

THE APPLICATION OF THE MARITIME ETHNOSCIENCE APPROACH IN SCIENCE EDUCATION: A SYSTEMATIC LITERATURE REVIEW

Nur Azizah Dj. Junus^{1*}, Nyoman Sriastuti², Risna H. Panyo³, Hasim⁴, Abubakar Sidik⁵

¹⁻⁵Departement of Natural Science, Universitas Negeri Gorontalo, Gorontalo, Indonesia

* Email: nur_s2ilmupengetahuanalam@mahasiswa.ung.ac.id

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Abstract

This study aims to examine the application of a maritime ethnoscience approach in science learning through a systematic literature review (SLR) of publications from 2017 to 2025. Of the 60 articles searched through Google Scholar and Scopus, 21 passed the selection process based on the inclusion criteria. The analysis shows that most studies focused on junior high school students, utilizing direct ethnoscience learning models, 4D development, and Problem-Based Learning (PBL). This review confirms that the application of maritime ethnoscience is effective in improving students' conceptual understanding, scientific literacy, critical thinking skills, and awareness of the marine environment. However, the limited concentration of research on a single educational level suggests opportunities for further study at the elementary, high school, and tertiary levels. These findings emphasize the urgency of integrating maritime local wisdom into science learning, not only to strengthen cultural identity but also to equip students with 21st-century competencies.

Keywords: Ethnoscience; Maritime Affairs; Science Learning; Scientific Literacy; Systematic Review

INTRODUCTION

Education plays a significant role in shaping quality individuals, particularly through the development of critical thinking skills. However, in the current educational landscape, challenges remain regarding the effectiveness of the learning models used (Sarkingobir & Bello, 2024). In the educational context, ethnoscience serves as a tool that is not only oriented towards imparting knowledge but also towards instilling values of cultural appreciation and concern for the local environment in students (Ariani & Hariyadi, 2024). The application of ethnoscience in learning has a positive impact on improving various student abilities, including learning outcomes, scientific literacy, critical thinking skills, higher-order thinking skills (HOTS), science process skills, and conceptual understanding (Nurhasnah et al., 2022).

The ethnoscience approach emphasizes the use of culture, traditional knowledge, and local wisdom as a foundation for understanding

scientific concepts. In line with constructivist theory, learning will be more meaningful when it is tailored to the student's circumstances and allows for direct experience (learning by doing). Through ethnoscience, students can see the connection between the subject matter and everyday life, thereby deepening their understanding.

The integration of culture and local wisdom in science learning has been proven to increase interest and motivation in learning (Munira et al., 2024). Its application creates a learning environment that is responsive to the cultural context, while strengthening scientific understanding and fostering appreciation for local traditions (Ali et al., 2025). By combining traditional knowledge and scientific principles, teachers can deliver contextual, relevant, and meaningful learning for students. This also brings science closer to students' real lives, especially in rural areas or indigenous communities (Wardani et al., 2024).

As one of the largest maritime nations in the world, Indonesia still faces delays in integrating maritime knowledge into classroom learning. This integration effort is crucial to instill an understanding of the ocean in students and increase their sensitivity to various maritime issues (Sarkity & Fernando, 2023). Low levels of maritime literacy are one of the root causes of maritime problems in Indonesia, which has implications for the younger generation's lack of understanding of various maritime issues (Indrawati et al., 2024). Maritime education plays a crucial role for students, as it not only provides a comprehensive understanding of the ocean and its resources but also fosters a love of the ocean and fosters responsibility in conservation efforts (Hayati & Ma'rifah, 2024). Most students have a positive view of the application of science in the maritime field (Lusiani, 2020). Given these conditions, research that addresses the maritime context in science learning is important and urgent to strengthen maritime literacy and develop students' ecological understanding.

METHODS

The research method used is a Systematic Literature Review (SLR). The literature review was conducted based on "Year, Subject Area, and Learning Model" on maritime ethnoscience in science learning published between 2017 and 2025. The literature was searched through databases such as Scopus, Google Scholar, and national and international journal portals using the keywords "maritime ethnoscience approach" and "science learning."

