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Integrating Local Wisdom into Environmental Education: A Systematic Review of Ethnoscience Research in Indonesia

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ABSTRACT
The erosion of environmental awareness and the diminishing recognition of traditional knowledge present significant challenges for contemporary education, particularly in Indonesia. This literature review examines the integration of ethnoscience into science education as a strategic response to these issues. Studies conducted between 2020 and 2025 reveal a growing emphasis on embedding local wisdom—such as indigenous agricultural practices and cultural rituals—into science curricula to enhance environmental consciousness and promote sustainable behaviors. A majority of the research focused on students, with senior high school (40%) and junior high school (26.7%) populations being the primary targets. Notably, research output surged in 2024, reflecting increasing academic interest. Ethnoscience-based instructional materials, including e-modules and interactive books, were widely implemented and demonstrated effectiveness in facilitating conceptual understanding while nurturing cultural appreciation. These tools were well-received by both educators and learners. Geographically, the studies spanned diverse regions, including Papua, Surabaya, and Ponorogo, underscoring the broad applicability of ethnoscience in Indonesian education. Although fewer studies concentrated on teachers, findings suggest that incorporating traditional knowledge into science education fosters cultural preservation, environmental stewardship, and sustainable development. This approach not only enriches the curriculum but also provides learners with a meaningful, context-driven educational experience rooted in both scientific inquiry and cultural heritage..

Keywords: *ethnoscience, environmental education, indonesia, systematic literature review, science learning*

INTRODUCTION

Ethnoscience arises from a long-standing process of cultural internalization, transmitted across generations through observation, experiential understanding, and the practical application of natural phenomena within local communities (Yusof et al., 2024; Winarto et al., 2023). This body of knowledge is deeply rooted in empirical experience, often stemming from direct environmental interactions—such as seasonal agricultural practices, the use of medicinal plants, and traditional water management systems. While ethnoscience frequently incorporates mythological and belief-based elements, studies have demonstrated that it also embodies scientific principles, particularly those related to sustainability and conservation—tenets that align

closely with the core objectives of modern environmental science (Fitri et al., 2025; Rahmadana et al., 2025).

Fundamentally, ethnoscience reflects indigenous ecological intelligence, offering valuable insights into ecosystem balance and resource management—dimensions that are increasingly relevant in addressing global environmental challenges such as climate change and ecological degradation (Lestari et al., 2024). However, amidst the rapid progress of contemporary science and technology, traditional knowledge systems like ethnoscience have often been marginalized or overlooked. This marginalization overlooks a critical cultural and intellectual asset that warrants preservation (Fahrozy et al., 2022; Jadidah et al., 2023).

One strategic approach to revitalizing ethnoscience is its integration into formal science education. Such integration not only bridges indigenous and scientific worldviews but also cultivates environmental awareness by encouraging students to adopt sustainable lifestyles and appreciate their local ecological contexts (Apriansyah et al., 2024; Fitri et al., 2024; Zidny & Eilks, 2022). Embedding ethnoscientific values in curricula fosters scientific literacy while simultaneously nurturing a sense of ecological responsibility—an imperative in an era marked by escalating environmental crises.

In the era of globalization, younger generations are increasingly immersed in globalized culture, often at the expense of their connection to local heritage. This cultural disconnection has been linked to a decline in national identity and reduced appreciation for indigenous wisdom (Ardianti et al., 2019; Hikmawati et al., 2020). Educational institutions can address this issue by reintroducing cultural identity through localized, culturally responsive learning (Puspita et al., 2024; Yuliarta et al., 2024).

As a culturally embedded epistemology, ethnoscience represents indigenous ways of categorizing and interpreting natural and social phenomena. It reflects localized classification systems and has been recognized as a legitimate form of ecological knowledge or "protoscience," bearing conceptual parallels to formal scientific understanding (Ardianti et al., 2023; Sturtevant, 2019; Arianingrum et al., 2024; Parmin & Fibrina, 2019). In educational contexts, ethnoscience enhances learners' understanding of natural systems and environmental processes, offering a holistic, contextualized alternative to conventional science education (Lidi et al., 2022).

Ethnoscience-based instruction emphasizes inquiry, contextual relevance, and critical thinking over rote memorization (Arrumi et al., 2024; Safitri et al., 2018). Its implementation often involves aligning curricular content with local cultural and environmental contexts. For example, the study of traditional salt-making practices in Bangkalan Regency has enabled students to grasp scientific concepts embedded in local customs while strengthening their community engagement (Puspita et al., 2024). Likewise, the development of modules based on herbal medicine in Sidenreng Rappang has demonstrated the pedagogical potential of traditional biodiversity knowledge to enhance cultural and scientific literacy (Apriansyah et al., 2024). An e-book produced in Surabaya that incorporates traditional environmental practices and disaster mitigation strategies has also proven effective in fostering critical thinking and sustainability awareness among students (Nabilah et al., 2022).

