ethnoscience in educational settings. The inclusion of mixed-method approaches signals a holistic research strategy that combines both quantitative and qualitative

elements, providing a comprehensive understanding of the multifaceted nature of ethnoscience learning. The Research and Development methodologies, including ADDIE, 4D, and various other frameworks, highlights the commitment to designing and refining instructional strategies for effective ethnoscience integration. The 4D and ADDIE models are models that are widely used because they are more concise developments but include a complete development process. In summary, the diverse array of research methodologies in this study reflects the complexity of examining ethnoscience in elementary science education, emphasizing the importance of employing a range of approaches to capture its multifaceted impact.

Subjects/Participants

Ethnoscience research in elementary science education has involved over 2 206 students across various studies. The distribution of this research across different elementary grade levels is illustrated in figure 5, highlighting the scope and reach of ethnoscience learning within the elementary school context.

Figure 5. Participant Distribution Based on Grades

Figure 5 provides a detailed overview of the distribution of ethnoscience learning research across different elementary school grades. A significant concentration of studies is evident in 4th and 5th grades, while 1st, 2nd, and 3rd grades remain notably underrepresented. This pattern highlights a potential research gap, suggesting an opportunity to focus more on the lower elementary grades, where students are in a critical phase of cognitive development and foundational learning. The early years of elementary education are pivotal for shaping students' understanding of the world, laying the groundwork for future academic success. Integrating ethnoscience during these formative stages can provide students with a culturally enriched and holistic education. By incorporating local knowledge systems into the science curriculum, educators can enhance student engagement and deepen their understanding of scientific concepts within their cultural contexts.

Despite the challenges of conducting research with younger students—such as ethical considerations and the need for age-appropriate methodologies—the potential benefits are substantial. Ethnoscience in lower elementary grades can help foster cultural identity, curiosity, and environmental awareness at an early age.[65] Additionally, it offers valuable insights into effective pedagogical strategies for introducing complex scientific ideas to younger students.[66] To address this research gap, it is recommended that future studies prioritize ethnoscience learning in 1st, 2nd, and 3rd grades. This includes developing age-appropriate curriculum materials, employing culturally sensitive teaching approaches, and creating assessment methods tailored to the cognitive levels of younger learners. Collaboration among educators, researchers, and local communities is essential to ensure the relevance and authenticity of the ethnoscience content being integrated into the classroom.

Location

Research on ethnoscience in elementary school science learning has been predominantly concentrated on the island of Java, with Central Java standing out as the leading province for such studies. This concentration is likely driven by the region's abundant resources, established research infrastructure, and academic institutions like Universitas Negeri Semarang, which has produced the highest volume of ethnoscience research in elementary education. Central Java's cultural and historical importance also plays a role in its prominence. However, this regional focus raises concerns about inclusivity, as other provinces, such as North Kalimantan, Riau, Jambi, Bengkulu, and Maluku, report minimal research activity, with only a single research location each. Moreover, significant cultural regions like Sulawesi, Papua, and Maluku remain largely unexplored. This geographical imbalance limits the applicability of current ethnoscience findings, as the perspectives of students from underrepresented areas are not fully included. Figure 7 emphasizes the need to extend ethnoscience research beyond Java, ensuring a more equitable representation of Indonesia's cultural diversity. Expanding research to these underrepresented regions would enhance our understanding of how local knowledge systems influence science learning, ultimately leading to educational approaches tailored to diverse cultural contexts.

Addressing this gap is crucial for fostering a more inclusive and culturally responsive science education that benefits students across all regions of Indonesia.

Ethnoscience Object

Ethnoscience in education can be closely tied to students' local environments. Table 5 provides a detailed example of ethnoscience objects utilized in learning, based on the results of paper classification. This table offers a comprehensive overview of ethnoscience objects incorporated into elementary school education across various provinces in Indonesia.

