

# Marine Science Literacy in Early Childhood

Suharti<sup>1,\*</sup>, Hapidin<sup>1</sup>, Yufiarti<sup>1</sup>

<sup>1</sup> Early Childhood Education Doctoral Program, Universitas Negeri Jakarta, Jakarta 13220, Indonesia

\*Corresponding author. Email: Suharti\_9920919001@mhs.unj.ac.id

## ABSTRACT

Science literacy is one of the discussions in science education. Early childhood living on the island is very close to the marine environment. So the discussion of scientific literacy requires more specific by the characteristics of the child's area of residence. Marine science literacy (MSL) is a specification of scientific literacy in the marine region. This study aims to investigate and explore marine science literacy (MSL) content in early childhood. This research uses a qualitative case study approach with four early childhood participants aged between 4-7 years with interview and observation methods. Research findings indicate that the MSL component consists of children's knowledge, attitudes and behaviour related to marine. More research to explore more in-depth about the aspects and content of marine science literacy needs to be done in the future

**Keywords:** *Marine science literacy, Science literacy, Science education*

## 1. INTRODUCTION

Science literacy is one of science education's target [1]; related to goals of science education [2]. One of the most important objectives of Science Education is the development of scientific literacy [3]. Science literacy defined the concept as the ability to read, write, and understand systematized human knowledge in science [4], [5]. Science literacy refers to scientific literacy [1]. Scientific literacy the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen includes being able to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically, it emphasises the importance of being able to apply scientific knowledge in the context of real-life situations [6]. Scientific literacy enables people to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively and valuing life-long learning [7]. Three types of science literacy that includes (a) practical: possession of the kind of scientific knowledge that can be used to help solve practical problems, (b) civic: to enable the citizen to become more aware of science and sciencerelated issues in order to participate in the democratic processes, and (c) cultural: knowledge and appreciation

of science as a major human achievement and cultural heritage [2].

Science literacy needs to be introduced early on because it is important for the development of scientific concepts and attitudes in children. Scientific literacy is important because it provides context for dealing with social problems, and because people who have scientific knowledge can deal with many problems better and make intelligent and informed decisions that will affect the quality of life including the quality of life of children [8]. Children born and raised on the island are faced with a marine environment every day. Early age children who are natural in their natural exploration have gone through scientific investigation procedures in the simplest context of the marine environment. Therefore, specific scientific literacy in young children living on the island will be meaningful if it is appropriate to the context of the environment in which they live.

Content of science literacy in early childhood includes life science, physical science and earth and space science (EES) [9]. In marine science literacy, content of science literacy is related to marine. In simple terms, life science discusses living things. Physical science deals with non-living things. Closely and space science discusses the earth and its changes, for example, changes in day and night. Science content in early childhood starts with the things closest to the child so that children can explore their environment in the

process of simple scientific investigation, which is then understood by them as scientific knowledge.

Furthermore, in early childhood who live in a marine environment, science literacy needs to be more specifically related to the characteristics of the marine area. Regional characteristics indirectly affect the way children look at developing their scientific attitudes. Marine science can be used as a model for teaching integrated science if curricula and instructional practices are aligned to national standards [10]. Marine sciences is justified by the country's historical connection to the sea [11]. Specifically, marine science literacy (MSL) is one of the topics of science literacy. This research investigates and exploits science literacy in the marine environment, which I later refer to as marine science literacy (MSL). Marine Science literacy in this study focused on early childhood.

## 2. METHOD

This research uses a qualitative approach with a case study interpretivism paradigm. The case study approach was chosen because it can explore more data in small samples. Participants in this study were selected randomly, namely four early childhoods living on the island of Untung Jawa, one of the islands in the Thousand Islands. Interviews and observations were used in collecting this research data. Researchers use semi-structural questions informally to investigate the understanding of marine science literacy in early childhood. In addition, the researcher made direct observations of the participants during the study. This research was conducted in September 2019. The data obtained were then analyzed through stages of familiarization, identifying a thematic framework, indexing, charting and mapping interpretation [12].

