



## Development of Science Learning Tools Based on Ethnoscience: Systematic Literature Review

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### ABSTRACT

Ethnoscience-based science learning tools play a critical role in integrating cultural knowledge with scientific concepts to enhance relevance, engagement, and learning outcomes. This study aims to systematically identify, classify, and analyze the types of ethnoscience-based science learning tools developed in Indonesia, thereby providing an evidence-based overview to inform practice and policy. A systematic literature review (SLR) was conducted following the PRISMA framework, using Google Scholar as the primary database. The search employed targeted keywords and applied strict inclusion and exclusion criteria, focusing on works published between 2016 and 2022. Twenty-two eligible studies—comprising 18 peer-reviewed journal articles and 4 undergraduate theses—were included in the synthesis. The findings reveal six categories of ethnoscience-based learning tools: modules (36%), student worksheets or LKPD (30%), lesson plans or RPP (10%), syllabi (10%), learning videos (10%), and test instruments (4%). Modules were most prevalent due to their adaptability for self-directed learning, structured integration of cultural content, and capacity to facilitate independent assessment. LKPD were also widely developed, supporting inquiry-based activities grounded in local knowledge. Less common formats such as lesson plans, syllabi, and learning videos serve essential roles in curriculum integration and multimodal delivery, while the scarcity of validated test instruments highlights a significant gap in outcome measurement.

This review contributes to the body of knowledge by offering the first structured evidence map of ethnoscience-based science learning tools in Indonesia. The results underscore the need for further development of culturally responsive assessment frameworks, longitudinal evaluations of tool effectiveness, and curriculum-level integration strategies to ensure sustainability and impact in science education.

**Keywords:**

Science Learning Devices, Ethnoscience, Science Learning, systematic literature review

## INTRODUCTION

Education is a fundamental driver of national development and a core determinant of societal well-being. It serves as the primary mechanism for shaping human resources, fostering social mobility, and enabling individuals to achieve a recognized position in society (Rusni, 2016). Beyond its

instrumental value in workforce preparation, education embodies a transformative process aimed at nurturing intellectual, moral, and civic capacities. In the Indonesian context, national education aspires to cultivate learners who are devout, morally upright, healthy, knowledgeable, capable, creative, independent, and committed to democratic values and civic responsibility. This vision resonates with Ki Hajar Dewantara's perspective that education should guide individuals toward becoming complete human beings who live harmoniously with nature and society (Hamid, 2016). Education thus functions both as a means of personal growth and as a foundation for collective progress.

The urgency of improving education quality in Indonesia has become more pronounced in the era of globalization. Global competitiveness demands a well-educated populace with advanced skills, adaptability, and innovation capacity. The enhancement of human resources remains closely tied to the professional development of educators and educational staff. Such improvement can be realized through targeted training, access to higher education, and participation in professional exchanges such as seminars and workshops (Mukhid, 2007). Strengthening the educational sector directly supports the achievement of the United Nations Sustainable Development Goals (SDGs), particularly in raising the Human Development Index. Education, as an enabling goal, accelerates progress toward multiple other targets within the SDG framework, including poverty reduction, health improvement, and social equity.

Natural Science (IPA) education holds a strategic position within the national curriculum as it fosters scientific literacy, technological awareness, and an understanding of natural phenomena. Science is both a body of validated knowledge and a process of inquiry, each reinforcing the other in a cyclical manner (Fitriyati et al., 2017). Effective science learning should therefore engage students not only in absorbing facts and concepts but also in developing the cognitive skills and dispositions necessary for scientific inquiry. Holbrook and Rannikmae (2009) highlight that ethnoscience-based approaches can nurture a positive attitude toward science by connecting classroom learning with real-world contexts. This connection enhances the relevance of science education and encourages students to see science as a dynamic and practical tool for understanding and improving their environment. The relationship between science, technology, and society must be foregrounded to ensure that learning outcomes translate into applicable competencies (Rosie & Chen, 2011).

