

Exploring Ethnoscience in Science Education: A Systematic Literature Review from 2020-2025

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Abstract

This study aims to explore the application of ethnoscience in science education through a systematic literature review from 2020 to May 2025. Ethnoscience, as a culturally-based educational approach, plays a crucial role in contextualizing scientific concepts in students' daily lives. This study employs the PRISMA protocol to ensure traceability and transparency in data collection. Of the 76 articles that met the inclusion criteria, most studies were conducted in Indonesia, focusing on primary and secondary education. The findings reveal that ethnoscience research in science education contributes to improving scientific literacy and 21st-century skills and integrating local wisdom values into pedagogical approaches. However, there remains a lack of cross-country research or intercultural comparisons. This study recommends further research with empirical classroom approaches and cross-cultural studies to enhance the validity and transferability of findings. The results of this review provide valuable insights for curriculum developers, educators, and policymakers to design culturally responsive science learning that aligns with students' sociocultural contexts. The integration of ethnoscience can serve as a strategic approach to promote inclusive education, foster identity awareness, and support the sustainability of local knowledge in formal science curricula.

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INTRODUCTION

Natural Sciences (IPA) is an important subject that not only aims to develop scientific knowledge and skills but also to foster students' awareness of the social and cultural environment around them [1]. This orientation has led to a growing trend in ethnoscience research from 2020 to 2025, where science education is increasingly directed toward integrating local knowledge and cultural contexts into learning processes. Ethnoscience-based approaches are recognized as effective in

contextualizing scientific concepts, thereby promoting meaningful learning and enhancing students' scientific literacy while preserving cultural identity [2], [3]. In this context, the ethnoscience approach, which integrates local knowledge into science education, becomes a relevant and contextual strategy to ground science in students' daily lives [4]–[6]. This approach encourages students to understand natural phenomena through their cultural perspectives, making learning more meaningful and relevant.

Ethnoscience research in science education has rapidly developed over the past five years. Based on an initial review of 76 articles from Google Scholar for the period 2020–2025, it was found that the majority of studies were conducted in Indonesia and focused on the levels of primary and secondary education (elementary and middle school). The main focus of the research is on creating teaching materials based on ethnoscience, improving science understanding and 21st-century skills, and including local cultural values in teaching methods (Fitriana & Suyono, 2023; Nurhayati et al., 2022).

The increased interest in ethnoscience aligns with the implementation of the Merdeka Curriculum, which promotes contextual learning based on local culture and is oriented toward the formation of the Pancasila Student Profile [7]. Moreover, the ethnoscience approach is also considered capable of bridging modern science and traditional knowledge, which have often been marginalized in the formal education system [3], [8]. This approach not only improves students' learning outcomes but also enriches the learning experience by linking scientific concepts with local culture and traditions present in the community [4], [9]. Thus, the application of ethnoscience in science learning can have a positive impact on student's learning outcomes and increase their awareness of the importance of preserving and maintaining local culture.

However, systematic studies mapping the trends, focus, methodologies, and educational levels of ethnoscience research are still limited. Therefore, this research aims to conduct a systematic literature review (SLR) on ethnoscience studies in science education published on Google Scholar within the period of 2020–2025. This study will reveal the characteristics of publications, the distribution across educational levels (elementary, middle, and high school), central themes, and an overview of the potential and challenges of implementing ethnoscience in contemporary science education.

By systematically understanding the landscape of ethnoscience research, this study is expected to make a significant contribution to the development of education policies based on local wisdom, as well as serve as a reference for researchers and practitioners in designing science education that is culturally and scientifically relevant [2], [10]. The results of this study are expected to strengthen the argument about the importance of integrating ethnoscience into the education curriculum, as well as provide recommendations for more contextual and effective learning practices [3], [6]. The results of this study are expected to serve as a foundation for the development of more interactive and ethnoscience-integrated learning media, thereby enhancing student motivation and learning outcomes.

Based on the data analysis, the researchers are interested in examining the characteristics of ethnoscience research publications in science education that were published during the 2020–2025 period, the main themes or focus areas of ethnoscience research in science education during that period, which educational levels (elementary, middle, or high school) ethnoscience research in science education has been most prevalent, and the contributions and challenges of implementing ethnoscience in science education based on the results of a systematic literature review.

METHOD

This research employs the PRISMA protocol to facilitate systematic and structured data collection (Hoque et al., 2022; Malapane et al., 2022; White & Delaney, 2021; Yu & Xu, 2022). Identification of literature from the Google Scholar database for the years 2020– May 8, 2025.

Study Design

This study was designed using the PRISMA protocol, as shown in Figure 1 ([11], [12]). This approach is specifically designed to present transparent and systematic information during the data collection phase in systematic research [13]–[15].