Despite these promising developments, a comprehensive synthesis of existing research remains lacking. No systematic literature review (SLR) has yet consolidated findings on the integration of ethnoscience into education for environmental awareness. While individual studies have explored various aspects, an overarching analysis of implementation strategies, pedagogical effectiveness, and geographic distribution within Indonesia is still absent. This gap highlights the

need for a holistic review to better understand how ethnoscience is employed across different educational levels, regions, and research methodologies.

To address this need, the present study undertakes a systematic literature review aimed at: (1) assessing the extent of ethnoscience integration in fostering students' environmental awareness; (2) identifying trends in research from 2020 to 2025; (3) analyzing the focus of studies based on educational levels; and (4) mapping the geographical distribution of such studies across Indonesia. This review intends to reveal prevailing patterns, highlight underexplored areas, and offer evidence-based recommendations to guide future research and pedagogical strategies. Ultimately, integrating ethnoscience into science education may serve as a culturally grounded and transformative approach to cultivating environmental responsibility among Indonesia's youth.

METHODOLOGY

Research Design

This study adopts a **systematic literature review (SLR)** approach, which provides a structured, replicable method for evaluating existing research in a defined field. As described by Xiao and Watson (2019), SLRs follow a rigorous, transparent framework for identifying, selecting, synthesizing, and analyzing relevant literature. The method enables researchers to map the state of knowledge, assess theoretical and methodological gaps, and inform future studies. Cottrell (2017) and Wallace & Wray (2016) emphasize that an SLR's primary contribution lies in producing a comprehensive and balanced overview of the literature, helping to advance scholarly understanding in meaningful ways.

Given these benefits, the current study employs an SLR to systematically examine the role of ethnoscience in promoting environmental awareness and enriching science education. Rather than compiling an exhaustive list of existing works or establishing best practices, this review seeks to identify conceptual trends, empirical insights, and research voids. The analysis combines systematic procedures with content analysis techniques, focusing on peer-reviewed publications from 2020 to 2025 that examine the intersection of ethnoscience, environmental awareness, and science education within the Indonesian context.

Population and Sampling

The sample for this study consists of **30 peer-reviewed research articles** published between 2020 and 2025. These articles were retrieved from reputable databases, including Google Scholar, Garuda, and SCOPUS. The search process employed targeted keywords such as "ethnoscience" and "environmental awareness" to identify relevant studies within the scope of the research.

Data Collections Process

The data collection process followed several key stages. The initial phase involved formulating precise research questions and identifying studies aligned with the review objectives. A set of inclusion and exclusion criteria (outlined in Table 1) guided the article selection. Using *Publish or Perish* software, a comprehensive database search was conducted. After the initial filtering, article abstracts were screened for relevance, followed by full-text reviews to confirm alignment with the study's thematic focus. Ultimately, 30 high-quality articles were selected for in-depth analysis.

Table 1. Inclusion and Exclusion Criteria

No.	Category	Inclusion Criteria	Exclusion Criteria
1.	Type of Publication	Articles published in journals	Articles published in conference proceedings, books, websites, blogs, and other similar sources
2.	Journal Specifications	International journal minimum indexed Scopus and accredited by SINTA	National journal not accredited
3.	Country	Indonesia	Not in Indonesia
4.	Publication Year	2020 - 2025	Less than 2020
5.	Research Setting	Qualitative (Descriptive), Quantitative (Experimental), Mixed Method, Research and Development	Systematic Literature, Literature Review, Comparative Study, Phenomenology
6.	Independent Variable	Ethnoscience, Environmental Awareness	Outside of Ethnoscience, Environmental Awareness
7.	Field	Science (Chemistry, Physics, and Biology)	Outside of science

To support the coding process, the researchers employed the Paper Classification Form (PCF) developed by Kizilaslan et al. (2012) as the principal analytical framework. Recognized for its robustness in both reliability and validity, the PCF encompasses a detailed set of classification indicators, including article title, author information, journal name, year of publication, journal type, language, indexing status, core academic discipline, research methodology, data collection techniques, sample characteristics, and data analysis methods. To complement this framework, the researchers also developed a customized data matrix designed to extract additional variables relevant to the study's focus—such as research objectives, the integration of pedagogical models, thematic scope, and principal findings.

The collected data were analyzed using descriptive statistics, specifically percentage-based techniques, to quantify research trends and characteristics. Following this, the selected articles were subjected to a thematic analysis aimed at identifying recurring patterns, particularly in relation to the implementation of ethnoscience, its contribution to environmental awareness, and its integration into science education. These patterns were systematically synthesized to address the study's research questions. The synthesis process involved categorizing and interpreting the emergent themes to construct a coherent set of findings, which are visually presented in Figure 1.