The articles analyzed were selected based on specific criteria: discussing the application of maritime ethnoscience in science learning, using educational subjects, using a quantitative, qualitative, or mixed approach, and being published in a peer-reviewed journal in Indonesian or English. Articles that were

duplicated, irrelevant, or did not meet quality standards were excluded from the review.

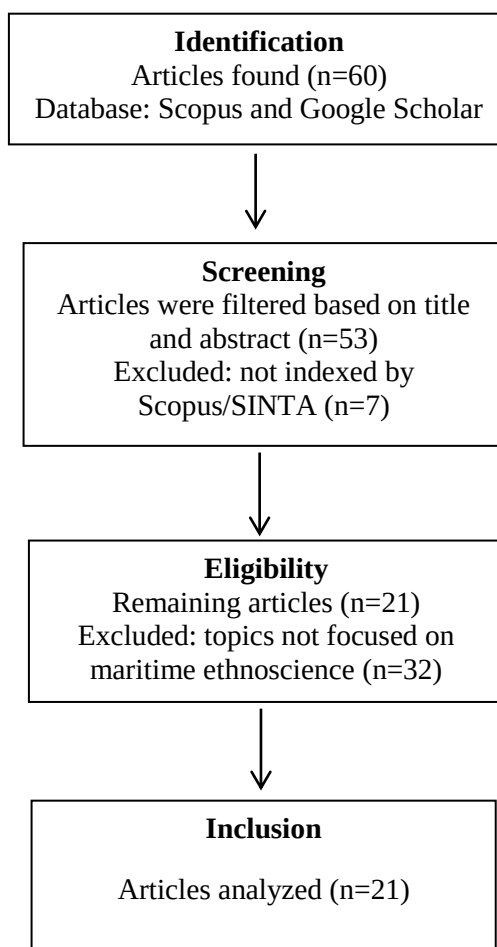
Study selection followed the PRISMA guidelines, including literature searches, title and abstract screening, full-text review, data extraction, and synthesis of results. The results of the study are presented in several main themes: the application of maritime ethnoscience in science learning, the influence of the learning model used, and the supporting and inhibiting factors. This study also maps trends, identifies research gaps for the 2017–2025 period, and provides recommendations for further research directions related to the development of a maritime ethnoscience approach in education.

Table 1. Inclusion and Exclusion Criteria

Category	Criteria
Inclusion	• Maritime ethnoscience approach • Published 2017–2025 • Indexed in Sinta or Scopus
Exclusion	• Not maritime ethnoscience • Published before 2017 • Not indexed in Sinta or Scopus

RESULTS AND DISCUSSION

The author searched Scopus and Google Scholar for articles using the Publish or Perish application. The search used the keywords "ethnoscience approach to science material," "maritime ethnoscience approach," and "maritime material in science." Sixty articles fit the theme of the maritime ethnoscience approach in science learning. Seven were excluded for not being in the Scopus or SINTA index. Thirty-two others were removed because their topics did not emphasize the maritime ethnoscience approach. Twenty-one articles passed selection for further analysis. This selection stage followed the PRISMA guidelines, as shown in Figure 1.

**Figure 1.** Flowchart Preferred Reporting Items for Systematic Review and Meta Analysis

In this study, the author searched for articles through the Scopus and Google Scholar databases with the help of the Publish or Perish application using the keywords "ethnosience approach to science material", "maritime ethnosience approach", and "maritime material in science". The search results collected 60 articles that fit the theme of the maritime

ethnosience approach in science learning. However, 7 articles were excluded because they were not included in the Scopus or SINTA index, while 32 other articles were removed because their topics did not emphasize the maritime ethnosience approach. Thus, there were 21 articles that passed the selection for further analysis, as shown in Table 1.