The initial step in implementing the PRISMA protocol, as shown in Figure 1, is the identification of literature sources from the Google Scholar database. This study conducted document collection and analysis from 2020 to May 8, 2025.

Inclusion and exclusion criteria

The researcher will determine specific inclusion criteria when searching for documents in this study. The exclusion criteria in this study are articles not available in full text, articles not relevant to the context of science education, articles in the form of theses, dissertations, non-peer-reviewed proceedings, or those that do not meet scientific eligibility. The inclusion criteria for this study are articles that focus on the integration of ethnoscience in science education, articles available in Indonesian or English, and articles published in accredited scientific journals or indexed by Google Scholar.

We carried out selection by applying the previously established inclusion and exclusion criteria, as shown in Table 1, after identifying relevant sources. These criteria encompass certain aspects that support the research objectives and the predetermined scope of the study [16], [17]. The next step in the selection process involves extracting data from the selected articles. We gather pertinent data concerning the enhancement of creative thinking in science education. Here is Table 1 related to the inclusion and exclusion criteria for this research.

Table 1. Inclusion and exclusion criteria for the studies

Category	Inclusion Criteria	Exclusion Criteria
Search terms	https://scholar.google.com/scholar?hl=id&as_sdt=0%2C5&q=etnosains+dalam++%22pembelajaran+ipa%22&oq=	
Publication period	Studies published from January 2020 to 8 Mei 2025	Studies published before January 2020
Language of publication	Full-text available in English and Indonesian	Full-text available in other languages
Document Type	Studies conducted in etnosains pembelajaran IPA, ethnoscience science education, etno-STEAM, kearifan lokal IPA, dan etnopedagogi dalam pembelajaran sains	Studies outside science education
Subject area	Social science	Studies outside social science (such as Business, Management, Accounting, Health Professions, Linguistics)

The research procedure uses PRISMA steps consisting of 3 stages: identification, screening, and inclusion. The diagram image below illustrates the scheme.

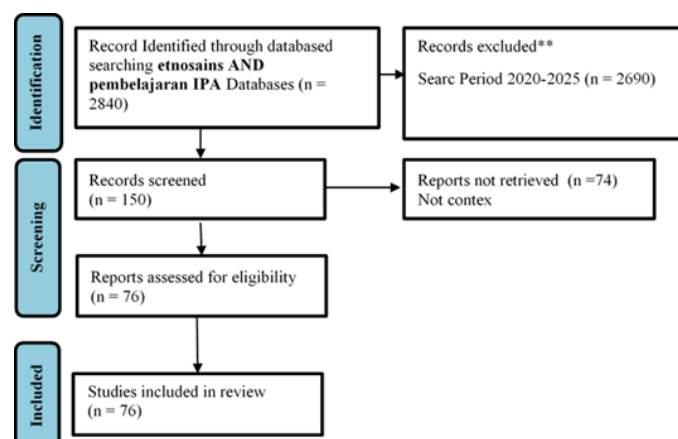


Figure 1. PRISMA diagram

Data from the article were coded using a matrix table (Excel) and then analyzed using content analysis techniques to identify dominant themes. Frequency distribution is presented in the form of tables and graphs to show research trends quantitatively.

RESULTS AND DISCUSSION

1. Distribution of Author Countries

Indonesia dominates almost all publications ($\pm 98\%$). Only a handful of English-written articles appear destined for international journals, yet they continue to explore the Indonesian context. We could not find any articles from outside Indonesia that examined the application of ethnoscience in other countries.

2. Main Study Focus

Research studies in the field of ethnoscience continue to evolve by incorporating several integrations that apply to research variables. The following Table 2 shows several studies related to ethnoscience.

Table 2. Classification of Research Themes

Main Study Focus	Article	Focus Title
Integration of ethnoscience in science education	21	Ethnoscience-based science learning in Sasak ethnic culture
Etno-STEAM / Etno-STEM / Etno-education	10	Etno-STEM in science education
Media and teaching materials based on ethnoscience	12	Ethnoscience-based teaching materials in junior high school
Local wisdom values & character	8	Strengthening Local Wisdom Values in Science Education
Improvement of 21st-century skills	7	Efforts to improve creative thinking ability in science
Ethnoscience modules & e-modules	5	How is the effectiveness of ethnoscience-based modules
Pedagogical approaches (PjBL, Inquiry, etc.)	5	Guided Inquiry Learning Model with Socio Scientific Issue
Study of ethnopedagogy & ethnophysics / chemistry	8	Ethnochemistry in secondary schools

Based on table 2 above, the distribution can be seen in detail in the following figure 2. In this figure 2, the number of research characters in the field of ethnoscience can be seen.

