



From Shore to Mind: Maritime Science Literacy of Children in Early Childhood

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Abstract

Indonesia, as a maritime nation, faces the challenge of low maritime science literacy among the younger generation, including in early childhood. This study aims to examine the potential, obstacles, and strategies for strengthening maritime science literacy in early childhood education institutions. The method used was a literature review by analyzing 30 references published between 2016 and 2024, including three journals by Nuryati. The results indicate that the integration of marine themes in early childhood education is still minimal due to limitations in media, curriculum, and teacher training. However, a thematic approach, the role of families, and marine-based media can be a solution to instill a scientific understanding of the ocean from an early age. This study recommends the need for national policies and cross-sectoral support so that maritime science literacy becomes an integral part of early childhood education.

Keywords: Scientific Literacy, Early Childhood, Maritime Education, Early Childhood Education, Sea.

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INTRODUCTION

Indonesia, an archipelagic nation with over 17,000 islands, boasts abundant marine resources. The sea is not only an economic hub but also a vital part of national identity. Unfortunately, despite being surrounded by the sea, maritime science literacy among Indonesians remains relatively low, especially among the younger generation. This suggests that the sea has not been incorporated into the mindset and learning culture from an early age (Nuryati, 2020).

Maritime science literacy is a component of science education that focuses on understanding scientific concepts related to the ocean and its life. This literacy encompasses an introduction to marine ecosystems, marine organisms, the role of the ocean in life, and the interrelationship between humans and the coastal environment. For early childhood, an introduction to maritime science is crucial through a fun, contextual, thematic approach (Rahmawati & Sari, 2021).

Early childhood is in a golden age of brain development. They possess a keen curiosity about their surroundings. If children are introduced to the ocean as a source of life and a space for exploration during this period, a strong ecological understanding and maritime values will be instilled. However, not many early childhood education institutions systematically implement ocean-themed learning, especially in the context of maritime science (Widodo, 2019).

Data from LIPI (2020) shows that only 13% of early childhood education materials address maritime aspects. Most simply introduce the ocean as a tourist destination or a place where fish swim, without delving into the science behind it. Yet, the ocean holds a variety of simple scientific concepts, such as waves, tides, the marine food chain, and the water cycle, that can be introduced to children through play.

One of the main causes of low maritime science literacy among early childhood students is the lack of learning resources appropriate to their developmental characteristics. Children's storybooks, educational games, and interactive media that address maritime science concepts are still very limited. Furthermore, most early childhood education teachers have not received training on how to teach marine science in a simple and engaging manner (Maharani & Yusuf, 2022).

In terms of curriculum, marine themes have not been prioritized in early childhood education lesson plans. Teachers tend to choose land-based themes such as livestock, plants, or public transportation. This is exacerbated by the lack of guidance from regional education offices on the importance of strengthening character and maritime knowledge from an early age (Nuryati, 2021).

In fact, if instilled from an early age, maritime science literacy will create a generation that not only emotionally loves the ocean but also understands it scientifically. This understanding will lay the foundation for producing future scientists, researchers, intelligent fishermen, and citizens who care about the marine environment. This way, national maritime development will be more sustainable because it is supported by scientific awareness from a young age (Putri & Ramadhan, 2020).

The existing research gap shows that most early childhood literacy studies still focus on reading, writing, and numeracy. Studies on scientific literacy, particularly maritime science, are still very limited. Furthermore, there are not many scientific publications that specifically

explore how maritime science can be introduced to preschool children through a fun and local-based approach (Sari & Nuryati, 2021).

Therefore, this research is crucial to address this need by examining how maritime science literacy can be developed and instilled in early childhood through appropriate methods. This study also aims to explore the potential for integrating marine themes into daily early childhood learning activities, including role-playing, mini-experiments, and contextual story reading.

The ultimate goal of this article is to encourage early childhood education in Indonesia to produce not only academically intelligent children but also children with a love and scientific understanding of the marine environment. By building a connection between the coast and children's minds, we instill a rational and visionary maritime spirit for the future of our maritime nation.