Ethnoscience refers to the system of knowledge and cognitive frameworks that are specific to a cultural group (Sudarmin, 2014). It encompasses the concepts, practices, and problem-solving strategies that emerge within a cultural context. Integrating ethnoscience into science education involves linking scientific concepts to the cultural backgrounds of students, thereby making learning more accessible and meaningful (Fahrurrozi, 2018). Sayakti (2003) emphasizes the importance of using local culture and the surrounding environment as instructional resources to foster deeper engagement. Empirical evidence supports this approach. Emdin (2011) found that bridging science and culture can significantly enhance student achievement, while Rahayu et al. (2015) demonstrated that culture-based learning leads to better outcomes due to its contextual relevance.

Despite its potential, the implementation of ethnoscience in formal science education faces several challenges. One key issue is the limited availability of ethnoscience-based learning tools that are systematically developed and validated for school use. Learning tools, which include syllabi, lesson plans, and assessment instruments, serve as essential scaffolds for effective teaching and learning. In the context of integrated science education, particularly at the junior high school level, such tools are still relatively rare and often not commercially accessible. While some resources can be found online, they are frequently the byproducts of individual research projects rather than standardized, widely adopted materials (Listyawati, 2016).

Addressing this gap requires a systematic approach to identifying and categorizing existing ethnoscience-based science learning tools. Conventional solutions have focused on developing isolated resources tailored to specific classroom needs, yet these efforts lack a comprehensive framework that captures the diversity of tools and their pedagogical underpinnings. Without such a framework, the scaling and replication of effective ethnoscience practices remain limited. Furthermore, the absence of a consolidated evidence base impedes educators from making informed choices about which tools to adopt or adapt for their contexts.

Prior studies have proposed integrating ethnoscience into various instructional components to strengthen cultural relevance and learner engagement. For example, the inclusion of local practices and traditional knowledge in lesson plans can contextualize abstract scientific concepts. Ethnoscience-informed assessment tools can evaluate both conceptual understanding and the ability to apply science in culturally grounded contexts. Modules and student worksheets designed with ethnoscience principles

can support independent learning and foster inquiry skills. These examples illustrate that ethnoscience can be embedded across the learning process rather than confined to occasional thematic lessons.

Scholarly literature underscores the value of ethnoscience-based instructional design in bridging the gap between formal science curricula and students' lived experiences. Integrating culture into science teaching aligns with constructivist principles, which posit that learning is most effective when new knowledge is anchored to prior understanding. In practice, however, the development of ethnoscience-based tools has been fragmented, with limited synthesis of existing work. This fragmentation results in missed opportunities to leverage prior successes and refine approaches for broader application. The diversity of cultural contexts in Indonesia further complicates the landscape, making it essential to document and analyze existing resources systematically.

Several studies have explored ethnoscience-based learning tools, yet no comprehensive review has been undertaken to classify and evaluate their types, characteristics, and frequency of use. Without such a review, educators and curriculum developers face uncertainty about the most prevalent and effective formats. This knowledge gap hinders the advancement of ethnoscience in mainstream education and limits the potential for evidence-based policy and practice. Moreover, while individual studies highlight positive outcomes such as increased motivation, improved critical thinking, and enhanced science literacy, the lack of aggregated evidence weakens the case for widespread adoption.

The present study aims to fill this gap by conducting a systematic literature review (SLR) of ethnoscience-based science learning tools in Indonesia. By applying a structured search and selection process, this study identifies, categorizes, and quantifies the types of learning tools developed and reported in the literature. The novelty of this work lies in its provision of a consolidated evidence base that maps the landscape of ethnoscience-based resources, offering practical guidance for educators and researchers. The scope of the review encompasses multiple tool formats including syllabi, lesson plans, modules, worksheets, videos, and assessment instruments. This synthesis not only informs pedagogical practice but also lays the groundwork for future research on the design, implementation, and evaluation of ethnoscience-based science education.