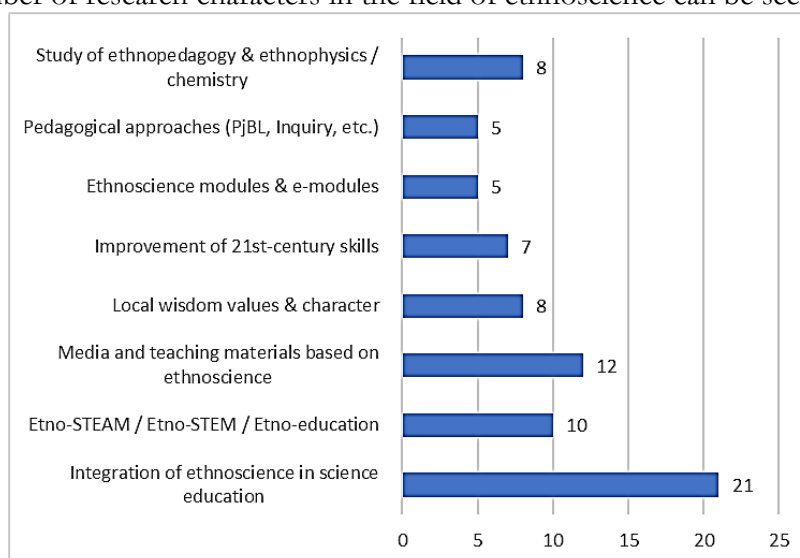


Figure 2. Distribution of Ethnoscience studies in science education

3. Education Level

Ethnoscience research is spread across several educational levels in Indonesia, from elementary schools, junior high schools, high schools, and at the general level. This shows that ethno research has been considered for implementation in national education. Here in Table 3, the distribution of ethno research across various levels of education can be seen.

Tabel 3. persebaran artikel penelitian pada level pendidikan:

Education Level	Article	Persentase
Elementary School	28	36%
Junior High School	24	31%
High School	17	22%
General	7	9%

Research related to ethnoscience is widespread, with the highest focus level at the elementary school level, indicating significant attention to strengthening local values from an early age. This can also be seen in Figure 3.

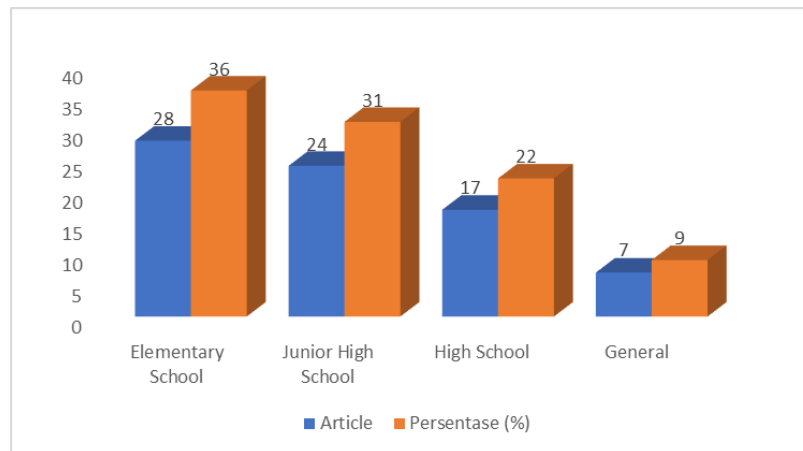


Figure 3. Distribution of ethno studies at the national education level

The review of 76 articles shows that the dominance of research on ethnoscience in science education is very strong in Indonesia, reaching about 98% of the total publications reviewed. This shows that the ethnoscience approach remains a highly contextual local domain, relevant to the cultural diversity and local wisdom values in Indonesia. This fact supports the view of Snively & Corsiglia (2001), who emphasize the importance of integrating local knowledge into science education to build a culturally based scientific understanding among students. The application of ethnoscience in science education can enhance student motivation and participation, as well as strengthen the connection between knowledge and the local culture surrounding them [19], [20]. Thus, ethnoscience not only serves as a teaching method but also as a bridge connecting students with their cultural heritage.

This analysis primarily focuses on the integration of ethnoscience into science education, as evidenced by 21 articles. These studies indicate that the ethnoscience approach contributes to the strengthening of science literacy, the enhancement of critical thinking skills, and the character development of students. Budiarti et al. (2020) found that ethnoscience-based science learning can strengthen students' understanding of physics through the interpretation of local scientific cultural practices. Additionally, the integration of ethnoscience is also relevant to the values of Pancasila, which supports character development and cultural understanding among students [22]. The integration of ethnoscience in learning can help students understand the cultural values that underpin their character, in line with the importance of character education in the national context [23]. Thus, the ethnoscience approach in science education enriches students' knowledge and shapes their character in accordance with existing local cultural values.

