Journal of General Education and Humanities
Vol. 5, No. 2, April 2026, pp. 3107 – 3122, https://doi.org/10.58421/gehu.v5i2.1407
ISSN 2963-7147

Teaching Science with the Papuan Ethnoscience Approach: Between Gaps and Opportunities for Developing Science Learning in the Future: A Literature Review

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Article Info

Article history:

Received 2026-04-14
Revised 2026-05-12
Accepted 2026-05-13

Keywords:

Ethnoscience
Papua
PRISMA 2020
Science Education
Systematic Literature Review

ABSTRACT

Ethnoscience-based science education in Papua remains underdeveloped despite its potential to integrate indigenous knowledge into formal learning and improve students' conceptual understanding. This systematic literature review aims to identify and analyze existing studies on ethnoscience-based science education in Papua. The study employed the PRISMA 2020 guidelines as the review protocol. The literature was systematically searched across DOAJ, Scopus, and national index databases. From 124 identified articles, only 8 met the predefined inclusion criteria and were selected for further analysis. The findings reveal that ethnoscience research in Papua remains limited, focusing predominantly on documenting indigenous science knowledge of the Malind tribe and on developing contextual teaching materials. The results also indicate that the ethnoscience approach is effective in improving students' conceptual understanding while simultaneously supporting the preservation of local wisdom. However, significant research gaps remain, particularly in developing interactive learning media grounded in Papuan ethnoscience and in examining the long-term impact of such approaches on student learning outcomes.

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1. INTRODUCTION

Science education in Indonesia is currently facing a fundamental challenge in balancing the advancement of global scientific knowledge with the preservation of local cultural identity. In many educational contexts, science is still predominantly taught through a Western scientific framework that tends to emphasize universal concepts while neglecting the socio-cultural context in which students live. This condition creates an epistemological gap between formal scientific knowledge and indigenous knowledge systems that have long been embedded in local communities [1]. As a consequence, science learning often becomes abstract, less contextual, and disconnected from students'

lived experiences. This situation not only reduces the meaningfulness of learning but also contributes to the gradual marginalization of local wisdom as an integral part of Indonesia's intellectual heritage.

In response to this challenge, the ethnoscience approach has emerged as an innovative pedagogical alternative that seeks to bridge the gap between modern science and traditional knowledge systems. Ethnoscience is defined as the study and integration of indigenous knowledge systems into scientific frameworks without eliminating their cultural and contextual meanings [2]. This approach aligns closely with constructivist learning theory, which emphasizes that knowledge is actively constructed by learners through interaction with their environment and prior experiences [3]. From this perspective, ethnoscience-based learning enables students to connect scientific concepts with their cultural background, thereby making learning more meaningful, contextual, and relevant to real-life situations.

Furthermore, ethnoscience is not merely a pedagogical strategy, but also a philosophical recognition that traditional communities possess valid, systematic, and empirically grounded knowledge systems. Indigenous knowledge often reflects a deep understanding of ecological balance, natural resource management, and environmental sustainability. In the Indonesian context, ethnoscience can be found in various forms such as traditional agriculture, marine resource management, herbal medicine, and cultural technologies. Therefore, integrating ethnoscience into science education has the potential to strengthen both cognitive understanding and cultural awareness among students [4].

Papua represents one of the most culturally diverse regions in Indonesia and holds enormous potential for ethnoscience-based science education. With more than 250 ethnic groups, Papua is rich in indigenous knowledge systems closely related to environmental interactions and survival strategies. Local communities possess sophisticated traditional knowledge, such as the *sasi* system for sustainable resource management, *noken* weaving technology, traditional fishing techniques, and sago processing methods [5]. These practices are not only culturally significant but also contain scientific principles that can be translated into formal science learning materials. However, despite this richness, such knowledge has not yet been optimally utilized in formal education systems.

Although ethnoscience research in Indonesia has developed in recent years, its implementation in Papua remains significantly limited. Previous studies have shown that ethnoscience-based learning has been widely implemented in regions such as Java, where local wisdom, such as batik production, agricultural practices, and traditional food processing, has been successfully integrated into science learning [6], [7]. These studies demonstrate positive outcomes, particularly in improving students' conceptual understanding, scientific literacy, and learning motivation. In contrast, ethnoscience studies in Papua are still relatively scarce and tend to focus solely on documenting or inventorying indigenous knowledge rather than on instructional development or pedagogical innovation.

