



Assessing Environmental Literacy for Flood Disaster Mitigation in Elementary School

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Abstract

This research aims to assess the environmental literacy of students at SDN Rogo, Dolo Selatan, Central Sulawesi, and its relationship with their flood disaster mitigation skills. A quantitative descriptive approach was used, with total sampling of all upper-grade students. Data were collected through a questionnaire evaluating students' understanding and attitudes toward flood disasters. Environmental literacy was measured using four indicators: ecological knowledge, cognitive skills, environmental affect, and pro-environmental behavior. These indicators reflect students' understanding of ecological concepts, analytical abilities regarding environmental issues, emotional awareness, and participation in sustainability practices. The findings show that students scored 78.85 percent in ecological knowledge, 76.34 percent in cognitive skills, 77.30 percent in environmental affect, and 78.13 percent in pro-environmental behavior, resulting in an overall environmental literacy score of 77.08 percent, categorized as good. These results indicate that students have a strong foundation in environmental understanding and are actively engaged in sustainable practices. Their cognitive and behavioral skills contribute to disaster risk reduction through informed decision-making and preventive actions. However, the study is limited to a single school context and relies on self-reported data, which may introduce response bias. Future research should involve broader samples and observational methods to improve the validity of the findings.

Keywords: environmental literacy, ecological knowledge, cognitive skills, environmental affect, behavior

INTRODUCTION

Environmental literacy is the ability of individuals to understand, analyze, and take action on environmental issues. In the context of disaster mitigation, environmental literacy enables students to recognize potential hazards in their surroundings and take appropriate preventive measures. Disaster mitigation education in schools is crucial to equip students with knowledge and skills to face natural disasters (Labudasari & Rochmah, 2020). Furthermore, connecting global environmental literacy studies with local case studies can help contextualize broader theories within specific community experiences, making the findings more generalizable.

Flooding is an event where water overflows onto normally dry land, occurring when water flow, such as from heavy rain or rivers, exceeds its capacity. Factors such as extreme rainfall, deforestation, land-use changes, and poor drainage systems are major causes of flooding in various regions. From an environmental perspective, flooding often results from a combination

of natural phenomena and human activities that exacerbate the hydrological conditions of an area (Elda et al., 2024). A deeper understanding of these contributing factors can help formulate more effective mitigation strategies. Flash floods are a common natural disaster in Sigi Regency, Central Sulawesi, with significant impacts on the local community. On April 17, 2024, a flash flood struck Balongga Village in Dolo Selatan District, Sigi Regency, affecting 73 houses, with nine deemed uninhabitable. The flood brought mud, wood, and stones, damaging infrastructure and forcing residents to evacuate to safer locations (Wismabrata, 2021). The causes of flash floods in Sigi include high rainfall, deforestation in upstream areas, land-use changes, and inadequate drainage systems (SDA-net, 2021). This case study highlights the need to strengthen environmental literacy among students, particularly in disaster-prone areas, to enhance their preparedness and response strategies.

Flood disaster mitigation for students is vital to raise awareness and knowledge about flood hazards and ways to reduce their risks. Studies show that developing flood disaster mitigation learning media can enhance students' understanding of the steps to take before, during, and after a disaster occurs (Partini & Pinoa, 2023). Moreover, disaster mitigation education in schools also plays a role in shaping students' proactive behavior toward the environment. By understanding the negative impacts of environmentally unfriendly behaviors, students can take preventive actions, such as maintaining environmental cleanliness and avoiding littering, which can reduce the risk of flooding. Establishing strong connections between global environmental literacy studies and local initiatives can further improve the effectiveness of these educational programs.

Students' environmental literacy plays a crucial role in disaster mitigation, as a good understanding of the environment enables them to recognize potential disaster risks and take appropriate preventive actions. Several studies suggest that integrating disaster mitigation materials into the curriculum can improve students' environmental literacy. For instance, developing integrated learning media on environmental literacy for flood disaster mitigation topics has proven effective in enhancing students' understanding (Aini et al., 2023). A more explicit connection between these educational efforts and their practical applications in disaster-prone areas will enhance the relevance and applicability of the research findings. Environmental literacy integrated into formal education can increase students' awareness of environmental issues while encouraging proactive behavior in disaster mitigation. Research indicates that teaching that links ecological concepts to disaster impacts, such as flooding, helps students understand the relationship between environmental damage and the increased risk of disasters. It also provides insights into the importance of preventive actions, such as keeping rivers clean, reducing plastic usage, and supporting reforestation activities. This approach not only enhances knowledge but also builds a sense of environmental responsibility in everyday life (Elda et al., 2024). Strengthening these educational frameworks with localized case studies, such as the flooding in Sigi, can further reinforce students' understanding and engagement.

Strengthening students' environmental literacy is crucial for building knowledge, affect, and skills about the environment, making students agents of change in preventing environmental damage (Napitupulu et al., 2022). The findings of this study are expected to identify the extent of students' knowledge, affect, and behaviors toward flood disaster mitigation to minimize risks, including material losses and casualties. Additionally, clarifying the selection of SDN Rogo as the research site will provide further context on why this location is particularly relevant for studying disaster mitigation education. Given its exposure to natural disasters, SDN Rogo serves

as a valuable case study to examine how environmental literacy influences disaster preparedness and response among students.

