

# Investigating the Need for Ocean Literacy in the Indonesian Science Classroom

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## ABSTRACT

Ocean literacy is a skill needed to conserve our ocean. However, there is vaguely research about it, including research on middle school students. The aim of this research is to investigate the need for ocean literacy to teach in a science classroom for middle school students in Indonesia. This research is a descriptive study with a survey method conducted at SMPN 2 Kretek Yogyakarta. Samples were randomly selected, and data were collected using modified IOLS (The International Ocean Literacy Survey), which consists of 42 multiple choice questions represented seven principles of ocean literacy. The data were analyzed descriptively and statistically non-parametric using the Mann-Whitney U-test to determine differences in ocean literacy based on gender. Data analysis results state that of all principles of ocean literacy, the 3<sup>rd</sup> and the 7<sup>th</sup> principle get the lowest score. The results of the Mann-Whitney U-test at the significance level of 0.05 is 0.204 of the Asymp Sig. (2-tailed), which means there is no difference in ocean literacy between male and female students.

**Keywords:** *Ocean Literacy, Middle School, Science Learning.*

## 1. INTRODUCTION

Indonesia is an archipelago country consisting of 16,056 registered islands [1]. This country is also known to have a wealth of various types of coral reefs that are home to fish biodiversity in the world [2]. Indonesian ocean have abundant natural resource wealth which is also a source of economy for society. Therefore, there are 12,857 Indonesians living as coastal communities [1], which is about 75% of the total population [3][1].

As we know, the ocean has many role, not only for humans but also for all its inhabitants. The sea has a vital role in maintaining the continuity of life on Earth, because the ocean contributes to the process of regulating materials such as oxygen, carbon dioxide, and geothermal. However, nowadays the impact of the damage to ocean ecosystems has also been felt significantly by humans, such as marine debris (mostly plastic and microplastic) [4]-[6] which threat to bioaccumulation for humans [7],[8], contamination by heavy metal [9] and oil spills [10], [11], and the impact of global warming for ocean [12] i.e., rise of sea level, ocean acidification [13] and coral bleaching [2].

Research data by Jambeck states that the most significant contributors to marine debris are developing countries, mostly in Asia, including Indonesia, which is ranked second [14]. Increasing marine debris in Indonesia is due to the factor of population growth and the industrial revolution which has led to changes in people's consumption patterns [5].

The Indonesian government has launched four programs, one of which is the Clean Beach and Sea Movement, to overcome the increase in marine debris. This program consists of socialization, education, and assistance under the direction of the Ministry of Marine Affairs and Fisheries [5]. Increasing public awareness to conserve the ocean through education would be optimal if they also taught by educational experts about ocean literacy. Educating through formal or non-formal can help the public to learn about fundamental concepts of ocean literacy. Increasing a sense of concern for protecting the ocean begins with a paradigm shift from initially seeing it as an effort to protect the Earth to be transformed into protecting human life because it is human nature, which will ultimately be threaten if environmental damage occurs. In Europe, ocean literacy aligned with environmental education that means ocean literacy not only about ocean content knowledge but

also related to awareness, attitude, skills, and participation [15]. The different thing in Indonesia, environmental education has not been structured in a specific curriculum. Indonesian students taught environmental education through science, the subject of science learning. Ocean literacy is a part of scientific literacy so that ocean literacy can learn through science classrooms. Strang states than someone can not be declared as a science-literate if he or she, not an ocean literate [16].

Ocean literacy is a new term that is often discussed and introduced by marine experts. Ocean literacy is also still little studied by practitioners of Education, especially for those in the Asian region [17]. Ocean literacy appears as a response to the threat of ocean sustainability, which is increasing every year. In 2002 UNESCO, through the program Decade of Education for Sustainable Development (DESD), strived to maintain biodiversity and increase public awareness of the ocean ecosystem. In the same year, marine scientists also formulated consisting of 7 basic principles and 45 sub-principles which intended for the K-12 curriculum in the United States. Ocean literacy defined as a person's understanding of the vital role of the ocean for their life and vice versa [18]. An ocean literate has the following three characteristics: 1) understanding the essential principles and basic concepts of ocean literacy, 2) communicating the sea in a meaningful way, and 3) making responsible decisions and informed regarding the ocean's resources [19]. There are several versions of the ocean literacy measurement instruments developed by experts [15], [20]-[22]. Recent studies also state that the community's ocean literacy is still in the low and medium category. Plankis found that the ocean literacy of K-12 students in America is still low [21], Guest found that youth in Canada has low ocean content knowledge [23], and Mogias found that the ability of Greek Pre-service teachers and Elementary Students from the Mediterranean region has moderate ocean content knowledge [24], [25].