Table 4. Ethnoscience Object Used in Research

Province	Unsur budaya
East Nusa Tenggara	Nawu Hi'pe activities, *SAKO SENG activity*
West Nusa Tenggara	Barodak Wedding Procession, Sasambo
Bali	Fire War Tradition, Rahinan Purnama, Tooth Cutting Ceremony (Mependes), Melis Ceremony, Megibung tradition, Pura Tanah Lot, The Peace Bell of Bali's Island of Love (Pulau Cinta Kasih Bali), *Satua Bali* (Balinese folklore)
North Kalimantan	Gunung Krayan Salt Making
West Kalimantan	Belalle', Chinese New Year Lantern Parade, Naga Sedau Stove Industry, Ngabayotn/Riding dango ceremony
East Java	*"Pudak"* Dough, *Kupat Ketek*, Remo dance, batik making, rujak cingur, lontong balap, fish preservation, and semanggi batik making, Jumiang Beach, Padelegan Beach, Talang Siring Beach, Salt Edutours, Lembung Mangrove Ecotourism, Tape Making, Batik, tops and banana stem boats traditional game, game of tug of war, kites
Central Java	local excellence in the Pantai Utara, Patiayam Site, salt production, Local Wisdom of Making Alcohol, the Body Funeral Process, Traditional Salt Farmers, tempe making process, *Knife Making, sedekah Bumi Bangsri, Brick manufacturing, Sayur Mrico, Manyung Fish,* tobacco Plant, process of wood carving, Sedekah Bumi even, tape singkong, "rokat tase" tradition, process of creating "bagan apung", petis food, terasi, seafood processed fish, Grebeg Maulud, Ketapel traditional game, *Padusan and Kungkum tradition*
West Java	"Bebentengan" game, *Sisingaan* dance, *Gembyung* Dance, *batik mega mendung*
Banten	Sate Bandeng (*Chanos Chanos*) food making
Jambi	*Nek Pung* Dance
Bengkulu	Pond ecosystems in Serawai Tribe
Yogyakarta	making wooden batik
Lampung	Asher plant, methods for cultivating coffee as a superior commodity, Protecting endangered species elephants as symbol of the Lampung province in Way Kambas National Park
West Sumatera	*Marancah, Bakaua Adat, Lansek Manih,* and Wood Branch Planting
South Sumatera	*Pempek traditional food*
Maluku	gici-gici traditional game, Fallow traditional house, Vuuf traditional fishing gear, hatudu and pom-pom traditional food, Titir (art instrument), Waba and makaNohom tradition

The diverse range of cultural elements reflects the rich tapestry of traditions, rituals, and practices embedded across different regions. The ethnoscience objects identified in the research encompass a broad spectrum of customs, technologies, landmarks, traditional foods, games, dances, folklores, arts, animals, plants, local wisdom, and songs. Each province contributes unique elements, offering students a rich cultural experience that deepens their understanding of local traditions. The distribution of these ethnoscience objects by category highlights the variety and depth of cultural representations in the research was illustrated in the figure 8.

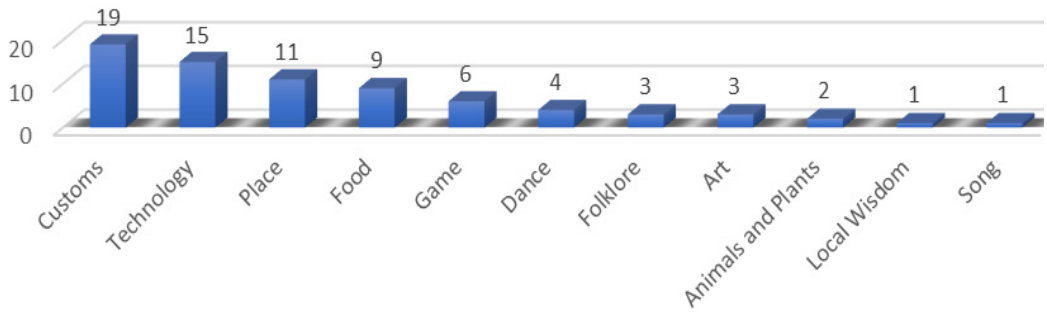

Figure 6. The Distribution of Ethnoscience Objects Category

According to the data presented in figure 8, customs rank as the most studied ethnoscience objects, followed by technology and place. On the other hand, local wisdom and songs are among the least explored, presenting opportunities for future research to investigate these areas as potential ethnoscience objects in elementary

school education. Customs, which refer to traditional behaviors and practices unique to specific societies or regions, offer a rich foundation for integrating cultural elements into learning.