## **METHODS**

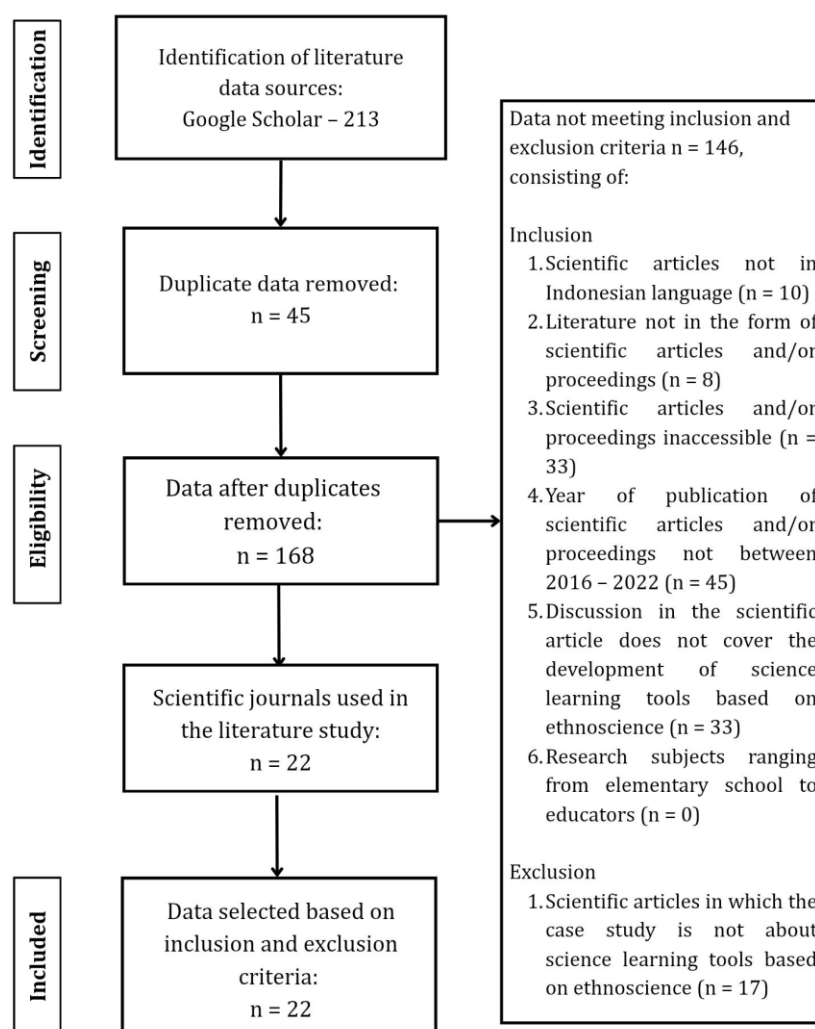
This study adopted a systematic literature review (SLR) approach to identify, analyze, and synthesize research on the development of ethnoscience-based science learning tools in Indonesia. An SLR is a rigorous method for collating existing knowledge by following a structured process that minimizes bias and enhances transparency (Cabrera & Cabrera, 2023). Its primary function is to answer clearly formulated research questions through the identification, selection, and critical appraisal of relevant studies, followed by the extraction and synthesis of data (Azarian et al., 2023). In this research, the SLR design was chosen to systematically document the variety, characteristics, and distribution of ethnoscience-based instructional materials, thereby providing a consolidated evidence base for educators, policymakers, and researchers. The methodology integrates the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure methodological rigor and replicability, as shown in Figure 1.

A comprehensive search strategy was then developed to ensure that the literature search was both exhaustive and precise. The primary database selected for this study was Google Scholar, as it offers broad coverage of Indonesian-language academic outputs, including journal articles, conference proceedings, and other scholarly materials. This choice aligns with previous Indonesian educational reviews that have recognized Google Scholar as a critical source for local-language publications. The search was conducted using a combination of controlled and natural language keywords to maximize retrieval. The final search string consisted of the Boolean query: "Perangkat Pembelajaran IPA" OR "Pembelajaran IPA" OR "Etnosains." These terms were selected to capture literature on science learning tools generally, science education, and specifically ethnoscience-oriented instruction.

The inclusion and exclusion criteria were applied in two phases to ensure relevance and quality. The inclusion criteria specified that eligible studies must be: (1) written in Indonesian; (2) in the form of full-text scientific articles or conference proceedings; (3) accessible in full for review; (4) published between 2016 and 2022; (5) focused on the development of ethnoscience-based science learning tools; and (6) targeted at populations ranging from elementary school students to educators. These criteria ensured the retrieval of studies with direct relevance to the research question and within the defined educational scope. The exclusion criteria were equally precise to remove studies that would not

contribute meaningfully to the synthesis. Studies were excluded if they were: (1) only available as abstracts; (2) case studies unrelated to ethnoscience-based science learning tools; or (3) sourced from non-scholarly platforms such as personal blogs (e.g., Blogspot). Applying these criteria was essential to maintain methodological quality, as recommended by systematic review protocols (Booth et al., 2016).