Table 1. Article Analysis Results

No	Author	Title	Jurnal	Title Rank	Research Results
1.	Irawan & Muhartati, (2019)	Identifikasi Nilai Etnosains Pada Kearifan Lokal Berkarang dan Menyondong Ikan Pada Masyarakat Pesisir Bintan	J. Pedagogi Hayati	SINTA 3	This study found that a maritime ethnosience approach using the PBL model was effective in science learning. Students actively understood scientific concepts related to the marine environment and solved real-life problems, demonstrating significant improvements in

No	Author	Title	Jurnal	Title Rank	Research Results
					learning outcomes.
2.	Nusantari & Lihawa, (2017)	Developing Of Biology Learning Book With Local Potential Of Living Thing Diversity Topic For SMP Students	Journal Of Pharmaceuti cal Sciences	Q1	This study demonstrated that the application of ethnoscience improved students' understanding of marine biodiversity. Linking the material to local ecosystems made students more motivated and aware of the importance of environmental conservation.
3.	Sarkity & Fernando, (2023)	Pengembangan Modul Ipa Terpadu Berbasis Problem Based Learning Terintegrasi Isu Kemaritiman	J. Pedagogi Hayati	SINTA 3	The results showed that the developed module was valid and practical, with significant improvements in student learning outcomes. This module successfully improved students' understanding of maritime issues.
4.	Sihombing et al., (2025)	Integrating Local Wisdom Into Environmental Education: A Systematic Review Of Ethnoscience Research In Indonesia.	Journal Of Natural Science And Integration	SINTA 2	This study revealed that the ethnoscience approach was effective in improving students' understanding of science and environmental awareness through the integration of local culture.
5.	Putri et al., (2024)	Implementation Of Science-Physics Learning Based On Coastal Fisherman Activities To Improve Students' Scientific Literacy Abilities	Journal Of Indonesian Science Teachers	SINTA 4	This study demonstrated that coastal fishing-based science-physics learning improved students' scientific literacy, with students in the experimental class achieving higher scores than the control class.
6.	Miftahurrahmah et al., (2021)	Profil Bahan Ajar Kontekstual Berbasis Kebudayaan Pada Proses Peningkatan Pengolahan Rumput Laut (Sargassum Sp.) Menjadi Senyawa Alginat	Jurnal Riset Dan Praktik Pendidikan Kimia (Jrpk)	SINTA 5	This study found that contextual, culture-based teaching materials improved students' understanding of chemistry concepts and connected science to everyday life.
7.	Ritonga et al., (2022)	Pengembangan Modul Pembelajaran Biologi Berbasis	Jurnal Manajemen Pendidikan	SINTA 5	The developed module has good validity and is highly practical, and successfully

No	Author	Title	Jurnal	Title Rank	Research Results
		Potensi Lokal Pembuatan Minyak Nilam (Pogostemon Cablin Benth) Di Kabupaten Aceh Tamiang	Islam		improves students' understanding of local potential and biodiversity.
8.	Okta et al., (2025)	Ethnoscience-Based Climate Change Adaptation: Survival Strategies For Agricultural Communities In Panimbang Regency	International Journal Of Ethno-Sciences And Education Research	SINTA 5	This study identified five strategies used by the Panimbang community to cope with climate change, demonstrating the importance of ethnoscience knowledge in adaptation and food security.
9.	Sri & Putri, (2024)	Preliminary Research On The Development Of The Ethnoscience-Based Teaching Modules For Student At Majene Middle	Sustainability Education	Q1	This study found that many students struggled to understand science material without a connection to local culture, highlighting the need for relevant learning modules to enhance motivation and understanding.
10.	Sariani & Suarjana, (2022)	Upaya Meningkatkan Belajar Matematika Melalui E-Lkpd Interaktif Muatan Matematika Materi Simetri Lipat Dan Simetri Putar	Mimbar Pgsd Undiksha	SINTA 2	The study demonstrated that interactive e-LKPD (learning materials) were effective in increasing students' motivation and understanding of symmetry, with positive feedback from both students and experts.
11.	Puspita et al., (2022)	Identifikasi Etnosains Yang Memiliki Potensi Untuk Diintegrasikan Dalam Pembelajaran IPA	Jurnal Penelitian Dan Pembelajaran Fisika Indonesia	SINTA 5	This study identified scientific concepts from the Malind community that can be integrated into science lessons, enhancing student understanding and learning relevance.
12	Solihin et al., (2024)	Eksplorasi Etnosains Monumen Kapal Selam Surabaya Sebagai Sumber Belajar IPAS Sekolah Dasar	Jurnal Review Pendidikan Dasar: Jurnal Kajian Pendidikan Dan Hasil Penelitian	SINTA 4	This study demonstrated that the Manongkah Kerang tradition contains relevant scientific concepts, which can enhance students' understanding and environmental awareness through ethnoscience integration.
13.	Indayati et	Pengembangan	Jurnal	SINTA 4	The research shows that the