LITERATURE REVIEW

Scientific Literacy in Early Childhood

Scientific literacy is the ability to understand, use, and communicate scientific information relevant to everyday life. In early childhood, scientific literacy does not yet take the form of memorizing scientific concepts, but rather concrete experiences and a basic understanding of simple natural phenomena (Nugroho & Sari, 2018). Activities such as observing plant growth, distinguishing between floating and sinking objects, or playing in the rain are early forms of science learning.

The Ministry of Education and Culture (2020) states that the development of scientific literacy in early childhood education (PAUD) must address the developmental characteristics of children, namely through directed play, direct exploration, and value reinforcement. A thematic and scientific approach is highly recommended so that children not only memorize information but also experience and reflect on it.

However, scientific literacy studies are still dominated by terrestrial contexts, such as plants and animals, without addressing the marine dimension. Yet, Indonesia boasts a wealth of marine biota and maritime natural phenomena with immense potential to be introduced to children. Maritime science literacy can serve as a bridge to enrich learning content and foster marine environmental awareness from an early age (Wahyuni, 2019).

The Concept of Maritime Education in Early Childhood Education

Maritime education is not just about sailing and fishing, but also about how to view the sea as part of culture, identity, and a source of life. In the context of early childhood education (PAUD), maritime education can be implemented through an introduction to the sea, the fishing profession, types of marine animals, and environmentally friendly activities on the beach (Nuryati, 2018).

Early childhood has a high potential to instill maritime values such as mutual cooperation, courage, hard work, and environmental stewardship. These values can be packaged in fun activities like telling stories about ships, making sea crafts, or singing nautical-themed songs (Hidayat, 2020). Through this approach, maritime education serves as a means of instilling national character from an early age.

Unfortunately, few early childhood education (PAUD) teachers understand the importance of maritime education. Lack of training, teaching materials, and support from

policymakers are major obstacles. Therefore, a simple, applicable, and practical maritime learning model based on children's daily lives is needed for easy implementation (Nuryati, 2021).

The Role of Coastal Environments in Children's Literacy

Coastal environments provide a rich learning environment for young children. Interactions with sand, seawater, shells, and other coastal organisms stimulate curiosity and deepen hands-on experiences. Children can learn about the concepts of weight and lightness, texture, color, and shape through beach activities (Putra & Andayani, 2019).

Several early childhood education institutions in coastal Indonesia have utilized the maritime environment as a natural laboratory. For example, planting miniature mangroves, making collages from shells, and observing shorebirds have become part of routine learning activities. These activities not only improve scientific literacy but also strengthen children's identity as part of a maritime community (Nuryati, 2020).

However, the use of coastal environments for early childhood education has not been widespread. Many schools lack access to beaches or have not established partnerships with local communities. Yet, collaboration between schools, communities, and environmental agencies can open up new, meaningful learning spaces (Sari & Wahyuni, 2022).

Maritime Learning Media and Methods

Effective learning media is crucial to supporting children's maritime science literacy. Engaging media such as sea dolls, marine ecosystem puzzles, marine-themed children's storybooks, and educational animated videos can increase children's interest in and understanding of the ocean (Rahayu & Fatimah, 2017). Visual and concrete media are easier for young children to digest than text or lectures.

Project-based learning methods or simple experiments are also effective. For example, children can be encouraged to try filtering seawater, observing the difference in weight between objects in water and on land, or creating a miniature ocean from recycled materials. These methods emphasize exploration, problem-solving, and hands-on experience, which are essential for scientific literacy (Yuliana, 2020).

Nuryati (2021) recommends a collaborative learning approach that combines play, experimentation, and storytelling in one activity. This model can strengthen children's understanding without causing boredom or stress. Furthermore, parental involvement in the learning process is key to ensuring children receive conceptual reinforcement at home.

Challenges and Strategies for Strengthening Maritime Literacy

The main challenges in strengthening maritime science literacy are limited resources and the lack of integration of marine themes into the national Early Childhood Education (PAUD) curriculum. A lack of guidebooks, teacher training, and teaching aids are common obstacles encountered in the field (Maharani, 2021).

Furthermore, early childhood education teachers in non-coastal areas often feel that marine themes are irrelevant to children's lives. This view needs to be clarified, as the ocean is

part of national identity, not just a coastal region. With a creative approach, marine themes can still be contextualized, even in mountainous areas (Prasetyo, 2020).