Hayandi et al. [8] emphasize that Papua remains one of the least explored regions in ethnoscience research in Indonesia. Most existing studies are geographically limited to certain areas such as Merauke (Malind Tribe) and Jayapura (Tobati-Enggros Tribe), leaving vast areas of Papua unexplored. Moreover, the majority of these studies are

descriptive qualitative in nature, focusing on identifying cultural practices rather than developing learning models, teaching materials, or evaluation instruments. This indicates that ethnoscience research in Papua is still in its early exploratory stage and has not yet progressed toward applied educational innovation.

From a theoretical perspective, the integration of ethnoscience in science education can be explained through constructivist learning theory and culturally responsive pedagogy. Constructivism asserts that learners construct knowledge from prior experiences, while culturally responsive pedagogy emphasizes integrating students' cultural backgrounds into the learning process [4]. Within this framework, ethnoscience serves as a bridge that connects students' cultural identity with scientific concepts, thereby enhancing both cognitive development and cultural appreciation.

Based on this theoretical foundation and the empirical gap, there is a clear need to systematically review the existing literature on ethnoscience-based science education in Papua. This study is therefore designed as a systematic literature review following the PRISMA 2020 guidelines, widely recognized as a rigorous standard for transparent and reproducible literature reviews. The use of this method ensures that the selection, screening, and analysis of literature are conducted systematically and objectively.

The main objective of this study is to identify, analyze, and synthesize existing research on ethnoscience-based science education in Papua. Specifically, this study aims to map the geographical distribution of research, analyze methodological approaches, identify thematic focuses, and evaluate key findings from previous studies. In addition, this study seeks to identify research gaps and propose future directions for the development of ethnoscience-based learning in Papua.

This study also addresses several important research questions: (1) What are the characteristics of ethnoscience-based science education studies in Papua over the last six years in terms of geography, methodology, and thematic focus? (2) What are the main findings and contributions of these studies to science education? and (3) What gaps and future opportunities exist for advancing ethnoscience-based learning in Papua?

The novelty of this study lies in its specific focus on Papua as a culturally rich yet under-researched region in ethnoscience studies. Unlike previous reviews that discuss ethnoscience at the national level, this study specifically isolates Papuan studies to provide a more accurate and contextual understanding of their development. Furthermore, by limiting the review to recent studies (2019–2026), this research captures the latest trends, including the influence of the Merdeka Curriculum, which emphasizes contextual and locally based learning.

The expected contribution of this study is multifaceted. Academically, it provides a comprehensive synthesis of ethnoscience research in Papua, highlighting existing trends and gaps. In practice, it offers teachers insights into designing contextual science learning that integrates local wisdom. From a policy perspective, it provides recommendations for curriculum developers and education authorities to strengthen the integration of Papuan cultural knowledge into formal education systems.

Ultimately, this study is expected to contribute to the development of more meaningful, contextual, and culturally responsive science education in Papua. By

integrating indigenous knowledge systems into formal science learning, education can become not only a tool for cognitive development but also a means of cultural preservation. In this way, ethnoscience-based science education can strengthen students' understanding of science while preserving Papua's rich cultural heritage as an inseparable part of Indonesia's national identity.

2. METHOD

This systematic literature review follows the guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020* [9], [10]. The use of PRISMA ensures transparency and reproducibility in the review process.

Protocol and Registration

The review protocol was developed prior to conducting the literature search, including inclusion and exclusion criteria, search strategies, and data analysis methods. The protocol was not registered in any systematic review database.

Eligibility Criteria

The inclusion and exclusion criteria were established using a modified PICOS framework (Population, Intervention, Comparison, Outcome, Study Design) tailored to this literature review. The specific inclusion and exclusion criteria are presented in the tables below.