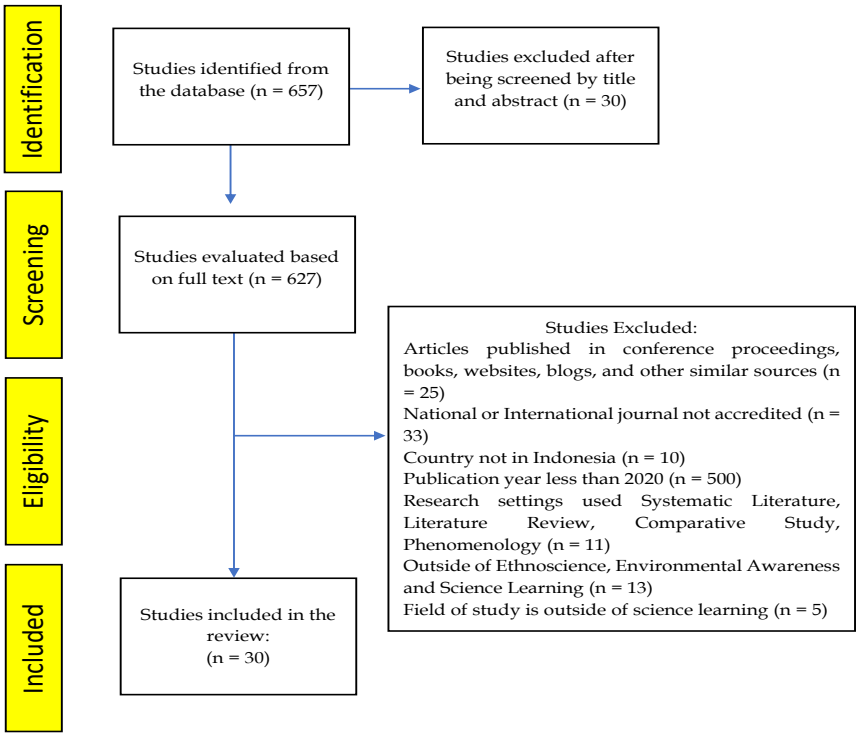

Figure 1. Flowchart of the Article Selection Procedure

Information regarding the journals utilized in the reviewed articles—including their indexing status and accreditation levels—is summarized in Table 2.

Table 2. The Shortlisted Articles for Review

No.	Journal Name	(f)	(%)	Rating
1	Jurnal Penelitian Pendidikan IPA	7	23.3	SINTA 2
2	Journal of Baltic Science Education	1	3.3	Scopus (Q2)
3	Journal of Innovation in Educational and Cultural Research	2	6.7	SINTA 1
4	Journal of Advanced Sciences and Mathematics Education	1	3.3	SINTA 2
5	Indonesian Journal of Science and Education	1	3.3	SINTA 3
6	Jurnal Pijar MIPA	3	10.0	SINTA 4
7	IJIS Edu: Indonesian Journal of Integrated Science Education	1	3.3	SINTA 2
8	Biosfer: Jurnal Tadris Biologi	1	3.3	SINTA 2
9	Education Sciences	1	3.3	Scopus (Q2)
10	INSECTA: Integrative Science Education and Teaching Activity Journal	1	3.3	SINTA 3
11	International Journal of Social Learning	1	3.3	SINTA 2
12	Research and Development in Education (RaDEn)	1	3.3	SINTA 2
13	JPBI (Jurnal Pendidikan Biologi Indonesia)	1	3.3	SINTA 2
14	Indonesian Journal of Science and Mathematics Education	2	6.7	SINTA 2
15	International Journal of Recent Educational Research	1	3.3	SINTA 2
16	International Journal of Elementary Education	1	3.3	SINTA 2
17	Bio-Lectura: Jurnal Pendidikan Biologi	1	3.3	SINTA 4
18	JTC-RE: Journal of Tropical Chemistry Research and Education	1	3.3	SINTA 4
19	Pakistan Journal of Life and Social Sciences	1	3.3	Scopus (Q4)
20	Inornatus: Biology Education Journal	1	3.3	SINTA 5
	Total	**30**	**100**	

RESULT AND DISCUSSION

Distribution of Research Based on Previous Study Results

This systematic literature review examines articles published between 2020 and 2025, focusing specifically on studies conducted within the Indonesian context. The synthesized findings from the 30 selected articles are detailed in Table 3.