Strategies that can be implemented include locally-based teacher training, the development of national maritime learning modules, and collaboration between early childhood education centers (PAUD) and maritime communities or conservation organizations. Thus, maritime education not only enriches learning but also builds character in children who love and understand the ocean scientifically (Nuryati, 2021).

RESEARCH METHOD

This study used a literature review approach as the primary method. A literature review is a research method that involves identifying, evaluating, and synthesizing relevant previous research findings to answer research questions or develop a specific theoretical framework (Snyder, 2019). In this context, the literature review was used to explore the concepts, strategies, and implementation of maritime science literacy in early childhood in Indonesia.

Data were collected from various library sources in the form of national and international journal articles, proceedings, academic reference books, and relevant education policy documents. The inclusion criteria used were (1) publications in 2016–2024, (2) focusing on the topics of early childhood education, science literacy, or maritime education, and (3) having theoretical and practical relevance to the objectives of this study. Data analysis was carried out through *the thematic content analysis stage*, namely by grouping literature data based on key themes that appear repeatedly, such as: the concept of maritime science literacy, media and learning methods, the role of the coastal environment, and challenges and strategies for strengthening. Each finding was analyzed by comparing one source with another to find similarities, differences, and conceptual patterns that can be formulated into main arguments. This analysis also considers the local context of early childhood education in Indonesia so that the study results are more applicable and according to field needs (Booth, Sutton, & Papaioannou, 2016).

For scientific validation, reference searches were conducted through trusted academic portals such as Google Scholar, DOAJ, SINTA, and the National Library. All sources were recorded and selected using manual reference management to ensure citation accuracy. This literature review approach was chosen because it can explore the broad scope of maritime science literacy issues that have been under-researched and provides space for the development of a conceptual model that can serve as a basis for future learning development.

RESULTS AND DISCUSSION

Low Maritime Science Literacy among Early Childhood

Research shows that maritime science literacy among early childhood students in Indonesia remains low. Children are often introduced to the ocean as a playground or a habitat for fish, without deeper scientific exploration. A 2020 study by the Indonesian Institute of Sciences (LIPI) even found that less than 15% of early childhood education institutions incorporate maritime aspects into their lesson plans.

This situation is reinforced by Nuryati's (2020) findings, which state that the majority of early childhood education (PAUD) schools lack specific teaching modules addressing marine

ecosystems, the marine food chain, or the ocean's role in environmental balance. Maritime literacy remains limited to narrative or symbolic forms, not yet systematically incorporating early childhood scientific understanding.

This indicates a gap between Indonesia's potential marine resources and its early childhood education system, which is unable to meet these needs. Early childhood education remains too land-centric, despite Indonesia being an archipelagic nation that should embrace the ocean as part of its identity from an early age (Putra & Rahayu, 2021).

Unpreparedness of Teachers and Institutions in Implementation

Literature indicates that teacher unpreparedness is the primary cause of the limited integration of maritime science literacy in early childhood education (PAUD). Most PAUD teachers lack a maritime education background and are unfamiliar with using maritime terminology in their learning (Maharani & Yusuf, 2022).

According to Nuryati (2021), early childhood education (PAUD) teachers tend to experience confusion when teaching marine topics due to the lack of applicable guidelines. They also feel insecure about using tools such as nautical charts, globes, or saltwater and freshwater experiment simulations. This is exacerbated by the lack of training provided by the government or education offices regarding child-oriented maritime education.

Beyond teachers, early childhood education institutions themselves have yet to incorporate maritime themes into their local curriculum. Annual themes tend to focus on general topics like "animals," "my family," or "vehicles," without incorporating "my sea" or "my country is a maritime nation." However, according to the Independent Curriculum, curriculum flexibility can be used to address local strategic issues (Ministry of Education and Culture, 2021).

Innovative Strategies in Children's Maritime Literacy

Despite numerous obstacles, several best practices have been identified in the literature. For example, several early childhood education institutions (PAUD) in coastal areas have successfully developed marine-themed activities such as creating mini aquariums, constructing marine food chains from pictures, and simulating tidal waves using water and sand (Yuliana, 2020).