The research demonstrates a comprehensive exploration of learning materials within the framework of ethnoscience, covering a broad spectrum of scientific concepts and natural phenomena. Topics such as force, work and energy, momentum and impulse, kinematics, dynamics, and the equilibrium of rigid bodies are integrated with traditional knowledge, reflecting a holistic approach to science education. The research also highlights the intersection of cultural practices with scientific principles, for example, through the study of fermentation processes, medicinal plants, herbs, and the effects of substances like additives and addictive chemicals. This blending of indigenous knowledge with formal science enhances the learning experience, offering a meaningful connection between cultural heritage and scientific education.

Moreover, the study emphasizes the practical applications of science in everyday life, as seen in topics like food and health, the properties of objects, light, and human organs. This makes science education more relevant and relatable to students by aligning with their cultural context and daily experiences. Additionally, the research delves into environmental science through topics such as natural resource conservation, the water cycle, and the characteristics of light. This focus underscores the importance of incorporating traditional wisdom into contemporary ecological education, fostering environmental awareness and sustainability.

The wide-ranging scope of the research not only promotes a deep understanding of scientific concepts but also emphasizes the interconnectedness of different disciplines within ethnoscience. By integrating topics such as force, sound, and the water cycle, the research adopts an interdisciplinary approach that mirrors the complexity of natural phenomena. In conclusion, this research represents a commendable effort to bridge the gap between traditional knowledge and formal scientific education. By incorporating cultural elements and practical applications, it offers a promising model for creating a more inclusive and culturally relevant science curriculum, ultimately deepening students' appreciation for both scientific concepts and the cultural diversity that shapes their understanding of the natural world.

Research Trend in Ethnoscience in Elementary Science Learning

The ethnoscience approach in education has gained increasing recognition over the years. The number of ethnoscience research studies focused on elementary school science learning has grown significantly in the past five years. Figure 9 highlights the development and rising output of scientific research on the integration of ethnoscience into elementary science curricula, reflecting the growing interest and emphasis on this educational approach.

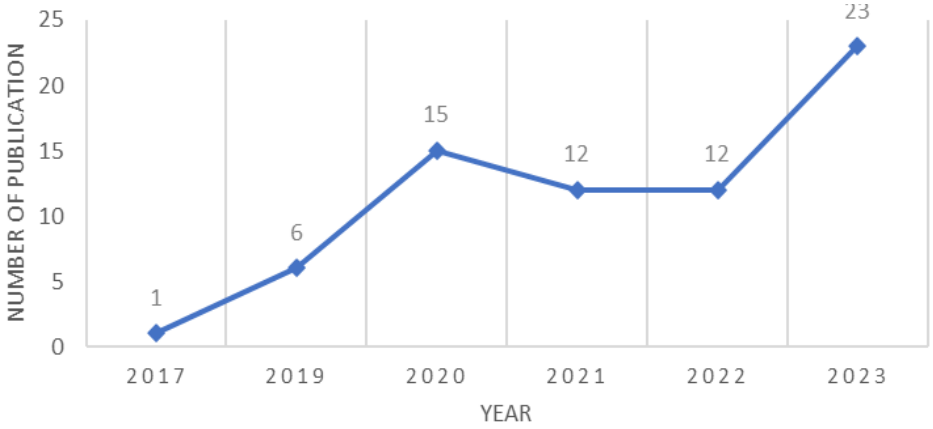

Figure 7. The Development of Ethnoscience research in Elementary Science Education

Figure 7 illustrates the development of ethnoscience research in elementary science education over the past five years, from 2017 to 2023. During this period, research activity has generally shown an upward trend, despite a decline in 2021 and 2022. However, the trend from 2022 to 2023 exhibits a significant resurgence, with the number of publications rising sharply from 12 articles in 2022 to 23 in 2023. This data highlights the growing popularity of ethnoscience research, signaling the need for classification to streamline future studies and enhance understanding in this expanding field.

The trends in figure 7 reveal a steady increase in the adoption of the ethnoscience approach within elementary science education, reflecting its growing relevance. While there was a temporary dip in 2021 and 2022, the overall trajectory remains positive, with a remarkable spike in 2023. This almost doubling of publications suggests that the field is gaining traction, possibly driven by shifts in educational policies, heightened research interest, or advancements in ethnoscience integration. The decline during 2021 and 2022 may have been

influenced by external factors, yet the significant rebound in 2023 indicates renewed focus and recognition of ethnoscience's importance in elementary science learning.