No	Author	Title	Jurnal	Title Rank	Research Results
	al., (2023)	Perangkat Pembelajaran IPA Berbasis Etnosains Daerah Pantai Kenjeran untuk Melatih Keterampilan Berpikir Kritis Siswa Kelas V Sekolah Dasar	Education And Development Institut Pendidikan Tapanuli Selatan		developed learning tools are valid and effective, improving students' critical thinking skills, with positive responses to the media.
14.	Sarkity & Fernando, (2023)	Pengembangan Modul Ipa Terpadu Berbasis Problem Based Learning Terintegrasi Isu Kemaritiman	J. Pedagogi Hayati	SINTA 3	The research found the developed modules to be valid and effective, with significant increases in scores in the experimental group, demonstrating the effectiveness of ethnoscience in learning.
15.	Usmeldi et al., (2021)	Pendampingan Guru Dan Peserta Didik Dalam Pembelajaran IPA Terpadu Di SMP	Abdimas Galuh	SINTA 4	The research shows that the developed modules are valid and practical, significantly improving student learning outcomes using an ethnoscience approach.
16.	Ramadhan i & Andriani, (2025)	Analisis Konsep Fisika Hukum Newton Pada Kearifan Lokal Perahu Bidar	Optika: Jurnal Pendidikan Fisika	SINTA 4	This research shows that the bidar boat reflects the application of Newton's laws, helping students understand physics and preserve local culture.
17.	Wardani et al., (2024)	Integrating Blambangan Culture Of Banyuwangi Into Elementary Science Education: An Ethnoscience Approach	International Journal Of Elementary Education	SINTA 2	This research demonstrates the connection between science material and Blambangan culture, increasing the relevance and understanding of scientific concepts based on local culture.
18.	Miftahurrahmah et al., (2021)	Profil Bahan Ajar Kontekstual Berbasis Kebudayaan Pada Proses Peningkatan Pengolahan Rumput Laut (Sargassum Sp.) Menjadi Senyawa Alginat	Jurnal Riset Dan Praktik Pendidikan Kimia (JRPPK)	SINTA 5	This research shows that culturally based teaching materials improve students' understanding of chemistry and connect science to everyday practices.

No	Author	Title	Jurnal	Title Rank	Research Results
19.	Mutmainnah et al., (2025)	Pengembangan LKPD Berbasis Model PjBL Berbantuan Phet untuk Meningkatkan Kretivitas Ilmiah Siswa Sma: Validitas Perangkat Pembelajaran	Epistemic: Scientific Thinking And Literacy	SINTA 5	This research shows that PjBL-based student worksheets (LKPD) enhance students' scientific creativity and conceptual understanding, supported by the local cultural context.
20.	Kusumah et al., (2022)	Development Of Ethnoscience Module On Pond Ecosystem, In Serawai Tribe, Seluma Regency	Ecs Journal Of Solid State Science And Technology	Q1	This research shows that the developed ethnoscience modules are effective in enhancing students' understanding of pond ecosystems and are relevant to local culture.
21.	Proulx et al., (2021)	Indigenous Traditional Ecological Knowledge And Ocean Observing: A Review Of Successful Partnerships	Frontiers In Marine Science	SINTA 1	This research emphasizes the importance of ethnoscience knowledge in creating awareness and appreciation for indigenous cultures in marine resource management.

The results of the systematic literature review (SLR) show a classification of articles according to the study subject and publication year 2017–2025, which is displayed in graphical form (Figure 2). Based on the mapping results, the most dominant research

subject was junior high school students, with 8 articles. The distribution of publications on this subject includes one article in 2017, one article in 2019, one article in 2021, two articles in 2022, two article in 2024, and one article in 2025.