Table 3. Distribution of Research Based on Previous Study Results

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
Ismawati et al.	2020	University	Ngargomulyo	Farming, livestock raising, forest management, and water conservation	The study's goal is to reconstruct the scientific knowledge embedded in the village's local wisdom to cultivate a conservation-oriented mindset in prospective science teachers, thereby deepening their understanding and dedication to environmental protection. The research shows that the Ngargomulyo village community practices environmental preservation through activities such as farming, livestock raising, forest management, and mining, alongside efforts to safeguard spring water sources. Additionally, environmental conservation messages are posted on boards at several locations.
Nabilah et al.	2022	Junior High School	Surabaya	Traditional environmental practices Local ecological knowledge Cultural wisdom for disaster mitigation Sustainable resource management Cultural rituals related to nature	The STEM-based e-book with gender-based sustainable development principles received validity, practicality, and effectiveness scores of 85.85%, 87.16%, and 83.5% for female students and 80% for male students, indicating it is highly valid, practical, and effective for classroom learning.
Zidny & Eilks	2022	University	Banten	Baduy Tribe on Java (*Jeruk Bali*/Citrus grandis)	The study found that students found the lesson engaging and relevant, enhancing their scientific literacy. By exploring indigenous knowledge through green chemistry activities, they gained insights into integrating diverse knowledge sources to advance sustainable chemistry goals. Hands-on activities enriched the learning experience and helped students evaluate sustainable chemistry methods.
Munawaroh et al.	2022	Junior High School	Ponorogo	Reog, Peacocks, And Rare Flora and Fauna in	This research developed the Etintec Student Book, an interactive resource on Ecology and Biodiversity based on Ponorogo Regency's cultural

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
				Ponorogo (Taman Wengker)	ethnoscience. The development followed a 3D model: define, design, and development. The defined problem was the lack of innovation in science learning media, leading to the creation of an ethnoscience-based interactive book. During the design phase, steps for creating the book were outlined, and in the development phase, the product underwent evaluation by media experts. The final validation score was 3.58, categorizing the book as suitable for use in science education.
Solheri et al.	2022	Junior High School	Pekanbaru	Friendly Agricultural	The study found that junior high school students' environmental literacy is at a medium level, with knowledge, attitudes, and behavior in the medium category and cognitive skills in the low category. Ethnoscience integration in learning has been partially implemented, and enhancing environmental literacy through ethnoscience-based learning can improve education in Indonesia.
Agustina et al.,	2023	Senior High School	Surabaya	Pilgrims Bringing Home the Water and Myth of the Bamboo Forest	The results show a validation score of 3.88, 97% approval, and excellent category, with a level 10 readability. Therefore, the Flipbook is effective for teaching environmental pollution management using Surabaya's local wisdom to enhance students' ethno-conservation skills.
Budiarti et al.,	2024	Elementary School	Sarmi Regency, Papua	*Sago*	The study highlights that traditional sago processing involves fundamental scientific principles such as simple machines, energy transfer, friction, and sedimentation, which can be effectively integrated into science education. This approach enriches students' understanding of scientific concepts, promotes cultural appreciation, and supports sustainability, emphasizing the importance of incorporating local wisdom into education to create culturally relevant and sustainability-focused learning environments.
Puspita et al.	2024	Teacher in Junior High School	Cimahi	Cireundeu Traditional Village	Most teachers lack knowledge of ESD, SDGs, and ethnoscience integration. While they recognize the value of connecting lessons with students' culture, they face challenges due to insufficient training and awareness of local wisdom. Further research is needed to support teachers in integrating these concepts.

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
Apriansyah et al.	2024	Senior High School	Sidenreng Rappang	Medicinal plants of the Bugis tribe	The ethnoscience-based e-module focused on the biodiversity of medicinal plants from the Bugis tribe, developed through the ADDIE model, received expert validation scores surpassing 81%, indicating its strong validity. Teachers and students provided practicality ratings of 86.25% and 90.62%, respectively, highlighting the module's effectiveness and suitability for educational use.
Artika et al.	2024	Senior High School	Pekanbaru	Integrating local cultural knowledge	The use of ethnoscience in the context of the PBL (Project-Based Learning) e-Student Worksheet, for example, emphasizes teaching scientific concepts like redox reactions through local cultural contexts and environmental concerns. This approach aims to improve students' character values and conservation attitudes by connecting science education to local, sustainable practices rooted in the culture and traditions of the community.
Yuliarta et al.	2024	Senior High School	Bontang	Mangrove, Sabana Ecosystem	The ethnoscience-based mangrove module developed for SMA IT Daarul Hikmah Bontang showed high validity (99% for content, 84.69% for material, and 73.6% for language) and practicality (88.65% from students). It positively improved students' critical thinking and environmental awareness, though the effectiveness was moderate.
Fitri et al.	2024	Senior High School	Padang	Prohibited Forests, Tropical Rainforests, Nagari Forests, Prohibited Forests, Customary Forests, Andaleh Wood, and Forbidden Pool/Fish	The global warming e-module, incorporating the PBL model and ethnoscience, achieved a validity score of 91.8% and practicality scores of 95.7% from teachers and 85.2% from students. The results indicate that the e-module is both valid and practical, making it suitable for enhancing physics learning and fostering environmental literacy among students.
Arianingrum et al.	2024	Junior High School	Desa Kemiri	Making eco enzymes, neglecting piles of trash around the house, and still believing in the myth of cutting down banyan trees	The ethnoscience module focused on environmental pollution is highly valid, practical, and effective in improving early literacy skills within the community. It can be applied in various community activities and educational contexts to raise awareness and deepen understanding of environmental pollution and its solutions.
Yasir et al.	2024	University	Madura	Bull racing and	This study shows that science learning