Nuryati (2018) in her research at a coastal early childhood education school in Central Java demonstrated that role-playing was highly effective in introducing maritime professions and marine life. Children played the roles of fishermen, lighthouse keepers, and fish traders, which not only fostered scientific literacy but also strengthened social character traits such as hard work and cooperation.

Furthermore, the use of illustrated stories about the ocean has been shown to stimulate children's interest in asking questions and exploring. Books such as *"Adventures on Coral Island"* or *"My Sea, My Friend"* are used as initial stimuli in maritime science literacy learning, which are then followed up with activities like making ocean posters or planting artificial coral reefs (Rahmawati & Sari, 2021).

The Role of Maritime Families and Communities

The study also emphasized the important role of families and communities in supporting early childhood maritime science literacy. Parents working in the maritime sector, such as fishermen or fish traders, have a significant opportunity to become a rich source of informal learning experiences (Hidayat, 2020).

However, not all parents understand that their experiences at sea can be used as educational tools. Therefore, it's necessary to educate and train parents on how to turn their daily activities into inspiring stories for their children. For example, parents can tell simple stories about the weather at sea, types of fish, or fishing gear.

Local communities, such as mangrove conservation groups, fishing cooperatives, and marine tourism managers, also play a crucial role in providing context-rich learning environments. Collaborations between early childhood education centers (PAUD) and these communities can result in field activities such as educational visits, mangrove seedling planting, or children's marine festivals (Sari & Wahyuni, 2022).

Conceptual Model of Maritime Science Literacy for Early Childhood

Based on the results of the literature review, a conceptual model of maritime science literacy for early childhood can be developed that involves three main pillars: (1) a thematic approach with marine content, (2) family and community participation, and (3) interactive maritime-based learning media. These three components need to be supported by teacher training and adaptive curriculum reinforcement.

This model aligns with Nuryati's (2021) idea, which emphasizes the importance of integrating maritime values into early childhood education. This approach not only introduces the concept of the ocean but also fosters a love and responsibility for it. Children learn not only that the ocean is salty, but also why it is essential to life and how to protect it.

This model can serve as a foundation for developing a locally-based early childhood education curriculum relevant to Indonesia's geographic context as a maritime nation. In other words, maritime literacy for children is not simply supplementary knowledge but a core component of character education and national identity development from an early age (Prasetyo, 2020).

CONCLUSION

Maritime science literacy in early childhood is a crucial foundation for developing a generation that understands, loves, and is responsible for the ocean as an integral part of their lives. As a maritime nation, Indonesia has a moral and strategic responsibility to instill maritime values and knowledge from an early age. Unfortunately, a literature review indicates that, to date, maritime science literacy has been poorly integrated into early childhood education. Several factors contributing to low maritime science literacy in early childhood include: poor teacher preparedness, the lack of marine-themed media and teaching modules appropriate to children's characteristics, and the lack of policy direction encouraging the integration of marine themes into the early childhood education curriculum. Teachers tend to choose more familiar land-based themes, even though young children are also very interested in new things, including the ocean and all its contents.

Despite the challenges, the study also shows significant opportunities to be exploited. Several early childhood education institutions (PAUD) in coastal areas have implemented innovative marine-based thematic learning with positive results. Approaches used include role-playing maritime professions, exploring coastal environments, and reading illustrated stories about the sea. Furthermore, families and local communities play a crucial role as partners in developing children's maritime literacy. Thus, a comprehensive national strategy is needed to develop and strengthen maritime science literacy in early childhood. This strategy includes teacher training, development of maritime learning media, and collaboration between early childhood education centers (PAUD), families, and the community. Maritime learning not only broadens children's horizons but also fosters a love of the environment, mutual cooperation, and pride in being a maritime nation.

The government and curriculum developers need to explicitly include maritime education elements in Early Childhood Education learning themes, so that maritime values can be introduced systematically from an early age. Early childhood education teachers need to receive training and guidance on how to teach maritime concepts to early childhood using fun and developmentally appropriate methods. Early Childhood Education institutions need to be facilitated with marine-themed learning media such as illustrated stories, teaching aids, marine exploration corners, and educational games relevant to the maritime world. Schools can collaborate with local ports, maritime museums, or coastal communities to provide children with hands-on experience and strengthen the connection between learning and real life.

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