Data is collected in Indonesian using digital recordings and recorded in field notes. Researchers transferring data on a computer and translating from Indonesian into English. Stage 1. Familiarization with the data. The researcher actually reads each transcript and listens to the audio recording of the interview with the entries that have been obtained to get to know the whole data that has been obtained. Step 2: Coding for identifying a thematic framework. The researcher begins by marking transcripts which describe the content of each section with code and are explained in more detail in each code. Step 3: Indexing. After the researcher learns the code from the transcript, it continues to examine all the codes to ensure meaningfulness, what is expressed about the views on marine science literacy understood by the participants. Step 4: Charting. After all, data was coded using an analytical framework; the researcher summarized the data in a matrix for each theme. Step 5: Mapping and interpretation. Themes are generated from data sets by reviewing matrices and making connections within and between focus groups

and categories. To gain further insights into the data, this study utilizes relevant theoretical ideas and literature which form the basis of research.

## 3. RESULT AND DISCUSSION

There are three main themes from the results of interviews and observations during the study: 1) Knowledge as marine science literacy content in early childhood; 2) Attitudes towards the marine environment 3) behaviour towards the marine environment. Each theme is explained further in more detail, and typical responses from interviews are recorded to corroborate the findings.

### 3.1. Knowledge as Marine Science Literacy Content In Early Childhood

Knowledge about marine in early childhood which includes various aspects related to various children's knowledge about marine. Knowledge of marine after crossing with science standards in early childhood can be categorized as science content. Science content in early childhood includes life science, physical science and Earth and Space Science (EES) [9]. In the context of this research, adapted to the real conditions in Indonesia, so that science content is in accordance with the Indonesian context.

#### 3.1.1. Life Science

Content of life science in marine science literacy covers the types of living things, Physical Characteristics and Behavior of Living Things. Children already have knowledge about life science. Related to the types of marine biota, children know the names of fish species, shellfish, including the physical characteristics of living creatures in the sea and around the marine environment. Children know that there are many sea animals and sea plants in the sea. Physical characteristics of living things understood by children related to the literacy of marine science include the colour, size, food, and place of life of species of living things that exist in the sea.

*In the sea there are many animals, there are bundles, stingrays, starfish. There are clams too, clams have contents and can be eaten. There are jellyfish too, if you touch jellyfish itchy, like my sister (Interview N, 28 September 2019).*

#### 3.1.2. Physical Science

Non-living objects encountered every day. The physical science content in the marine context is related to objects and all non-living things that children encounter in the sea. The physical content of science in early childhood is related to things that are close and often encountered by children, namely sand, seawater,

waves, and wind. Children explore physical science based on children's play experience with their peers and the knowledge they get from their parents.

*Children are used to playing beach sand. The children draw on the beach sand when the waves come they run away laughing together. Children distinguish the texture of beach sand. Some are fine and coarse in texture because there are former shell fragments and coral reefs on the beach (Field note, 28 September 2019)*

*Now the seawater is receding, so we can play water in the sea. But if the water is high tide, you can't play at sea. Usually, seawater will rise at night. (Interview U, 28 September 2019, 04.15-04.20 pm)*

### 3.1.3. Earth And Space Science (EES)

Earth And Space Science (EES) daily and seasonal changes including long-term and short-term weather changes; The moon, sun and stars can be observed at different times of the day or night. Earth And Space Science (EES) content in early childhood is still simple. Considering that they live in the marine environment, children understand the content of Earth and Space Science (EES) in accordance with their understanding related to the sea, which is the change of time of day and night and what happens with seawater at the time of that change of time.

*My father was looking for fish into the sea that night and going home from the sea early in the morning. (Interviews U and Y, September 28, 2019)*

### 3.2. Attitude towards the marine

Children's attitude towards the marine environment is characterized by children's understanding of the marine environment as a playground and must be kept clean. Children have the attitude that the marine environment is a place where they have a lot of wealth and can provide benefits. Besides that, the sea is a place where their parents make a living as fishermen. Children have the attitude to protect the sea by not taking coral reefs from the sea.

*I and my friends play in the sea. At the sea I swim at the edge of the sea. If I relax a little bit in the middle I use a float (Interview N, 28 September 2019)*

*Children understand that the sea is where their parents make a living. They also have the attitude that the sea must be protected, for example not to take coral reefs from the sea. (Field note, 29 September 2019)*

### 3.3. Behavior towards the marine

As a child born on an island and from birth to see his residence surrounded by the ocean, children have a

behaviour that is closely related to everyday life at sea. The behaviours that appear in the daily activities of children are fishing, swimming by the sea, going to sea with their fathers, and looking for shells, playing with sand. The children also have the behaviour of guarding the sea, especially related to coral reefs. They said that often tourists who come to snorkel bring coral reefs. The children were reminded not to bring it, but the tourists still carry the coral reefs they took. But unfortunately, the behaviour of guarding the sea associated with plastic waste is even less visible. Researchers witnessed during the interview that early childhood participants took part in throwing away used careless plastic waste.