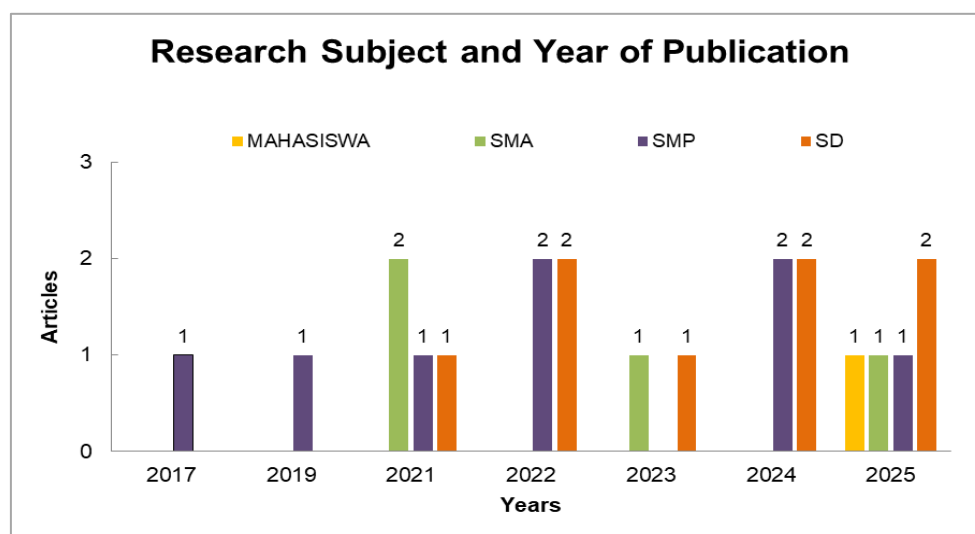


Figure 2. Mapping of Articles by Research Subject and Year of Publication

The review results indicate that the majority of research focused on junior high school students, with eight articles recorded. This relates to the characteristics of junior high school students who are undergoing a cognitive transition, where they begin to think abstractly but still require concrete examples.

This finding aligns with a study on the characteristics of junior high school students in the cognitive transition phase, which revealed that during this period, students begin to shift from concrete to abstract thinking, although they often require assistance through real-life illustrations to master more complex ideas. Children in this age range typically exhibit a strong curiosity about new ideas, but still face challenges in applying abstract thinking without a well-defined foundation. Further studies indicate that their learning process is more optimal with a teaching approach that combines hands-on exercises and dialogue sessions, allowing them to witness the direct application of the material being discussed (Alexander, 2024).

The study's reliance on junior high school (SMP) suggests that researchers view this level as particularly responsive to culture-based learning. However, this focus could create pedagogical integration, as students at elementary, high school, and university levels also require contextual learning to develop comprehensive ecological and maritime literacy. Bernadtua et al., (2024) argue that maritime education should be developed at all levels of education to ensure a deeper understanding of environmental concerns and responsibilities among young people. By providing inclusive and comprehensive education at all levels, students can develop a deeper awareness of environmental issues, including climate change and the sustainable use of natural resources. Therefore, integrating elements of environmental education into

maritime curricula at all levels is crucial for fostering ecological awareness and encouraging sustainable action.

However, the reason why junior high school remains the focus of the majority of research can be explained through the characteristics of its cognitive development. In line with this perspective, Marinda, (2020) emphasized that junior high school students, who are in a critical cognitive transition phase, begin to develop abstract thinking skills but still require concrete illustrations to grasp complex concepts. Students at this stage show strong curiosity and interest in new ideas, yet they often struggle with overly conceptual material that lacks direct, experiential foundations. This underscores the importance of integrating authentic, context-rich learning experiences, particularly when teaching concepts related to ecology and maritime practices.