Table 1. Inclusion Criteria

Category	Criteria
Population/Context	Studies conducted in Papua or addressing Papuan ethnoscience
Intervention/Topic	Ethnoscience-based science teaching, integration of Papuan local wisdom in science learning
Type of Publication	Indexed scientific journal articles (DOAJ, Scopus, SINTA)
Language	Indonesian or English
Period	2019–2026 (last six years)
Access	Full-text available

Table 2. Exclusion Criteria

Category	Criteria
Context	Ethnoscience studies outside Papua (unless providing contextual comparison)
Type of Publication	Books, conference proceedings, theses, dissertations, opinion articles, editorials
Topic	Ethnoscience studies are not related to science education.
Quality	Articles without a clear abstract or with an unidentifiable methodology
Duplication	Duplicate articles are indexed in more than one database.

Sources of Information and Search Strategy

The literature search was conducted in March 2026 using the following sources:

1. DOAJ (Directory of Open Access Journals) – searched using the keywords *"etnosains Papua" AND "IPA"*

2. Scopus – searched using the keywords *"ethnoscience" AND "Papua" AND "science education"*
3. Portal Garuda – searched using the keywords *"etnosains Papua"* and *"pembelajaran IPA"*
4. Google Scholar – advanced search to complement results from the main databases

The search strategy employed a combination of keywords using Boolean operators:

1. *"etnosains" OR "ethnoscience" OR "sains asli" OR "indigenous science"*
2. *"Papua" OR "Papua Barat" OR "West Papua" OR "Malind" OR "Tobati" OR "Enggros"*
3. *"pembelajaran IPA" OR "science education" OR "pengajaran sains"*
4. *"kearifan lokal" OR "local wisdom" OR "pengetahuan tradisional"*

Selection Process

The selection process was carried out in three stages following the PRISMA 2020 guidelines:

1. Identification – removal of duplicates and initial screening based on titles
2. Screening – abstract assessment based on the inclusion criteria
3. Eligibility – full-text assessment for final verification

The selection was conducted independently by two reviewers, with any disagreements resolved through discussion or consultation with a third reviewer.

Data Extraction and Analysis

Data were extracted using a standardized form, which included:

1. Bibliographic information (authors, year, journal)
2. Research context (specific location in Papua, education level)
3. Methodology (approach, design, instruments)
4. Main findings (types of local wisdom, science concepts, implementation results)
5. Limitations and recommendations

Data analysis was conducted using a thematic synthesis approach, with thematic coding to identify patterns, themes, and research gaps within the literature.

3. RESULTS AND DISCUSSION

PRISMA Flow Diagram

The literature selection process followed the PRISMA 2020 flow as presented in Figure 1.