*Children perform daily activities at sea, both with their peers or with their parents. One participant was invited every night to go out to sea to fish with his father. (Field note, 29 September 2019)*

*I like fishing and fishing with friends. I look for bait before fishing, usually, the bait is sea lice or shrimp. (Interview U, 28 December 2019)*

*I like looking for shells to collect and to play (interview Y, September 28, 2019)*

### 3.4. Discussion

Early childhood acquire knowledge based on their direct experience through play [13], [14]. To be literate in science, a person must have command of certain facts and general concepts about our universe and a knowledge of what scientific methods are about [8]. In addition, knowledge about marine environment will be obtained by children through interactions with the environment [15], [16]. In learning in structured classrooms, the purpose of scientific literacy that focuses on literacy skills, all students need to participate effectively [17]. Likewise, in learning through play through direct experience in the real environment. Learning a concept through direct experience will have a long-term effect on children [18]. Including MSL, children must understand the general concept of marine.

The domain of knowledge is one component of scientific literacy [19]. MSL which consists of components of knowledge, attitudes and behaviour towards the marine environment in accordance with the scientific literacy model consisting of 3 components which covers What do people know consisting of Subject competence, Epistemological competence, and Learning competence; What can people do? Which consists of Learning competence, Social competence, Procedural competence, Communicative competence; and What do people value? Which consists of ethical competence Graber [7]. According Fakhriyah, et.al, (2017), acientific literacy that includes aspects of scientific knowledge, scientific competence, scientific

context as well as the factors that influence the students' science literacy skills [20].

Marine Science Literacy (MSL) is closely related to environmental education especially the marine environment. Because MSL content is interspersed with environmental education. MSL strengths demonstrated in prior science education training, be it of an environmental, engineering or inquiry focus [21]. The construct of environmental attitudes is based on the psychological tendency expressed by the individual evaluation of the natural environment resulting in an inclination towards preservation (conservation and protection of the environment) or utilization (feeling of dominance over the environment) [22]. Science literacy as understanding scientific concepts, processes, and practices necessary to participate in civic and personal decision making and thinking objectively and critically about science issues facing society [23]. Science literacy which includes environmental education aims to build and strengthen awareness for environmental problems and through examples of realization that are worthy of growing individual motivation to change behavioural habits [24]. So that MSL aims to provide educational science and the marine environment as well as in order to foster attitudes towards marine environment problems from an early age. Attitudes towards science play an important role in science literacy [25] The marine environment provides a unique context for students to explore natural and cultural connections [26]. MSL bridges the relationship between marine science and science literacy in the context of marine environment.

#### 4. CONCLUSION

This study shows that marine science literacy of young children who live on the island is formed through children's daily activities and children's interactions with peers. In addition, parents contributing provides information about the content of marine science literacy. I highlight that marine science literacy is the ability of children to carry out simple scientific investigations, process information based on experience, and understand everything related to the sea that consists of knowledge, attitudes and behaviours that reflect marine. I am aware of the limitations of this research because I need further research to explore more deeply about the aspects and content of literacy in marine science in the future.

#### ACKNOWLEDGMENTS

We would like to thank to Universitas Negeri Jakarta, MESI (Marine Education Study in Indonesia), and the Head of Untung Jawa Island.