Topics such as density and Archimedes' law (as related to fishing boats), ocean waves and tides, and coastal ecosystems become relevant when integrated into a maritime context. The application of maritime ethnoscience at this level is deemed appropriate because it is closely related to everyday experiences, such as fishing activities, seaweed processing, and the cultural traditions of coastal communities.

In contrast, research involving elementary, high school, and university students is still relatively limited. Yet, maritime topics have the potential to be developed at all levels of education. In elementary school, for example, science lessons on the life cycles of living things, simple ecosystems, and the use of natural resources can be linked to the sea, such as introducing mangroves, fish, and shellfish, to foster environmental awareness from an early age. At the high school level, more complex science topics such as fluid dynamics, biotechnology, and environmental chemistry

can be contextualized through maritime issues. For example, students can study ocean currents using the concept of fluids, learn about seaweed processing, or study marine pollution from a chemical perspective.

Meanwhile, in higher education, maritime studies can be developed through project-based research, such as on marine biodiversity, microplastic pollution, and renewable energy from ocean waves. With this approach, students not only deepen scientific concepts but also practice critical thinking skills, improve scientific literacy, and foster environmental awareness.

The uneven distribution of research subjects presents an opportunity to expand maritime ethnoscience studies across educational levels. Its application will not only enrich science learning according to the specific material at each level but also strengthen the younger generation's understanding of Indonesia's maritime culture and potential. Integrating coastal local wisdom into science learning adds value to the educational process while fostering a national identity based on marine resources. In line with this, Jamiludin et

al. (2021); Nuraeni et al. (2023) emphasize that integrating coastal local wisdom across all educational levels enriches the curriculum, builds environmental awareness, and fosters a love of marine potential. This approach not only strengthens students' understanding of local culture and traditions but also prepares a young generation with character, environmental awareness, and the ability to manage marine resources sustainably. Therefore, expanding maritime ethnoscience studies across all educational levels is a strategic step to strengthen scientific literacy, maritime identity, and environmental awareness among Indonesia's younger generation.

A review of learning models shows that Ethnoscience and 4D development are the most dominant, with findings in 4 articles. Next in popularity is Problem-Based Learning (PBL), identified in 3 articles. The ADDIE model, R&D, and the ethnographic approach were each found in 2 articles, while PjBL, Borg & Gall, quasi-experimental, and the collaborative approach only appeared once, as shown in (Figure 3).