The selection process adhered to the PRISMA guidelines to enhance transparency. The PRISMA flow diagram (Figure 1) documents each step from initial retrieval to final inclusion. A total of 213 articles were identified through database searching. Following the removal of 45 duplicates, 168 records remained for screening. After applying the inclusion and exclusion criteria, 146 articles were excluded for reasons such as irrelevance to ethnoscience, lack of full text, or absence of a focus on learning tools. This screening resulted in the inclusion of 22 studies in the final synthesis.



**Figure 1. Prisma Flow Diagram**

To refine the scope and guide data extraction, the PICO framework (Population, Intervention, Comparison, Outcomes) was employed. This framework is widely used in evidence synthesis for its capacity to focus reviews on the essential elements of research questions (Higgins et al., 2022). In this study, the Population element was defined as research in the domain of ethnoscience. The Intervention element was the development of ethnoscience-based science learning tools. The Comparison element was deemed not applicable, as the review did not involve direct comparative analysis between different pedagogical approaches. The Outcomes element encompassed the identification of specific learning tool

types such as lesson plans (RPP), student worksheets (LKPD), syllabi, learning videos, and assessment instruments.

The application of the PICO framework ensured consistency in study selection and data extraction. For each included study, key bibliographic and methodological details were recorded, including the author(s), year of publication, study title, type of learning tool developed, and reported educational outcomes. This systematic approach to data organization is recommended to minimize selection bias and facilitate thematic synthesis (Schardt et al., 2007).

Data synthesis was conducted through a narrative and comparative analysis, drawing on the constant comparative method. Studies were first categorized according to the type of learning tool developed. This classification allowed the identification of the most prevalent tool formats and facilitated discussion of possible reasons for their relative frequency. For example, modules and student worksheets emerged as the dominant categories, a finding that aligns with earlier reports suggesting that these formats are particularly adaptable for integrating cultural content into science lessons.

**Table 1. PICO Summary**

Component	Description
Population / Problem	Ethnoscience
Intervention	Development of Ethnoscience-Based Science Learning Tools
Comparison	n/a
Outcomes	Lesson Plan (RPP), Student Worksheet (LKPD), Syllabus, Instruments, Learning Video

The final stage of the SLR process was data extraction and presentation. A summary table was compiled, listing each study along with the author(s), publication year, type of learning tool developed, and reported outcomes. This tabulation facilitated cross-study comparison and highlighted patterns in tool development. For instance, some studies focused exclusively on the design phase of learning tools, while others also incorporated empirical testing with student populations. The presence or absence of outcome evaluation was noted, as it bears directly on the evidence base for the effectiveness of ethnoscience-based tool

## RESULTS AND DISCUSSION

This systematic literature review (SLR) identified and analyzed empirical studies on the development of ethnoscience-based science learning tools in Indonesia, retrieved from the Google Scholar database. The search produced a total of 22 relevant works, including 18 peer-reviewed journal articles and 4 undergraduate theses, all meeting the defined inclusion criteria. The extracted studies spanned the years 2016 to 2022 and represented diverse approaches, content areas, and forms of learning tools. Table 1 summarizes the included studies, their authors, publication years, learning tool types, and thematic foci.

No	Researchers	Title	Learning Tools
1	Fuadah & Faizatun (2021)	Development of Electronic Student Worksheet (E-LKPD) Based on Problem Based Learning (PBL) with Ethnoscience Content on Redox Reaction Material	LKPD
2	Ukhti Maisarah (2021)	Development of Ethnoscience-Based Science Module in Malay Culture on Environmental Pollution Material	Module
3	Daista Gusmarti (2021)	Development of Natural Science Module Based on Ethnoscience on Ecosystem Material to Improve Conservation Awareness of Grade VI Students	Module