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
				keris	based on local wisdom effectively enhances the cultural heritage conservation character in science bachelor candidates, outperforming conventional learning. Local wisdom-based learning achieved high scores on all conservation indicators, while conventional learning had one medium score. The findings suggest that integrating local wisdom into science education can support cultural heritage preservation and sustainable development.
Pratiwi et al.	2024	Elementary School	Bandar Lampung	Seruit and Lampung Typical Medicinal Plants	The study revealed that 85% of teachers and 95% of students in five elementary schools in Bandar Lampung expressed a need for ethnoscience-based E-Worksheets. These materials, focusing on the importance of eating and drinking, aim to improve students' understanding of the Nature of Science (NoS) and raise environmental awareness.
Rafidah et al.	2024	Senior High School	Malang Raya	*Bersih Kali*	The environmental change e-book, designed with problem-based learning and integrated with Malang Raya local wisdom, is highly valid based on presentation, content, and learning step criteria. With a readability level suited for grade 10 high school students, the e-book is deemed highly appropriate and effective for classroom use.
Wardani et al.	2024	Elementary School	Banyuwangi	*Blambangan* Culture	This study concludes that the mapping results can serve as a foundation for developing more contextual teaching materials through an ethnoscience approach, thereby enhancing students' understanding of science concepts based on local culture.
Muliadi et al.	2024	University	Mataram	*Sasaknese* Traditional Games	The study reveals that preservice teachers have very positive perceptions of ethnoscience learning that integrates Sasaknese traditional games. Their responses across all statement items consistently fall into the "Very High" category, reflecting strong approval of this approach. Overall, ethnoscience-based instruction using traditional games is seen as a highly effective and engaging method by future educators.
Jihannita et al.	2024	Junior High School	Ponorogo	*Singo Barong* Mask	The findings indicated that both the feasibility and practicality of the module received excellent ratings. Therefore, the ethnoscience-integrated science module based on the Singo Barong mask is deemed appropriate

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
					for use in science education to enhance students' scientific literacy and foster attitudes toward cultural preservation.
Sudarmin et al.	2024	University	West Java	Tea Aroma Volatile	This study concludes that: (a) the implementation of Ethno-STEM-integrated project-based learning enhances global diversity traits, including knowledge, attitudes, and cognitive skills; and (b) scientific knowledge is reconstructed through indigenous wisdom related to the local tea culture, encompassing tea preparation, its benefits, and community responses.
Pieter & Risamasu	2024	Senior High School	Jayapura	*Enggros* and *Tobati* Tribes	The research findings indicated that the developed teaching materials positively influenced student learning, showing significant differences in science process skills and concept mastery between students using the new materials and those using conventional ones. These materials effectively facilitated students' learning transitions and enhanced both their science process skills and conceptual understanding in science education.
Silahooy et al.	2024	Junior High School	Papua	*Sasi Laut* or *Sasisen*	The study shows that student books integrated with Papuan local wisdom have a greater impact than conventional ones. This approach enhances students' understanding of managing endemic organisms and encourages them to think critically about conservation to prevent extinction.
Lestari et al.	2024	Senior High School	Karanganyar	Natural Medicinal Plants	The inquiry model led to a significant improvement in students' environmental literacy, while the discovery learning model showed a smaller change. Different learning models enhanced students' understanding of environmental issues, though the effect varied across schools.
Lestari & Ikhsan	2025	Junior High School	Riau	*Durian Tempoyak*	The study reveals that the Malay community still upholds the tradition of making durian tempoyak, involving material preparation, fermentation, and its relevance to science education. This ethnoscientific practice serves as a bridge between local culture and scientific concepts, especially in biotechnology, while also supporting cultural appreciation and 21st-century skill development in students.
Nada et al.	2025	Junior High	Kudus	*Adem Powder*	Integrating local wisdom with science improves students' understanding by