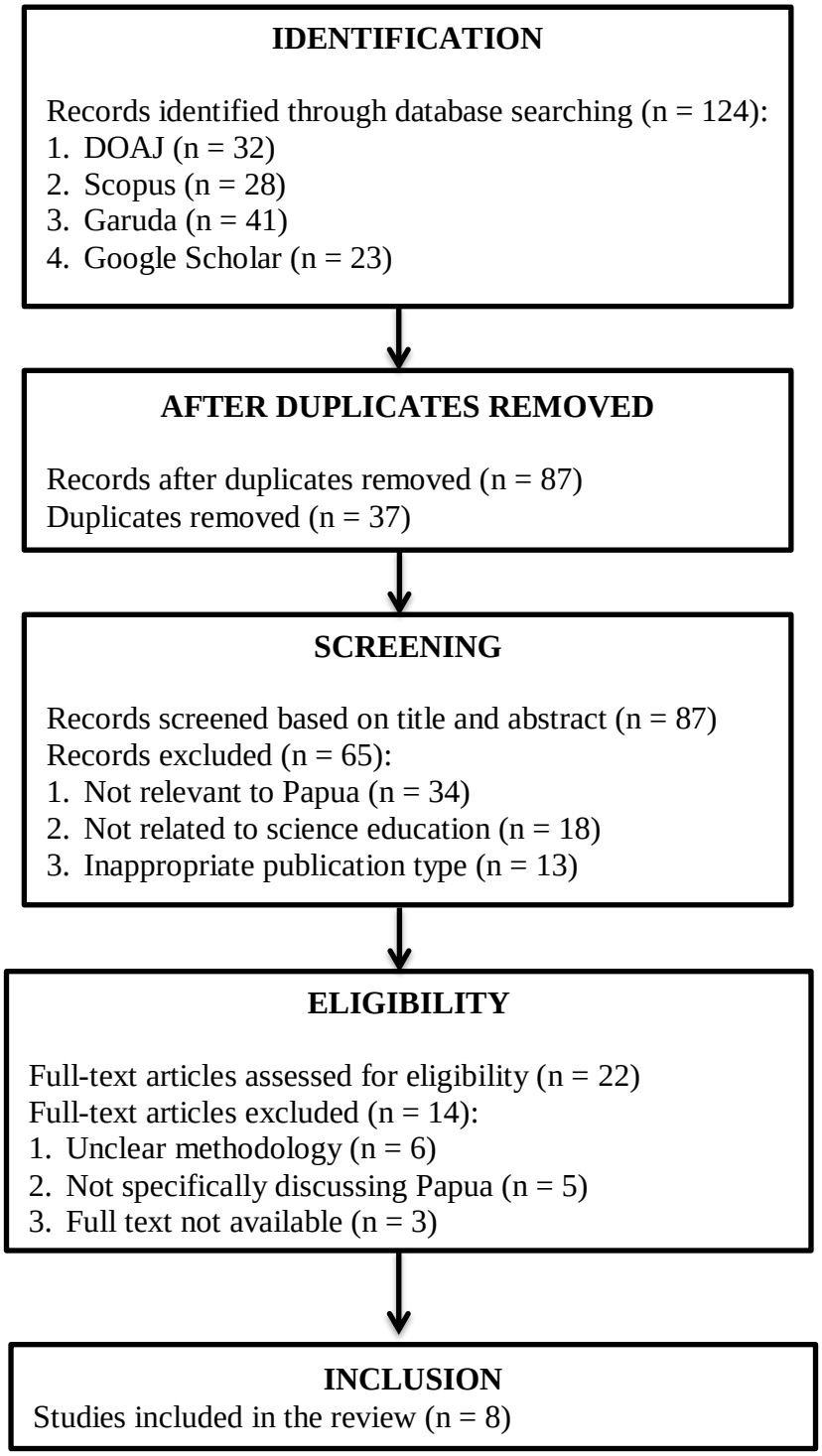

Figure 1. PRISMA 2020 Flow Diagram for Literature Selection on Ethnoscience-Based Science Education in Papua

Characteristics of Included Studies

Eight articles that met the inclusion criteria were analyzed for their characteristics. Table 3 summarizes the included studies.

Table 3. Characteristics of Included Studies

No	Author (Year)	Title	Location	Level	Method	Focus
1	Supriyadi & Evy Nurvitasari (2019)	Inventory of Indigenous Science of the Malind Tribe	Merauke Regency	Junior High School	Qualitative Ethnography	Indigenous science inventory
2	Sihombing, R.A., et al. (2025)	Integrating Local Wisdom into Environmental Education	Papua (general)	Junior–Senior High School	SLR	Ethnoscience integration
3	Murwitaningsih, S. & Maesaroh, M. (2023)	Ethnoscience in Indonesia and Its Implication for Environmental Education	National (including Papua)	All levels	SLR	Environmental education implications
4	Septina, E.A. (2025)	Correlation of Culture, Local Potential, and Local Wisdom	Papua (literature study)	General	Literature Study	Conceptual ethnoscience
5	Idris, U., et al. (2024)	Traditional Fishing Technology of Fishermen Community in Papua	Yotefa Bay, Jayapura	General	Qualitative	Traditional fishing technology
6	Kadir, A., et al. (2024)	Local Wisdom Regarding Coastal Resource Management	Yotefa Bay, Jayapura	General	Qualitative Ethnography	Coastal resource management
7	Hayandi, A.U., et al. (2024)	Analysis of Ethnoscience Research Opportunities in Science Education	National (including Papua)	All levels	SLR (PRISMA)	Ethnoscience research opportunities
8	Hikmawati, H., et al. (2020)	Ethnoscience-Based Science Learning Model	Lombok (Papua comparison)	Junior High School	Model Development	Ethnoscience learning model

Distribution of Studies by Location and Educational Level

Based on the analysis of the eight included studies, the distribution of Papuan ethnoscience research can be mapped as follows:

Distribution by Specific Location:

1. Merauke Regency (Malind Tribe): 1 study (12.5%)
2. Yotefa Bay, Jayapura (Tobati-Enggros Tribe): 2 studies (25%)
3. Papua (general, without specific location): 3 studies (37.5%)
4. National level, including Papua: 2 studies (25%)