4	Annisa (2021)	Development of Animation Video Using Powtoon Application Based on Ethnoscience on Biotechnology Material for Grade IX	Learning Video
5	Luqman Al-Farisi (2017)	Development of Integrated Science Learning Tools with Ethnoscience Approach	Syllabus
6	Pertama (2017)	Development of Learning Tools Using Guided Inquiry Model Assisted by Android (Ethnoscience Android) on Vibration and Wave Motion Material	Lesson Plan (Rpp)
7	Fransisca et al. (2021)	Development of Learning Video Using Kinemaster on Electrolyte and Nonelectrolyte Solution Material Integrated with Ethnoscience for Grade X SMA/MA	Learning Video
8	Wahda et al. (2018)	Validity of Student Worksheet Based on Ethnoscience for Grade IX to Improve Critical Thinking Skills	Test Instrument
9	Ria Febu Khoerunnisa & Nurbangun (2019)	Development of Integrated Science Module Based on Ethnoscience to Foster Entrepreneurship Interest	Module
10	Mardhianti et al. (2020)	Development of Science Learning Module Based on Ethnoscience on Environmental Pollution Material to Train Science Literacy Skills for Grade VII Junior High School Students	Module
11	Ariningtyas et al. (2017)	Effectiveness of Student Worksheet with Ethnoscience Content on Hydrolysis of Salts Material to Improve Science Literacy Skills of High School Students	LKPD
12	Nalayah et al. (2016)	Development of Thematic Science Module Based on Ethnoscience in Jember District on Tobacco Cultivation Theme for Junior High School	Module
13	Misbah (2020)	Development of Physics Module Integrated with Local Wisdom to Train the Character of Being Willing to Share with the Community	Module
14	Junita & Yuliani (2022)	Development of Ethnoscience-Based E-LKPD to Train Science Literacy Skills on Membrane Transport Material	LKPD
15	Safrina & Suryanti (2021)	Development of Science Learning Tools Based on Ethnoscience on Energy Material	Lesson Plan
16	Astari & Sumarni (2020)	Development of Student Worksheet with Ethnoscience Content to Improve Critical Thinking Skills	LKPD
17	Astuti & Linuwih (2019)	Science Teaching Materials Based on Ethnoscience on Global Warming Theme for Grade VII Junior High School Students	Module
18	Pertiwi et al. (2021)	Development of Student Worksheet (LKPD) Based on Ethnoscience on Electrolyte and Nonelectrolyte Solution Concept	LKPD
19	Sarini & Selamat (2019)	Development of Science Teaching Materials Based on Balinese Local Wisdom for Prospective Science Teachers	Module
20	Andriana et al. (2017)	Development of Student Worksheet (LKS) Based on Local Wisdom in Science Subjects	LKPD

21	Tomi (2021)	Development of Biology Learning Tools Based on Local Wisdom on Reproductive System Material for High School Students	Module
22	Nureflia et al. (2018)	Development of Student Activity Sheet Based on Ethnoscience with Character on Plant Taxonomy Material for High School Students	LKPD

The distribution of learning tool types revealed six distinct categories: lesson plans (RPP) representing 10%, student worksheets (LKPD) representing 30%, modules representing 36%, syllabi representing 10%, learning videos representing 10%, and test instruments representing 4%. This distribution is notable as it suggests that among ethnoscience-based science learning tools, modules and worksheets dominate the research and development landscape.

The predominance of modules at 36% reflects their pedagogical versatility and alignment with science education goals. Modules are self-contained instructional packages that facilitate independent learning, allow for the integration of cultural context into scientific content, and provide structured opportunities for self-assessment. Sihotang et al., (2025) emphasized that modules support learner autonomy by enabling students to proceed at their own pace and select learning strategies suited to their needs. This aligns with Rahmawati et.al., (2019) characterization of modules as systematically organized materials containing objectives, content, methods, and self-evaluation tools designed around competency standards. In the reviewed studies, modules were used to contextualize topics such as environmental pollution (Maisarah, 2021; Mardhianti et al., 2020) and ecosystem conservation (Nurhayati, et.al., 2025).