Ten articles present the application of the Etno-STEAM and Etno-STEM approaches, a developing innovation in ethnoscience-based learning. This approach combines science, technology,

engineering, art, and mathematics with local cultural values to foster 21st-century skills such as creativity, collaboration, and problem-solving. These findings align with the idea of Tan & Lee (2022) that modern scientific literacy must take into account the social and cultural context of students in order to be more meaningful and applicable. The implementation of the Ethno-STEAM and Ethno-STEM approaches in science education shows significant potential to enhance student engagement and the relevance of education to their cultural context. This approach also has the potential to boost students' confidence in facing academic challenges, as they feel more connected to the material being taught and their culture [25]. It is important to continue exploring and applying the ethnoscience approach in education to ensure that learning remains relevant and beneficial for students from various ethnic backgrounds.

Next, as many as 12 articles highlight the importance of developing ethnoscience-based media and teaching materials, including modules, e-modules, booklets, and visual media such as Canva and digital comics. This innovation is designed to enhance student engagement and make learning more contextual and relevant. Research by Khoerunnisa, R, F., (2016) shows that ethnoscience-based modules can improve students' learning outcomes and entrepreneurial skills because the learning materials are closer to their daily lives. The development of ethnoscience-based learning media also supports the achievement of cultural and citizenship literacy among students, which are important goals in education in Indonesia [27]. The development of this contextual teaching media is expected to encourage students to participate more actively in the learning process and understand the relationship between science and the existing local culture.

Ethnoscience-based learning is also considered an effective means to shape character and instill local wisdom values. As many as eight articles emphasize the importance of cultural values such as cooperation, responsibility, and love for the homeland as part of science education. This is in line with the Pancasila Student Profile concept introduced in the Merdeka Curriculum and reinforced by research findings [28] on the internalization of cultural values in science education. Thus, the ethnoscience approach in science learning contributes to scientific understanding and strengthens students' character in accordance with existing Pancasila values [29]. It is important to integrate Pancasila values into every aspect of education, including ethnoscience-based learning, to shape students' character grounded in local culture.

This study also shows that the ethnoscience approach supports the development of 21st-century skills such as creative thinking, critical thinking, and collaborative skills. Several articles highlight the effectiveness of ethnoscience-based pedagogical models such as problem-based learning, project-based learning, and inquiry learning in achieving those skills. This is relevant to the idea of Trilling & Fadel (2009) regarding the importance of education that prepares students to face complex challenges in the future. These pedagogical models can be integrated with an ethnoscience approach to create a more dynamic and contextual learning environment, supporting students' independence and creativity in learning [2], [31], [32]. It is important to continue developing and implementing ethnoscience-based pedagogical models to improve the quality of education and the relevance of learning in Indonesia.

From the perspective of educational levels, the majority of research is focused on the elementary school level (36%), followed by the middle school level (31%) and the high school level (22%). This fact shows that significant attention is given to strengthening scientific understanding and character based on local culture from an early age. Research by Rapsanjani et al. (2023) concluded that science learning based on local culture in elementary schools can serve as a foundation for stronger character education and scientific skills, and this study emphasizes that local culture can be a medium for science learning. Therefore, it is important to continue promoting research and ethnoscience-based learning practices at all levels of education to strengthen students' character and scientific literacy. This research highlights that including ethnoscience in education can improve students' scientific knowledge and character starting in elementary school, which matches the educational needs in Indonesia and helps develop students' character based on local cultural values [3]. This aligns with the importance of character education in the national context and the relevance of ethnoscience in the educational curriculum in Indonesia [34].

However, there are limitations in most studies that are conceptual or literature reviews. Experimental and implementational research that can longitudinally test the real effectiveness of ethnoscience in the classroom is still very much needed. Research [35] emphasizes that the success of culture-based science education requires community collaboration, policy support, and ongoing empirical testing. Therefore, it is crucial to conduct further research in this context to ensure the effective and sustainable implementation of the ethnoscience approach in Indonesian education. Further research development is expected to produce more innovative and applicable learning models, as well as support the integration of ethnoscience into the education curriculum in Indonesia.

CONCLUSION

Based on the analysis of this research data, the main trend in ethnoscience research focuses on strengthening contextual science learning based on local culture to build character and 21st-century literacy. Research gap: Minimal cross-country research or cross-cultural comparisons. Future research will primarily concentrate on direct empirical studies in the classroom, along with cross-cultural or cross-national integration, to enhance the validity of findings and the applicability of ethnoscience.

This study is limited by its exclusive reliance on literature indexed in Google Scholar, which may exclude relevant studies from other academic databases or unpublished local research. Therefore, the findings should be interpreted with caution regarding global generalizability. Based on the results, it is recommended that policymakers and curriculum developers incorporate ethnoscience principles into the development of science teaching materials, teacher training programs, and local content policies. Integrating ethnoscience into the instructional design can support the creation of culturally responsive learning environments that foster students' scientific understanding while preserving and valuing local wisdom.

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