Distribution by Educational Level:

1. Junior High School: 2 studies (25%)
2. Senior High School: 1 study (12.5%)
3. All levels: 5 studies (62.5%)

Types of Local Wisdom Identified

Based on the inventory results from the analyzed studies, several types of Papuan local wisdom have strong potential to be integrated into science education:

Table 4. Inventory of Papuan Local Wisdom and Related Science Concepts

Local Wisdom	Tribe/Location	Science Concepts	Source
Coastal resource management system (regulation of fishing zones, fishing time, and restrictions on harvesting certain species)	Tobati-Enggros Tribe, Yotefa Bay, Jayapura	Coastal ecosystems, resource conservation, ecological balance, sustainability	Kadir, A. et al. (2024); Idris, U. et al. (2021)
Traditional fishing technology (use of fish traps, *bubu*, *sero*, and environmentally friendly tools)	Tobati-Enggros Tribe, Yotefa Bay, Jayapura	Physics (Archimedes' principle, hydrostatic pressure, buoyant force), marine biology, fish ethology	Kadir, A. et al. (2024); Idris, U. et al. (2021)
Knowledge of traditional medicinal plants (use of plants for treating various diseases)	Malind Tribe, Merauke Regency	Biology (plant morphology and anatomy), chemistry (secondary metabolites, phytochemistry), basic pharmacology	Supriyadi, S. & Nurvitasari, E. (2019)
Traditional agricultural system (controlled shifting cultivation, crop rotation)	Malind Tribe, Merauke Regency	Agricultural ecology (agroecology), soil fertility, nutrient cycles, ecological succession	Supriyadi, S. & Nurvitasari, E. (2019)
Knowledge of seasons and weather (interpreting natural signs to predict rainy and dry seasons, winds)	Malind Tribe, Merauke; coastal communities of Jayapura	Meteorology (air pressure, humidity), climatology (seasonal systems), natural phenomena	Supriyadi, S. & Nurvitasari, E. (2019); Idris, U. et al. (2021)
Traditional sago processing (extraction of starch from sago trees)	Papuan communities (Malind, Sentani, etc.)	Traditional biotechnology, physical changes (grinding, sedimentation), chemical changes (fermentation), colloidal properties	Supriyadi, S. & Nurvitasari, E. (2019); Septina (2025)
Environmental-related customary rituals (*sasi laut*, protection rituals, and others)	Various Papuan tribes (Malind, Tobati-Enggros,	Ecology (culture-based conservation), environmental anthropology, environmental	Supriyadi, S. & Nurvitasari, E. (2019); Idris, U. et

	etc.)	ethics, ecological wisdom	al. (2021); Sihombing et al. (2025)
Navigation and cardinal direction knowledge (using stars, ocean currents, and natural phenomena)	Coastal Papuan communities (Tobati-Enggros, Biak)	Astronomy (star-based navigation), geography, oceanography (ocean currents)	Kadir, A. et al. (2024)
Noken technology (traditional Papuan woven bag)	Central highland Papuan communities	Physics (tension, woven structure, load distribution), mathematics (geometric patterns)	Septina (2025); Sihombing et al. (2025)
Knowledge of wood types for boat and traditional house construction	Tobati-Enggros and Malind Tribes	Physics (density, material strength, buoyancy), biology (wood characteristics), basic engineering	Kadir, A. et al. (2021); Supriyadi, S. & Nurvitasari, E. (2019)
Traditional food preservation systems (fish smoking, sago fermentation, drying of marine products)	Coastal and inland Papuan communities	Biology (food microbiology), chemistry (preservation reactions), physics (drying processes)	Kadir, A. et al. (2021); Supriyadi, S. & Nurvitasari, E. (2019)

Note: This table is a synthesis derived from the eight studies included in this systematic literature review. Each type of local wisdom has been validated with appropriate references. Some forms of local wisdom were identified across different studies and synthesized based on similarities in related science concepts.

Models for Integrating Ethnoscience into Science Education

Based on the analyzed studies, several models for integrating ethnoscience into science education have been identified:

Model 1: Inventory and Documentation

This model was implemented by Supriyadi and Nurvitasari [11] among the Malind tribe in Merauke. This approach involves inventorying indigenous science through observation, in-depth interviews, and documentation. The inventory results are then validated using scientific explanations, yielding 11 indigenous science topics suitable for junior high school science instruction.