Student worksheets (LKPD) constituted the second largest category at 30%, underscoring their importance as flexible, activity-based learning tools. LKPD formats lend themselves well to ethnoscience because they can be tailored to specific cultural contexts and designed to scaffold inquiry-based learning. The reviewed LKPD studies (e.g., Latifah, 2023; Safitri, 2024) demonstrated that integrating local knowledge with guided problem-solving activities can enhance students' critical thinking and science literacy, echoing findings by Ilhami,2022 on the benefits of culturally responsive pedagogy. Notably, LKPDs based on ethnoscience content often involve hands-on experiments or observational tasks linked to local practices, which reinforces the link between classroom learning and real-world phenomena.

Lesson plans (RPP), syllabi, and learning videos each accounted for 10% of the identified tools. While less prevalent, these formats are crucial in embedding ethnoscience within the broader curricular structure and diversifying instructional delivery. Lesson plans reviewed in the studies by wardani (2022) adapted existing models such as guided inquiry and contextual teaching to incorporate local cultural content, thereby fostering relevance and engagement. Syllabi outlined course-level integrations of ethnoscience, ensuring sustained exposure across multiple units. Learning videos, such as those developed) utilized multimedia platforms like Powtoon and Kinemaster to deliver culturally contextualized content, leveraging the motivational benefits of audiovisual learning.

Test instruments were the least represented category, with only one identified example. This scarcity points to a critical gap in ethnoscience-based educational research. Valid and reliable assessment tools are essential to evaluating the effectiveness of culturally integrated science instruction. Without such tools, claims about the impact of ethnoscience approaches remain largely inferential. Developing standardized assessments that measure not only cognitive outcomes but also attitudinal and socio-cultural competencies would strengthen the evidence base (Tomova, 2021).

Beyond quantitative distribution, thematic patterns emerged across the reviewed studies. A significant proportion of modules and LKPDs targeted environmental science topics, likely due to their inherent connections with local ecological knowledge and practices. This thematic alignment resonates that science education should foreground the interplay between science, technology, and society. The studies also varied in their methodological rigor. While many reported validity testing of developed tools, fewer provided longitudinal evidence of their impact on learning outcomes. This reflects a broader trend in educational technology research, where development-focused studies often prioritize design over sustained evaluation. Embedding robust evaluation phases, including pre- and post-intervention measurements, would align future work with the iterative refinement principles advocated in design-based research (DBR) methodologies.

Overall, the findings highlight both strengths and gaps in the current state of ethnoscience-based science learning tools in Indonesia. The concentration of research on modules and LKPDs indicates a strong foundation in activity-based and self-directed learning resources. However, the underrepresentation of assessment tools and systemic curricular elements suggests opportunities for expanding the scope of future work. Moreover, while many studies reported positive learner outcomes, more rigorous and diverse forms of evidence are needed to substantiate these claims and guide best practices.

## CONCLUSION

This systematic literature review identified six categories of ethnoscience-based science learning tools developed in Indonesia between 2016 and 2022: modules, student worksheets (LKPD), lesson plans (RPP), syllabi, learning videos, and test instruments. Among these, modules emerged as the most widely developed format, accounting for 36% of the reviewed studies, followed by LKPD at 30%. The remaining categories—RPP, syllabi, and learning videos—each represented 10%, while test instruments were least represented at 4%. The predominance of modules and LKPD underscores their adaptability for integrating cultural context into science learning and their alignment with inquiry-based, student-centered pedagogies. These findings carry important implications for science education. The concentration on modules and LKPD suggests a strong foundation in activity-based and self-directed learning resources that can bridge formal scientific concepts with local cultural knowledge. However, the scarcity of validated assessment tools signals a critical gap, as robust evaluation instruments are essential for measuring cognitive, attitudinal, and socio-cultural learning outcomes in ethnoscience-based instruction. Furthermore, the relatively limited attention to curricular-level integration, such as in syllabi and RPP, indicates that ethnoscience remains primarily implemented at the classroom level rather than systematically embedded across curricula. This review contributes to the existing body of knowledge by providing a structured evidence map of ethnoscience-based learning tools, clarifying their distribution, and highlighting areas for further innovation. Future research should focus on developing culturally responsive assessment frameworks, conducting longitudinal evaluations of tool effectiveness, and exploring strategies for institutionalizing ethnoscience within national curriculum standards to ensure sustained educational impact.

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