The increasing attention to ethnoscience in elementary education reflects a broader recognition of the need to incorporate cultural knowledge and traditional practices into science curricula. The sharp rise in publications from 2022 to 2023 underscores the growing acceptance of ethnoscience as a valuable tool for fostering inclusive and culturally responsive science education. This surge suggests that educators and researchers are beginning to appreciate the role of ethnoscience in enhancing the quality and relevance of science learning for elementary students, encouraging further exploration and engagement with this approach.

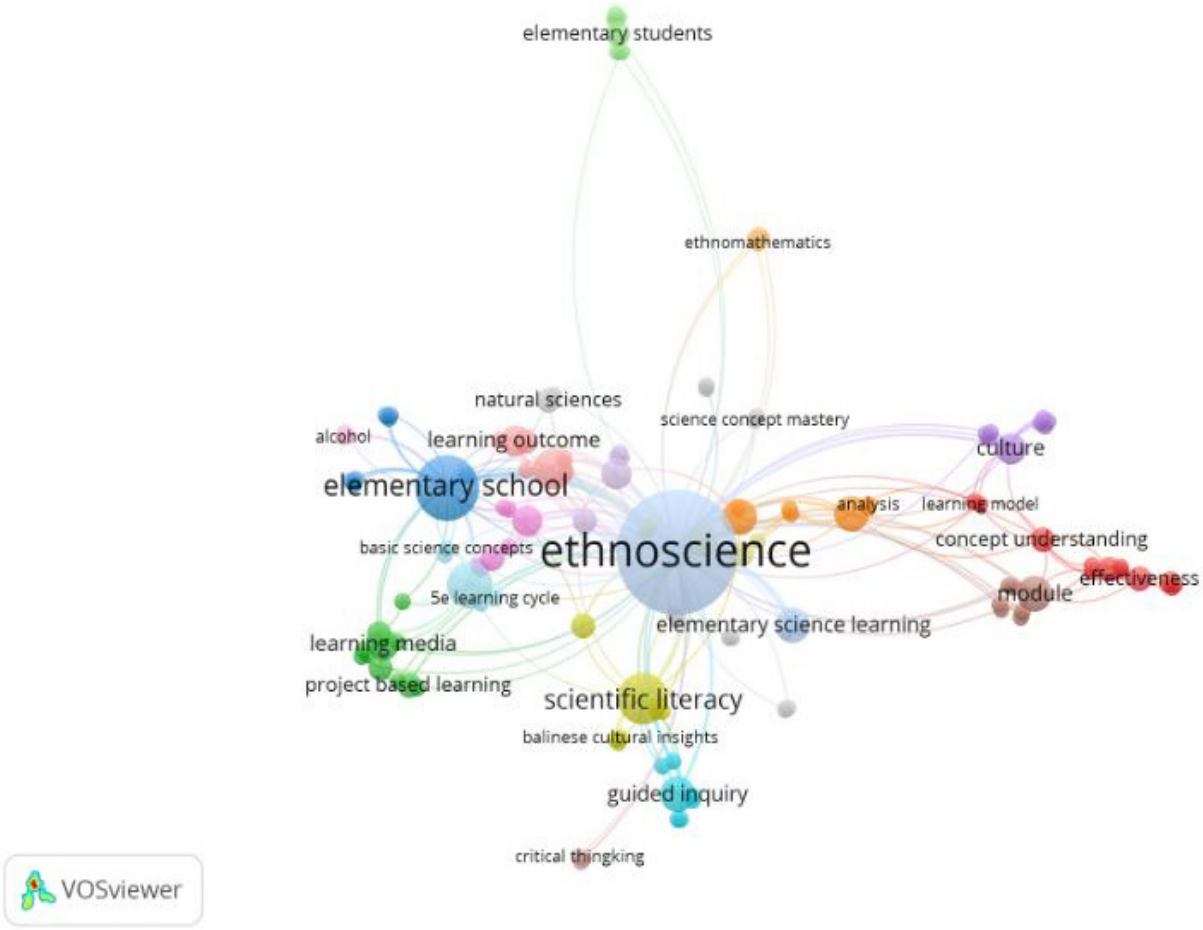

Figure 8. Network Visualization of Ethnoscience in Elementary Science Learning

Figure 8 visualizes the cluster analysis based on the co-occurrence of author keywords in ethnoscience research. A minimum threshold of two occurrences per keyword was set, resulting in a total of 31 keywords, which are grouped into six distinct but interconnected clusters. The size of each node in the visualization corresponds to the frequency of keyword usage—the larger the node, the more frequently the keyword appears.