## 2. RESEARCH METHOD

### 2.1. Research Design and Participant

It is a descriptive research used survey methods conducted at SMPN 2 Kretek Yogyakarta, which located near the coast (Parangtritis Coast). The sample of this research was 60 Grade Eight. All of students were chosen randomly.

### 2.2. Instruments

The instrument used to measure students' ocean literacy is an adaptation of the IOLS previously developed by Fauville [15]. Some of the questions in the tool also found in the instruments developed by Plankis [21] and Mogias [24]. The ocean literacy instrument in

this study is a multiple-choice question with four possible answer that adjust to the cognitive abilities and geographic location of students. The ocean literacy instrument consists of 43 items representing all ocean literacy sub-principles (Table 1). The duration of the test is 60 minutes.

**Table 1.** Distribution of ocean literacy questions

| No   | Principles   | Number of Questions |
|--|--|---------------------|
| 1 <sup>st</sup>  | Earth has one big ocean with many features                 | 9                   |
| 2 <sup>nd</sup>  | The sea and life in it shaped our planet                   | 6                   |
| 3 <sup>rd</sup>  | The sea has a significant influence on weather and climate | 7                   |
| 4 <sup>th</sup>  | The sea makes Earth habitable                              | 2                   |
| 5 <sup>th</sup>  | The sea supports ecosystem and has a great diversity       | 10                  |
| 6 <sup>th</sup>  | The ocean and humans are inextricably interconnected       | 7                   |
| 7 <sup>th</sup>  | The sea still unexplored largely                           | 7                   |
| <b>PS:</b> The number of questions on each principle of ocean literacy adjusts to the number of its sub-principles |  |                     |

### 2.3. Data Analysis

There were two data analyzes carried out, namely descriptively and statistically. Descriptive analysis carried out by determining the average score of students on each principle of ocean literacy. Data also grouped into three categories (Table 2), according to Azwar [26].

**Table 2.** Score categories

| Category  | Range                |
|-----------|----------------------|
| Low       | $x < 46.9$           |
| Moderate  | $46.9 < x \leq 67.3$ |
| Very High | $67.3 < x$           |

Statistical analysis using SPSS v.21 and processed non-parametric because the normality test (Liliefors value) not fulfilled so that the Kruskal Wallis test determined normality. The Mann-Whitney U-test conducted to see the differences in the achievement of ocean literacy between male and female students.

## 3. RESULTS AND DISCUSSION

### 3.1. Results

There are 60 samples accepted for further analysis. The data consisted of 29 male students and 31 female students. Based on the data analysis, it is known that the average score (57.1), maximum score (74.4), and minimum score (27.9). Then, data categorized according to table 2. The results of the data analysis stated that

73% of students classified as moderate, while 13% were in low and high categories (see Table 3). The detailed explanation based on gender can see in figure 1.

which is known to have a value of 0.204, which is known to have a value of 0.204, which is small from the significance level value (0.05). The findings state that

**Table 3.** Data analysis student’s ocean literacy

| Participants | Descriptive |      |            |           | Styles         |            |         |                       |
|--------------|-------------|------|------------|-----------|----------------|------------|---------|-----------------------|
|              | n           | Mean | Max. Score | Min Score | Mann-Whitney U | Wilcoxon W | Z       | Asymp Sig. (2-tailed) |
| Overall      | 60          | 57.1 | 74.4       | 27.9      | 10.2           | 364.000    | 860.000 | -1.271                |
| Male         | 29          | 58.2 | 74.4       | 27.9      | 11.1           |            |         |                       |
| Female       | 31          | 56.0 | 69.8       | 34.9      | 9.3            |            |         |                       |

Based on data analysis per the principle of ocean literacy, it is known that from the seven ocean literacy principles, the lowest score is in 4<sup>th</sup> principles and 7<sup>th</sup> principles, and the highest score is in 3<sup>rd</sup> principles and 6<sup>th</sup> principles. Male students only had a slightly higher average of 58.2, with female students having an average of 56.0 (see Figure 1).

there is no gender influence on students’ ocean literacy.

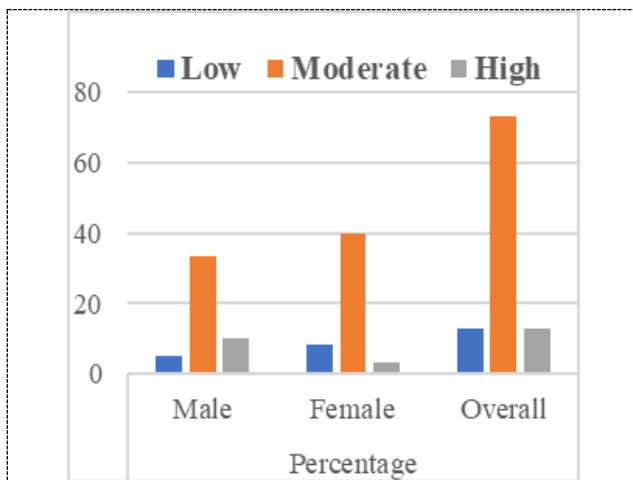
**3.2. Discussion**

The results of the measurement of ocean literacy of 60 students tell us that even though they live on the coast, their ocean literacy is still in the moderate category. These results are the same as the research conducted by Mogias on Elementary School students [25]. Based on the study of ocean literacy in terms of gender, it is known that the average score of male students not much different from female students (see Figure 1).