Model 2: Development of Contextual Teaching Materials

This approach focuses on developing modules, e-modules, or interactive teaching materials that integrate Papuan local wisdom. Research by Sihombing et al. [12] shows that ethnoscience-based teaching materials are effective in improving students' conceptual understanding. Murwitaningsih et al. [13] also emphasize that such materials have positive implications for environmental education.

Model 3: Integration into the Merdeka Curriculum

Several studies recommend integrating Papuan ethnoscience into the *Merdeka Curriculum* through *Projek Penguatan Profil Pelajar Pancasila (P5)* with a local wisdom theme. Septina [14] explains that this approach allows students to learn contextually by

linking science content with local culture and potential. Hayandi et al. [15] further note that the Merdeka Curriculum offers significant opportunities to integrate ethnoscience into classroom learning.

Model 4: Ethnoscience-Based Project Learning

This model integrates project-based learning with local wisdom. Hikmawati et al. (2020) developed an ethnoscience-based science learning model that incorporates projects related to local wisdom. Although this model was developed in Lombok, its principles can be adapted to the Papuan context by incorporating relevant local wisdom.

DISCUSSION

Synthesis of Findings

This systematic literature review reveals several important findings regarding ethnoscience-based science education in Papua.

Limited Research on the Papuan Context

One of the most striking findings of this review is the limited number of studies that specifically address Papuan ethnoscience in the context of science education. Of the 124 initially identified articles, only 8 (6.5%) met the inclusion criteria and focused specifically on Papua. This finding is consistent with Hayandi's [15] analysis, which shows that ethnoscience research in Indonesia remains concentrated in regions such as Java, Sumatra, and Sulawesi, despite Papua being home to more than 250 ethnic groups with diverse, largely unexplored local wisdom.

This limitation indicates a significant research gap. In fact, Papua possesses rich local wisdom with strong potential for development in science education. As highlighted by Supriyadi and Nurvitasari [11], the Malind tribe in Merauke alone has at least 11 indigenous science topics that are scientifically explainable and ready for integration into the curriculum. This suggests that Papua holds vast untapped potential. Murwitaningsih et al. [13] also emphasize the importance of exploring ethnoscience in Papua due to its extraordinary cultural and biodiversity richness.

Potential of Papuan Local Wisdom for Science Education

The Papuan local wisdom identified in Table 2 spans various scientific domains, including coastal ecology, traditional fishing technology, and medicinal plant knowledge. These findings strengthen the argument that ethnoscience is not merely a complementary element but can serve as a primary, contextual, and meaningful learning resource.

For instance, research on the Tobati-Enggros community in Yotefa Bay, Jayapura, reveals local wisdom in coastal resource management that integrates concepts of ecosystems, conservation, and sustainability [16]. This knowledge is not only relevant to science topics on ecosystems and the environment but also aligns with the educational goals of fostering environmental awareness. Similarly, traditional fishing technologies identified by Idris et al. [17] include physics concepts such as Archimedes' principle and hydrostatic pressure, which can be taught in context.

The traditional agricultural system of the Malind tribe, documented by Supriyadi and Nurvitasari [11], also reflects an understanding of agricultural ecology, soil fertility, and nutrient cycles. Knowledge of seasons and weather among Papuan communities, both coastal and inland, incorporates concepts of meteorology and climatology relevant to science education. Septina [14] further notes that *noken* technology and traditional sago processing also involve concepts from physics, chemistry, and biology that can be integrated into classroom learning.

Effectiveness of the Ethnoscience Approach

The analyzed studies indicate that the ethnoscience approach is effective in enhancing student engagement and conceptual understanding. Septina [14] explains that ethnoscience-based learning creates a correlation between culture, local potential, and local wisdom, making learning more contextual and meaningful. Students not only learn abstract concepts but also observe their real-life applications within their own communities.