The first and largest cluster revolves around the keyword "ethnoscience." This cluster connects ethnoscience with various concepts, including elementary school education, scientific literacy, guided inquiry, learning modules, culture, the 5E learning cycle, learning outcomes, and elementary science learning. These connections highlight the broad application of ethnoscience in elementary education, emphasizing its role in enhancing scientific literacy and improving learning outcomes through culturally relevant teaching methods such as inquiry-based learning and the 5E learning cycle.

Top Journals and Publishers

Tables 5 and 6 present the top five journals and publishers ranked by article production. Each journal and publisher is listed alongside the number of articles they have published, followed by the percentage these publications represent within the entire dataset used for analysis. This provides a clear snapshot of the most influential outlets contributing to the body of research.

Table 5. Leading journals by number of articles.

Top 5 Journals	Frequency	Percentage
Journal of Physics: Conference Series	8	11,6 %
Journal of Primary Education	7	10,1 %
Jurnal Penelitian Pendidikan IPA	3	4,3 %
Jurnal Pendidikan IPA Indonesia	3	4,3 %
Jurnal Basicedu	3	4,3 %

Table 5 highlights the journals with the highest publication frequency in the dataset, with the Journal of Physics: Conference Series and Journal of Primary Education being the most prominent contributors. The remaining journals, while contributing fewer articles, still play a significant role in the body of research.

Table 6. Leading publisher by number of articles

Top 5 Publisher	Frequency	Percentage
Universitas Negeri Semarang	13	18,8 %
IOP Publishing	8	11,6 %
Universitas Mataram	5	7,2 %
Universitas Pahlawan	4	5,8 %
Universitas Pendidikan Ganesha	2	2,9 %

The data presented in tables 5 and 6 also invite further exploration into the factors influencing the distribution of publications. Questions may arise about the editorial policies of the leading journals, the collaborative dynamics between institutions, and the thematic focus of the published articles. Analyzing these aspects could deepen our understanding of the academic landscape in ethnoscience education and contribute to shaping future research agendas in this evolving field. These findings provide valuable information for scholars, educators, and policymakers interested in ethnoscience education. The concentration of articles in specific journals and under certain publishers can guide researchers in selecting reputable outlets for dissemination. Moreover, it reflects the collective efforts of different academic institutions, suggesting potential avenues for collaboration and networking within the field.

CONCLUSIONS

Ethnoscience, which integrates local cultural knowledge into science education, has increasingly been recognized for its potential to enrich the science curriculum in Indonesia. By bridging the gap between traditional practices and scientific concepts, it makes learning more relatable and engaging for students. Research on ethnoscience has primarily focused on its impact on students' scientific literacy, conceptual understanding, and critical thinking, while a significant portion of studies has also explored the development of ethnoscience-based products, such as culturally tailored teaching materials and tools. Despite the growing body of research, important gaps remain, particularly in its application to younger elementary students (grades 1-3) and in regions beyond Java, limiting a more comprehensive understanding of its effectiveness. There is also a need for greater exploration of underutilized aspects of ethnoscience, such as local songs and cultural wisdom, to further diversify its implementation.

The evidence shows that ethnoscience positively influences students' cognitive and creative skills while fostering social and environmental awareness, aligning with Indonesia's multicultural educational context. However, future research should prioritize the development of culturally responsive materials for younger students and extend studies to underrepresented regions. Collaborative efforts among educators, researchers, and local communities are crucial to effectively integrate ethnoscience into the curriculum. While ethnoscience presents a promising approach to making science education more culturally relevant and inclusive, further research and practical implementation are necessary to fully realize its potential across Indonesia's diverse educational settings.

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FINANCING

No financing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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