Writer's Name	Year	Educational Levels	City/District	Ethnoscience	Findings
		School			connecting learning to their cultural context. This approach not only supports cultural heritage preservation and national identity but also offers meaningful, contextual science education. Ethnoscience-based learning provides innovative ways to boost student engagement and safeguard local knowledge in the face of globalization.
Sari et al.	2025	Senior High School	Bengkulu	Culinary Tradition *"Lemea"*	The study reveals that the Indigenous knowledge of Lemea fermentation can be integrated into scientific concepts, enhancing high school biology education in Phases E and F. This research contributes to the advancement of ethnopedagogy as an innovative approach in science education, providing a model for curriculum development that incorporates local cultural values, fostering meaningful and context-based learning.
Putri et al.	2025	Physics Teachers in Senior High School	Lampung	Bioethanol from seaweed	The results show that although teachers have a generally favorable view of the Ethnoscience-STEM-PjBL approach, the majority have not yet applied it in their teaching.
Ramadhana et al.	2025	Senior High School	Papua	Traditional Houses of *Honai Dani* Tribe	The Honai traditional house has significant potential to be used as a valuable resource in biochemistry education through an ethnoscience approach.
Fitri et al.	2025	Senior High School	North Kalimantan	*Ketapang Malay* Tribe	The study found that the ethnoscience-based reels of the Malay tribe are valid (96.3%) and practical (90.30%) for use as engaging and relevant learning resources, offering an innovative alternative for chemistry education in schools.
Komarudin et al.	2025	Senior High School	South Sumatra	Lake *Ranau*	The findings show that an e-module was developed, incorporating concise explanations, visual elements, videos, interactive quizzes, and practical experiments. The results emphasize the significance of creating an ethnoscience-based e-module to enhance students' literacy on renewable energy topics.

Table 3 provides a comprehensive summary of research conducted between 2020 and 2025 on the integration of ethnoscience into science education in Indonesia. A notable concentration of studies emerged in 2024, emphasizing the application of local wisdom across diverse contexts—from traditional agricultural practices to cultural rituals and environmental conservation efforts. These studies span multiple educational levels, ranging from elementary

schools to higher education institutions, underscoring the versatility and pedagogical relevance of ethnoscience-based approaches across various academic stages.

A unifying theme across the literature is the incorporation of indigenous cultural knowledge into science curricula to enhance students' conceptual understanding while simultaneously cultivating cultural appreciation. For example, Budiarti et al. (2024) and Fitri et al. (2024) illustrated how traditional practices, such as sago processing and the use of medicinal plants, can be meaningfully connected to scientific principles, thereby enriching student learning and supporting sustainability goals. Similarly, Yasir et al. (2024) demonstrated that integrating local cultural elements—such as bull racing and keris traditions—into science instruction contributes to the development of conservation-oriented attitudes among students.

Across various regions in Indonesia, ethnoscience-based learning tools—including e-modules, interactive books, and student worksheets—have gained widespread acceptance. These instructional materials were frequently evaluated for content validity and practicality through expert assessments, with high approval ratings reported by both educators and learners. For instance, Fitri et al. (2024) developed an e-module on global warming that received strong validation scores, indicating its potential to significantly enhance environmental literacy.

Furthermore, several studies—such as those by Artika et al. (2024) and Sari et al. (2025)—integrated local wisdom within Project-Based Learning (PBL) frameworks, revealing positive outcomes in terms of students' critical thinking abilities, environmental awareness, and scientific literacy. The evidence collectively underscores the pedagogical value of using culturally responsive learning materials to engage students while addressing global environmental challenges. Overall, the findings reflect a growing scholarly consensus regarding the importance of ethnoscience in Indonesian education. By integrating traditional knowledge systems with contemporary scientific practices, educators can foster a deeper, more contextually meaningful learning experience. This approach not only enriches the science curriculum but also strengthens students' connection to their cultural heritage, thus bridging the gap between local wisdom and global scientific understanding.

Distribution of Research Based on Year Publications

The temporal distribution of the selected studies, spanning from 2020 to 2025, is illustrated in Figure 2.