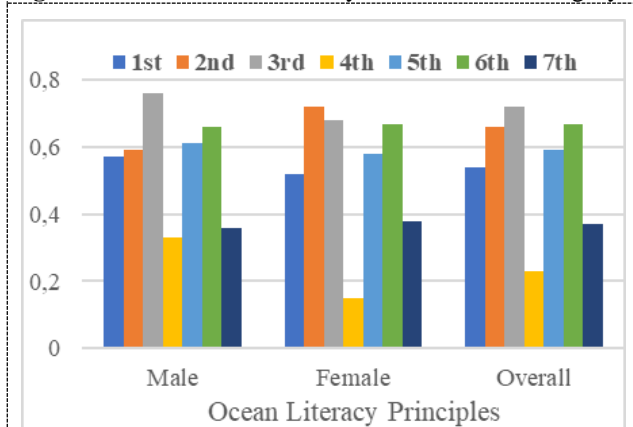
Mean score of male students is only slightly higher than female students. This is because, most male students in Indonesia have more access and opportunities to do activities outside the home. The ocean knowledge related to the intensity and acquisition of student’s nature- related experience [25]. Male students outperformed female students on 3<sup>rd</sup> and 4<sup>th</sup> ocean literacy principal and female students outperformed male students on 2<sup>nd</sup> ocean literacy principal (see Figure 2). Statistical analysis also state that students’ ocean literacy does not correlate with student gender [22], [23], [25], [31].

There were 65% of students have difficulty answering question number 8 (Figure 3).

This question about understanding the concept of the water cycle as part of the biogeochemical cycle [27]-[29] even though this material has studied at the primary school level. There were 72% of students also experienced misconceptions when asked about the source of sea salt. [23]. Most students think that salt has existed since the beginning of the sea, even though the correct answer is that sea salt comes from the erosion of land rocks.



**Figure 1** Students ocean literacy score based on category



**Figure 2** Students ocean literacy score for each principle

Table 3 presents the statistical summary ocean literacy score of male and female students. The average ocean literacy of male students is not much different from that of females. The results of statistical analysis were interpreted by the value of Asymp. Sig. (2-tailed)

8. When you were in Elementary school, you have learned that there are water cycle like the one in the picture below.



Source: <http://sangjuara.co/siklus-air/>

Based on this figure, the stages of the water cycle that can occur in the sea are ...

- A. condensation and precipitation
- B. infiltration and condensation
- C. precipitation and
- D. evaporation and infiltration

Figure 3 Sample Question

39. Look at the following picture!  
This is a Boya which is a device used to detect the presence of tsunami waves. This tool will be connected via satellite to track the movement of ocean currents.



Source: <https://id.wikipedia.org/wiki/Boya>

The use of technology as above aims to ...

- A. Reduce measurement error
- B. Reduce the impact on the marine environment
- C. Reduce the cost of observation
- D. Collect more observational data

Figure 4 Sample Question

Based on the analysis per the principle of marine literacy, it knew that the lowest student score is in the fourth and seventh ocean literacy principles (see Figure 2) [30]. The fourth principle relates to the main reason why humans must preserve the sea because of its vital role for humans. The sea makes the Earth humanizable. The sea is the most significant oxygen resources for humans. Students do not know yet that most of the oxygen comes from the sea through photosynthetic activity by phytoplankton. So far, students only know that oxygen comes from the atmosphere and plants. The seventh principle deals with invitations in exploring further about the sea. Students do not yet know various technologies related to the marine exploration. In question number 39 (Figure 5) regarding the function of the Buoy, the students did not realize that its role was as a tsunami early detection device.

Based on this fact, the concepts related to the sea (its component, functions, and processes) should be taught more deeply to students by adopting the idea of ocean literacy principles into teacher learning instruction [[3], [32]]. Students should also be encouraged to do hands-on activities related to marine exploration because this can also train ocean literacy [33]. The hands-on activity is expected to increase curiosity and students' interest in learning about the ocean or further to work in the STEM field (ocean career) [23].

#### 4. CONCLUSION

Students' ocean literacy is still in the moderate category. So that more intensive learning is needed to improve it. Students need to understand more about the role of the ocean so that the Earth could be inhabited by humans and need to learn about advanced efforts to explore the sea widely. The results of data analysis also stated that gender does not have a significant effect on students' ocean literacy.

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