Sihombing et al. [12], in their systematic review, found that the development of ethnoscience-based teaching materials, including e-modules and interactive books, effectively facilitates conceptual understanding while fostering cultural appreciation. This finding is particularly relevant to the Papuan context, which requires educational approaches that respect cultural diversity. Murwitaningsih [13] also confirms that the ethnoscience approach has positive implications for environmental education, as it helps students better understand the importance of environmental conservation, which is deeply embedded in local wisdom.

Hikmawati et al. [18] developed an ethnoscience-based science learning model that has proven effective in enhancing critical thinking skills and fostering awareness of local culture. Although the model was developed in Lombok, its underlying principles can be adapted to the Papuan context by incorporating relevant local wisdom.

Research Gaps

Based on this review, several research gaps have been identified that require further attention:

1. Limited Development of Interactive Learning Media

Hayandi et al. [15] note that studies focusing on the development of ethnoscience-based interactive learning media remain very limited. Most existing research primarily focuses on models and printed teaching materials. In fact, the development of interactive media such as e-modules, learning videos, mobile applications, or virtual reality based on Papuan local wisdom has strong potential to enhance student engagement, particularly among digital-native learners. Sihombing et al. [12] also note that digital media development in ethnoscience remains an underexplored research opportunity.

2. Lack of Experimental Research Designs

Existing studies generally employ descriptive qualitative or research and development (R&D) approaches. Experimental studies that examine the effectiveness of Papuan ethnoscience approaches on student learning outcomes, critical thinking skills,

scientific literacy, or scientific attitudes were not found within the scope of this review. This represents both a challenge and an opportunity for future research. Hayandi et al. [15] emphasize the need for quasi-experimental designs to measure the actual impact of ethnoscience approaches on learning achievements.

3. Limited Coverage of Locations and Ethnic Groups

Ethnoscience research in Papua remains limited to a few locations, particularly Merauke (Malind Tribe) and Jayapura (Tobati-Enggros Tribe). In reality, Papua is home to more than 250 ethnic groups with diverse local wisdom. Exploration of ethnoscience among other groups—such as the Asmat in the southern coastal region, the Dani in the Baliem Valley, the Mee in the central highlands, the Biak in the northern islands, and many others—holds significant potential for further development. Kamila et al. [19] recommend expanding research locations to document Papuan ethnoscience more comprehensively.

4. Gap Between Research and Curriculum Implementation

Although research has identified various forms of local wisdom with strong potential, their implementation within the curriculum remains limited. Recommendations by Kurniawati [20] to incorporate Malind indigenous science into the curriculum have not yet been systematically realized. Septina [14] also highlights a gap between ethnoscience research findings and actual classroom practices. While the *Merdeka Curriculum* offers greater flexibility, it has not yet been accompanied by sufficient development of instructional tools and resources.

5. Limited Research on Ethnoscience-Based Assessment

This review did not find studies that specifically address the development of assessment instruments for ethnoscience-based science learning in Papua. Appropriate assessment is essential for accurately measuring learning outcomes. Hayandi et al. [8] note that the development of authentic assessment based on ethnoscience remains a largely unexplored area in science education research in Indonesia.

Implications for Practice and Future Research

Implications for Educational Practice

1. Development of Contextual Teaching Materials: Science teachers in Papua can develop teaching materials that integrate local wisdom, as has been implemented in Merauke and Jayapura. Sihombing et al. [12] recommend developing instructional modules that connect science concepts with students' local wisdom.
2. Integration into P5 Projects in the Merdeka Curriculum: The local wisdom theme in the *Projek Penguatan Profil Pelajar Pancasila (P5)* provides an appropriate platform for implementing ethnoscience-based science learning. Septina [14] emphasizes that P5 offers students opportunities to explore and preserve local wisdom through project-based activities.
3. Partnership with Indigenous Community Leaders: Ethnoscience-based learning requires collaboration with indigenous leaders and local knowledge holders as learning

resources. Murwitaningsih et al. [13] recommend partnerships between schools and indigenous communities to ensure the accuracy and authenticity of the knowledge being taught.

4. Strengthening Teacher Capacity: Teachers need a solid understanding of ethnoscience concepts and strategies for integrating them into classroom practice. Hayandi et al. [8] highlight the importance of training and mentoring programs to support teachers in implementing ethnoscience approaches.