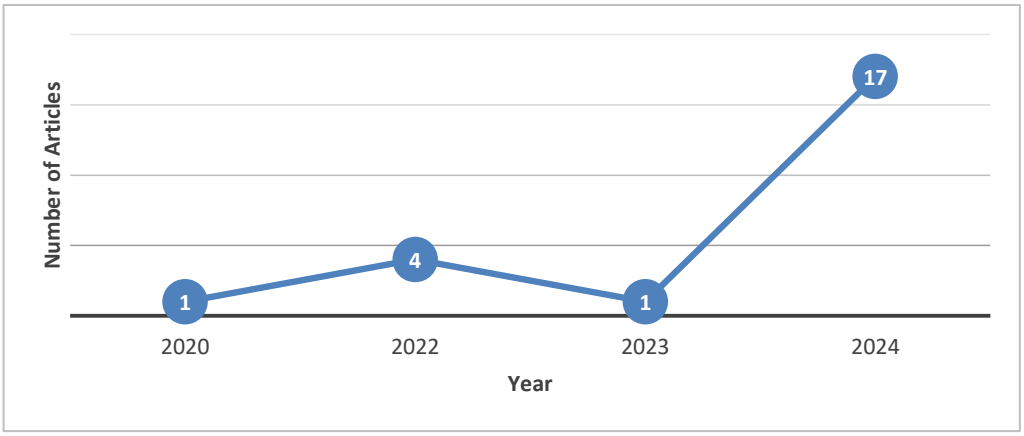

Figure 2. The Distribution of Research Based on Year of Publication

The distribution of research publications from 2020 to 2025 reveals a fluctuating trend in scholarly interest surrounding the integration of ethnoscience into education. In 2020, only one article was published, accounting for 3.3% of the total sample, indicating minimal research activity at the outset of the review period. A moderate increase occurred in 2022, with four publications (13.3%), reflecting a growing academic engagement with the topic. However, this

momentum temporarily declined in 2023, which again recorded just a single publication (3.3%). The most notable surge in research output took place in 2024, with 17 studies published—comprising 56.7% of the total—marking a peak in scholarly production that may be attributed to heightened institutional support, policy shifts, or increased awareness of environmental and cultural issues. Although the number of publications declined to seven in 2025 (23.3%), this figure still indicates sustained interest in the topic. Overall, the data demonstrate a marked escalation in research activity in 2024, followed by a slight decrease, yet the continued output in 2025 suggests that the field remains vibrant and relevant.

The Distribution of Research Based on the Educational Levels

The analysis of participant samples in the reviewed articles aims to examine how research on ethnoscience and its impact on environmental awareness is distributed across various educational levels. This examination provides valuable insights into the focus areas of previous studies and highlights the extent to which different educational stages—ranging from elementary to higher education—have been explored. The detailed distribution of research according to educational levels is presented in Table 4.

Table 4. The Distribution of Research Based on the Educational Levels

Participants/Sample	Education Stage (Level)	(f)	(%)	Total (%)
Student	Elementary/Primary School	3	10	93.4
	Junior High School	8	26.7	
	High School	12	40.0	
	University/undergraduate	5	16.7	
Teacher	Junior High School	1	3.3	6.6
	Physics Teacher (Senior High School)	1	3.3	
Total		**30**	**100**	**100**

The distribution of research participants by educational level reveals a predominant focus on students across various stages of formal education. Approximately 93.4% of the reviewed studies involved student participants, with the highest representation from senior high school students (40.0%), followed by junior high school students (26.7%), university students (16.7%), and elementary students (10.0%). This pattern indicates that educational interventions—particularly those integrating local wisdom, ethnoscience, or STEM-oriented pedagogies—are primarily designed for and tested on learners at the secondary and tertiary levels. In contrast, only 6.6% of the studies focused on teachers, comprising junior high school science teachers and senior high school physics teachers, each representing 3.3% of the sample. This disproportion highlights a notable research gap regarding educators' roles in the implementation of ethnoscience-based or culturally contextualized teaching models. Future research should more actively explore how teachers perceive, adapt to, and facilitate ethnoscientific content within the curriculum. Overall, the findings underscore a strong student-centered emphasis in the current literature, suggesting the need for more balanced investigations that also consider the critical role of teachers in fostering culturally relevant science education.

The Distribution of Research Based on City/Districts of Ethnoscience Implementation in Indonesia

The distribution of research based on the cities or districts where ethnoscience has been implemented in Indonesia, including frequency (f) and percentage (%) for each location, offers a comprehensive overview of regional research trends and focal areas. This information is systematically presented in Table 5.

Table 5. The Distribution of Research Based on the City/Districts in Indonesia

No	City/Districts	f	(%)
1.	Papua	3	10.0
2.	Surabaya	2	6.7
3.	Ponorogo	2	6.7
4.	Pekanbaru	2	6.7
5.	Ngargomulyo	1	3.3
6.	Banten	1	3.3
7.	Sarmi Regency, Papua	1	3.3
8.	Cimahi	1	3.3
9.	Sidenreng Rappang	1	3.3
10.	Bontang	1	3.3
11.	Padang	1	3.3
12.	Desa Kemiri	1	3.3
13.	Madura	1	3.3
14.	Bandar Lampung	1	3.3
15.	Malang Raya	1	3.3
16.	Banyuwangi	1	3.3
17.	Mataram	1	3.3
18.	West Java	1	3.3
19.	Jayapura	1	3.3
20.	Karanganyar	1	3.3
21.	Riau	1	3.3
22.	Kudus	1	3.3
23.	Bengkulu	1	3.3
	Total	**30**	**100**