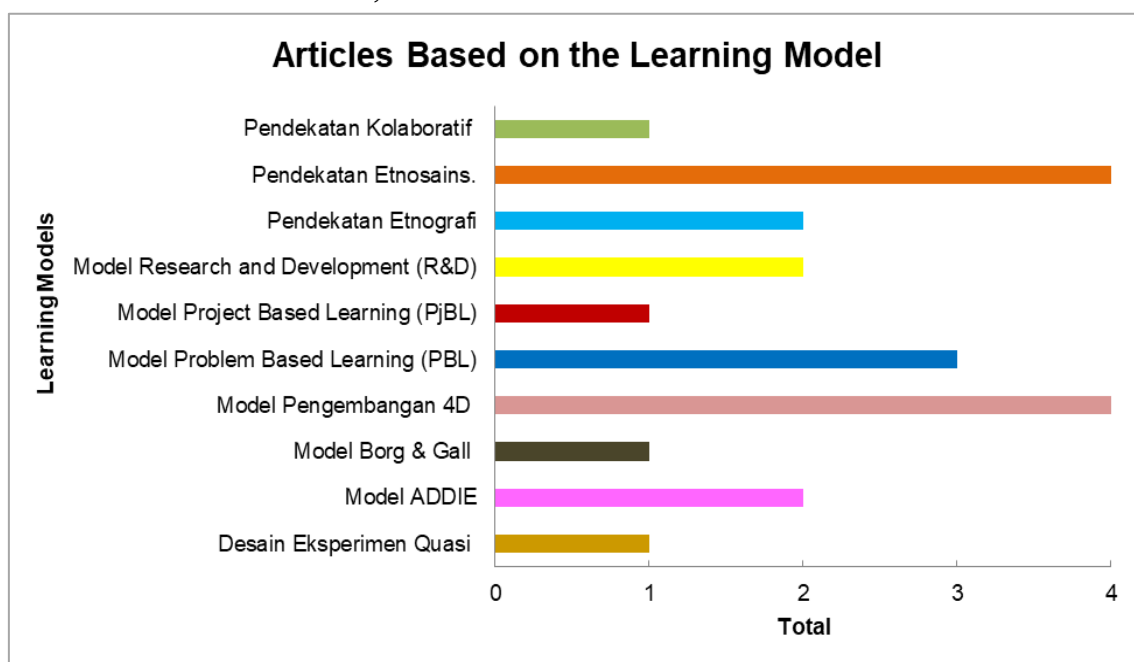


Figure 3. Mapping of Articles Based on the Learning Model.

Mapping of articles shows that the application of maritime ethnoscience in science learning utilizes a variety of learning models, with the direct ethnoscience model and the 4D development model dominant, each found in four articles. The findings of a study on the use of the direct ethnoscience model and the 4D development model indicate that both approaches are effective in strengthening students' mastery of ethnoscience content. The direct ethnoscience approach facilitates intensive student participation in exploring local traditional knowledge, enabling them to recognize the relationship between science, tradition, and their surroundings. Conversely, the 4D development model (Define, Design, Develop, and Disseminate) provides a structured approach for developing and implementing teaching materials. The study indicates that implementing this model not only deepens students' understanding of ethnoscience ideas but also fosters critical analysis and innovation skills. Both strategies have proven effective in creating contextually relevant and meaningful learning processes, while supporting students in integrating formal knowledge with local wisdom. Analysis of the results revealed significant improvements in academic achievement and conceptual mastery, accompanied by a strengthening of cultural elements among students (Ismail et al., 2024).

Problem-Based Learning (PBL) is also frequently used because it is considered effective in training students to solve authentic problems related to the lives of coastal communities. Several other studies use the ADDIE, R&D, and ethnographic models, while PjBL, Borg & Gall, quasi-experimental, and collaborative learning models are only found in a limited number. This demonstrates a tendency for researchers to integrate maritime ethnoscience with contextual and problem-solving-based learning models.

In general, this pattern emphasizes that integrating learning with the surrounding environment not only enriches the learning experience but also fosters positive attitudes such as concern, responsibility, and awareness of the importance of preserving nature. Similarly, Weiland & Morrison, (2013) emphasize the need to integrate environmental issues into science learning to hone analytical skills, increase appreciation for local potential, and foster environmental awareness. Similarly, Nusantara, (2020) also emphasizes that ethnoscience can be an effective means of presenting science learning that is relevant to culture and everyday life. Thus, maritime ethnoscience has great potential to support the development of scientific literacy, critical thinking skills, and environmental stewardship in students.

Furthermore, Asyhari & Sifa, (2021) also explained that the application of the Problem-Based Learning (PBL) model with local issues has been proven effective in improving students' problem-solving skills. Research shows that by using the context of local issues, learning becomes more relevant and understandable to students, so they are more interested and actively involved in the learning process. Furthermore, PBL facilitates students' critical and analytical thinking, encouraging them to collaborate and communicate in groups. This not only prepares students to face real-life problems but also increases their independence and confidence in solving complex problems. Therefore, the implementation of PBL with local issues is highly recommended for integration into the curriculum to improve the quality of education.

CONCLUSION

The results of this systematic literature review indicate that studies on the application of maritime ethnoscience in science learning

have experienced significant developments between 2017 and 2025. Most research focuses on junior high school students, with a tendency to use contextual and problem-solving-based learning models, including hands-on ethnoscience, Problem-Based Learning (PBL), and the 4D development model. The application of an ethnoscience approach has been proven to encourage improved learning outcomes, motivation, critical thinking skills, and student awareness of maritime issues. However, the continued concentration of research at one educational level indicates a gap that needs to be expanded through studies at the elementary, high school, and university levels. Therefore, the integration of maritime ethnoscience is not only relevant for deepening understanding of scientific concepts but also plays a crucial role in shaping cultural awareness and national identity grounded in Indonesia's maritime potential.

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