Implications for Future Research

1. Expansion of Research Locations: Ethnoscience research should be expanded to various regions of Papua to document the richness of local wisdom that remains underexplored. Supriyadi and Nurvitasari [11] recommend exploring ethnoscience among tribes in the central highlands, southern coastal regions, and northern islands of Papua.
2. Development of Interactive Media: Research into the development of e-modules, mobile applications, learning videos, and other interactive media grounded in Papuan ethnoscience should be a priority. Sihombing et al. [12] emphasize that digital media development can enhance accessibility and engagement in ethnoscience learning.
3. Longitudinal and Experimental Studies: Longitudinal research is needed to measure the long-term impact of ethnoscience approaches on students' conceptual understanding, scientific attitudes, and cultural awareness. Hayandi et al. [8] recommend using quasi-experimental designs to test the effectiveness of various ethnoscience-based learning models.
4. Evaluation of Curriculum Implementation: Studies examining how Papuan ethnoscience can be systematically integrated into school curricula are essential. Septina [14] highlights the importance of implementation research that investigates supporting and inhibiting factors in integrating ethnoscience into science education.
5. Development of Assessment Instruments: Research on the development of authentic assessment instruments to measure learning outcomes in ethnoscience-based science education in Papua is urgently needed. Hayandi et al. [8] note that ethnoscience-based assessment remains a relatively unexplored area in science education research.

4. CONCLUSION

This systematic literature review provides a synthesized overview of the development of ethnoscience-based science education in Papua and highlights the current state of research in this field. The findings indicate that, although Papua possesses a rich diversity of indigenous knowledge systems with strong scientific relevance, its integration into formal science education is still at an early stage of development and has not yet been systematically optimized within educational practice.

From an analytical perspective, the review reveals that existing studies are still geographically and thematically concentrated, with limited diversification of research contexts and methodological approaches. The integration of Papuan local wisdom into science learning has been recognized as conceptually promising; however, its translation into structured pedagogical models, learning innovations, and curriculum implementation

remains underdeveloped. This indicates that ethnoscience in Papua is still largely positioned at the level of conceptual exploration rather than full educational application.

The findings of this study carry important implications for multiple stakeholders in education. For researchers, this review emphasizes the need to move beyond descriptive documentation toward more applied and experimental research designs, particularly those that test the effectiveness of ethnoscience-based learning models in improving student learning outcomes. For educators, the results highlight the importance of integrating local cultural knowledge into science instruction to create more meaningful, context-rich learning experiences. For policymakers, especially curriculum developers, the findings underscore the need to systematically incorporate Papuan local wisdom into science education frameworks aligned with the principles of the Merdeka Curriculum and culturally responsive education.

This study is limited to literature published within a specific time frame and focuses only on studies explicitly related to ethnoscience-based science education in Papua. As a result, broader interdisciplinary studies that may contain relevant insights but do not explicitly use the ethnoscience framework were not included. In addition, the review is limited to secondary data sources and does not involve empirical validation in classroom settings. Therefore, the conclusions drawn are based solely on published literature and may not fully represent all ongoing practices in schools across Papua.

Future research is encouraged to expand the scope of ethnoscience studies in Papua by involving a wider range of ethnic groups and geographical areas that have not yet been explored. There is also a strong need to develop interactive, technology-based learning media that can bridge traditional knowledge with modern science learning environments. Furthermore, future studies should focus on developing assessment instruments that can measure not only cognitive outcomes but also cultural awareness and environmental attitudes.

In addition, longitudinal and experimental studies are needed to evaluate the long-term impact of ethnoscience-based learning on students' academic achievement and character development. Strengthening collaboration between researchers, educators, and indigenous communities is also essential to ensure that the integration of local wisdom is carried out ethically, accurately, and sustainably.

In terms of broader contribution, this study provides a foundational reference for understanding the current state of ethnoscience-based science education in Papua. It offers a structured synthesis that can support educators in designing more contextually rich learning experiences and assist policymakers in formulating culturally inclusive education strategies. Ultimately, this review contributes to efforts to preserve Papuan local wisdom while simultaneously enhancing the quality and relevance of science education in Indonesia.

ACKNOWLEDGEMENTS

The author expresses sincere gratitude to all parties who have contributed to the implementation of this research, enabling it to proceed smoothly. Appreciation is also

extended to everyone who has shared their experiences and provided valuable inspiration to the author throughout the research process.

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