#### REFERENCES

- [1] J. Holbrook and M. Rannikmae, "The Meaning of Scientific Literacy Jack," *Int. J. Environ. Sci. Educ.*, vol. 4, no. 3, pp. 275–288, 2009.
- [2] X. Liu, "Beyond science literacy: Science and the public," *Int. J. Environ. Sci. Educ.*, vol. 4, no. 3, pp. 301–311, 2009.
- [3] V. Dragoş and V. Mih, "Scientific Literacy in School," *Procedia - Soc. Behav. Sci.*, vol. 209, no. July, pp. 167–172, 2015.
- [4] A. M. Kohnen and M. P. Whitacre, "What Makes Professional Development Coherent? Uncovering Teacher Perspectives on a Science Literacy Project," *Action Teach. Educ.*, vol. 39, no. 4, pp. 414–431, 2017.
- [5] R. C. Laugksch, "Scientific Literacy: A Conceptual Overview," *John Wiley Sons*, vol. 112, no. 2, pp. 91–122, 1999.
- [6] OECD, "How does PISA for Development measure scientific literacy?," 2017.
- [7] W. Gräber *et al.*, "Scientific Literacy: From Theory to Practice," *Res. Sci. Educ. - Past, Present, Futur.*, no. 1996, pp. 61–70, 2005.
- [8] E. Zen, "Science Literacy and Why it is Important," *J. Geol. Educ.*, vol. 38, no. 5, pp. 463–464, 1990.
- [9] Ohio Department of Education, "Ohio's learning standards," Ohio, 2018.
- [10] J. Lambert, "High school marine science and scientific literacy: The promise of an integrated science course," *Int. J. Sci. Educ.*, vol. 28, no. 6, p. 633, 2006.
- [11] B. M. L. Pinto, J. L. Costa, and H. N. Cabral, "How Do Science Communication Practitioners View Scientists and Audiences in Relation to Public Engagement Activities? A Research Note Concerning the Marine Sciences in Portugal," *Bull. Sci. Technol. Soc.*, vol. 37, no. 3, pp. 159–166, 2018.
- [12] L. Fridani, "Mothers' perspectives and engagements in supporting children's readiness and transition to primary school in Indonesia," *Educ. 3-13*, pp. 1–12, 2020.
- [13] Nas.edu, "Child Development and Early Learning: A Foundation for Professional Knowledge and Competencies," Washington DC, 2015.
- [14] UNICEF, "Learning Through Play," 2018.
- [15] R. Gifford, "Environmental Psychology Matters,"

- Annu. Rev. Psychol.*, vol. 65, no. 1, pp. 541–579, 2014.
- [16] S. Yeung, “Environmental Consciousness among Students in Senior Secondary Schools: The Case of Hong Kong,” *Environ. Educ. Res.*, vol. 4, no. 2, pp. 195–210, 1998.
- [17] K. A. Carrier, “Supporting Science Learning through Science Literacy Objectives for English Language Learners,” *Sci. Act. Classr. Proj. Curric. Ideas*, vol. 42, no. 2, pp. 5–11, 2005.
- [18] J. Farmer, D. Knapp, and G. M. Benton, “An Elementary School Environmental Education Field Trip: Long-Term Effects on Ecological and Environmental Knowledge and Attitude Development,” *Environ. Educ.*, vol. 38, no. 3, pp. 33–42, 2007.
- [19] A. L. Mitman, J. R. Mergendoller, V. A. Marchman, and M. J. Packer, “Instruction Addressing the Components of Scientific Literacy and Its Relation to Student Outcomes,” *Am. Educ. Res. J.*, vol. 24, no. 4, pp. 611–633, 1987.
- [20] F. Fakhriyah, S. Masfuah, M. Roysa, A. Rusilowati, and E. S. Rahayu, “Student’s science literacy in the aspect of content science?,” *J. Pendidik. IPA Indones.*, vol. 6, no. 1, pp. 81–87, 2017.
- [21] T. A. Goodale, “Factors That Influence Curricular Development for In-Service Teachers,” 2020.
- [22] T. L. Milfont and J. Duckitt, “The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes,” *J. Environ. Psychol.*, vol. 30, no. 1, pp. 80–94, 2010.
- [23] K. Mackey and T. Culbertson, “Science fairs for science literacy,” *Eos (Washington. DC)*, vol. 95, no. 10, pp. 89–90, 2014.
- [24] T. Braun, R. Cottrell, and P. Dierkes, “Fostering changes in attitude, knowledge and behavior: demographic variation in environmental education effects,” *Environ. Educ. Res.*, vol. 24, no. 6, pp. 899–920, 2017.
- [25] A. Altun and Ö. K. Kalkan, “Cross-national study on students and school factors affecting science literacy,” *Educ. Stud.*, vol. 00, no. 00, pp. 1–19, 2019.
- [26] C. S. Wiener and K. Matsumoto, “Ecosystem pen pals: Using place-based marine science and culture to connect students,” *J. Geosci. Educ.*, vol. 62, no. 1, pp. 41–48, 2014.