Based on the frequency distribution table, the reviewed data reveal that ethnoscience-related research spans 30 cities or regencies across Indonesia. Papua emerges as the most frequently represented region, cited in three studies (10%), signaling a concentrated interest in the educational integration of indigenous knowledge systems within this culturally rich area. This recurring attention may reflect ongoing efforts to preserve local wisdom while embedding it into science education frameworks. Other regions—including Surabaya, Ponorogo, and Pekanbaru—each appear twice (6.7%), suggesting that these locales also serve as significant sites for educational innovation rooted in ethnoscience. The prominence of such cities, known for their strong educational infrastructures and vibrant cultural identities, underscores their roles as hubs for implementing contextually relevant learning models.

The remaining 23 regions each contribute one study (3.3%), collectively representing a geographically diverse range of settings—from Ngargomulyo and Banten to Sarmi Regency (Papua), Cimahi, Padang, Banyuwangi, and North Kalimantan. Although these areas are less frequently cited individually, their inclusion demonstrates the widespread national interest in integrating local knowledge into formal education. This broad regional representation illustrates the expansive applicability of ethnoscience-based education and its potential for scalable, nationwide implementation. Across the literature, a recurring theme is the strategic use of local wisdom within science curricula to strengthen students' scientific understanding while simultaneously cultivating cultural appreciation. For instance, Budiarti et al. (2024) and Fitri et al. (2024) examined traditional practices such as sago processing and the use of medicinal plants, demonstrating how these can be meaningfully aligned with core scientific concepts. Similarly, Yasir et al. (2024) explored the educational value of integrating bull racing and the kris tradition into science instruction, revealing how such practices can instill conservation values and deepen ecological awareness among students.

The reviewed studies also highlight the effective implementation of ethnoscience-based learning resources—including digital modules, interactive books, and student worksheets—which have received high validity and practicality ratings from both educators and learners. Fitri et al. (2024), for example, developed a well-regarded e-learning module on global warming, which was shown to significantly enhance students' environmental literacy. Furthermore, the integration of

ethnoscience with Project-Based Learning (PBL), as seen in Artika et al. (2024) and Sari et al. (2025), yielded improvements in students' critical thinking, environmental consciousness, and scientific literacy. These findings support the pedagogical value of culturally grounded instructional strategies in fostering both cognitive and affective learning outcomes. In summary, the collective research underscores a growing recognition of ethnoscience as a valuable educational resource in Indonesia. By bridging indigenous knowledge and contemporary science, these approaches not only enrich the curriculum but also reinforce cultural identity and ecological responsibility. As such, ethnoscience-based education represents a promising pathway toward more meaningful, context-sensitive, and sustainable learning experiences across diverse Indonesian settings.

CONCLUSION

Based on the synthesis of findings from the reviewed studies, this systematic literature review affirms the growing recognition of ethnoscience as a transformative approach in advancing environmental awareness and science education within the Indonesian context. The integration of local wisdom—deeply embedded in cultural traditions—into the science curriculum offers rich, contextually relevant opportunities to connect traditional ecological knowledge with modern scientific understanding. Themes such as indigenous agricultural techniques, the use of medicinal plants, and community-based conservation practices not only enhance students' grasp of scientific principles but also promote a holistic appreciation for environmental sustainability. The utilization of ethnoscience-based learning media, including e-modules, interactive books, and student worksheets, has demonstrated notable impacts on learners' environmental literacy, critical thinking skills, and cultural identity. These tools have been particularly effective in making abstract scientific concepts more tangible and culturally resonant. However, despite these positive outcomes, challenges persist. Limited teacher training, a lack of systematic support for curriculum development, and insufficient awareness regarding local wisdom among educators remain significant barriers to broader implementation.

Nevertheless, the cumulative evidence underscores the potential of ethnoscience to serve as a pedagogical bridge between traditional knowledge and contemporary science, thereby fostering more meaningful, place-based learning experiences. To fully harness this potential, future efforts must prioritize professional development programs, institutional support, and collaborative research that empowers educators to implement ethnoscience-integrated strategies effectively. In conclusion, the incorporation of ethnoscience into science education not only supports national educational goals but also cultivates environmentally conscious, culturally rooted learners. As Indonesia continues to navigate the challenges of environmental degradation and cultural erosion, ethnoscience-informed pedagogy presents a compelling pathway toward education that is both locally grounded and globally relevant.

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