METHODS

This research employs a quantitative descriptive method (Creswell & Creswell, 2018) aimed at describing the level of environmental literacy among students in areas prone to flash floods, specifically in Dolo Selatan. The research adopts a quantitative approach to collect data on students' knowledge, cognitive skills, environmental affect, and behaviors related to environmental literacy, which are then correlated with their flood disaster mitigation abilities. In this research, the participants consisted of all upper-grade students at SDN Rogo, specifically grades IV, V, and VI. Since the population size was less than 100, the total sampling technique was employed, where the entire population was included as the research sample. Total sampling is described as a sampling method in which every individual in the population is included in the sample. This approach ensures that all elements within the population being studied are fully represented (Firmansyah & Dede, 2022).

This research utilizes various relevant sources of information to support the analysis of students' environmental literacy in the context of flash flood disaster mitigation in Dolo Selatan, Central Sulawesi. The primary sources include academic journals discussing environmental literacy as well as other journals examining the relationship between environmental literacy and disaster preparedness. Additionally, educational psychology reference books are used to explain students' cognitive and affective development, which serve as the foundation for understanding their ability to analyze environmental issues and preparedness for disasters. The research also refers to official curriculum documents that outline the integration of environmental education into school learning, making it relevant for understanding how students' environmental literacy can be developed through teaching and learning activities. The primary data in this study were obtained through a questionnaire designed to measure students' environmental literacy. Additional literature, such as environmental education theories and studies on disaster mitigation, supports the interpretation of the research findings.

Validity and reliability tests were conducted to ensure data accuracy. The reliability test aimed to measure the consistency of the results obtained, while the validity test ensured that the instrument truly measured the aspects of environmental literacy being studied. Furthermore, statistical analysis in this study was carried out by comparing the average scores of each environmental literacy indicator to identify which aspects need improvement in supporting students' environmental literacy, particularly in enhancing their disaster mitigation knowledge. This research also adapted the MSELS instrument to be more relevant to the local context of students at SDN Rogo, with some modifications to the questions to reflect the local environmental conditions. In the development process, the first step was designing the questionnaire framework based on four components or indicators of environmental literacy. This questionnaire framework is presented in table 1.

Table 1. Framework of Environmental Literacy Instrument

Indicator	Competency	Questions Number	Total
Ecological Knowledge	Understanding basic concepts related to environmental issues	1 – 9	9
Cognitive Skill	Being able to analyze, evaluate, think critically, and solve environmental problems	10 – 18	9
Environmental Affect	Demonstrating care and empathy towards environmental issues through personal awareness and a willingness to contribute to environmental preservation	19– 25	7
Behavior	Carrying out concrete actions that support environmental sustainability	26– 33	8

Source: McBeth & Volk (2010)

For the categories of environmental literacy in this study, the Eco Schools Value categories by Igbokwe (2016) were used, as presented in table 2.

Table 2. Environmental Literacy Category

Score	Interpretation
< 50	Not enough at all
50 - 59	Not enough
60 - 69	Enough
70 - 79	Good
> 80	Very good

Source: Igbokwe (2016)

Data on environmental literacy were collected using a questionnaire specifically designed for this study. The questionnaire was directed at students as respondents and included questions aligned with the aspects of environmental literacy being measured. This study refers to the four main components of environmental literacy based on the Middle School Environmental Literacy Survey (MSELS) developed by McBeth (2010). These components include: ecological knowledge, cognitive skills, environmental affect, and behavior. The questionnaire consisted of closed-ended questions aimed at measuring students' knowledge, affect, skills, and behaviors regarding environmental issues, adapted to the conditions surrounding the study location. It also incorporated disaster-related content, particularly on flood disaster knowledge. The questionnaire was designed in two formats: test and non-test. The test format was used to evaluate indicators of ecological knowledge and cognitive skills, while the non-test format was aimed at assessing environmental affect and behaviors.

After measuring students' environmental literacy, the collected data were analyzed to identify literacy levels based on indicators such as knowledge, cognitive skills, environmental affection, and behavior. Following the analysis, the next step was to draw conclusions from the study to determine the extent to which students' literacy abilities influenced their preparedness for flood disaster mitigation. The data analysis technique used in this study employs descriptive statistics. The data processed through descriptive statistics consist of a summary of students' responses to environmental literacy indicators. The collected research data were then analyzed using descriptive statistics and aligned with the criteria for environmental literacy.

RESULT AND DISCUSSION

Result

Environmental literacy is the ability of individuals to understand, interpret, and take appropriate actions to maintain, restore, or enhance the health of ecosystems. Environmental literacy equips individuals with awareness of their surroundings, enabling them to address environmental issues optimally (Hudha et al., 2021). After measuring the environmental literacy of students in grades IV, V, and VI at SDN Rogo, the results are presented in table 3. The collected data were analyzed using descriptive statistics and aligned with environmental literacy criteria. The total scores obtained for each indicator were as follows: ecological knowledge scored 220 out of a maximum score of 279, cognitive skills scored 213 out of a maximum score of 279, environmental affect scored 671 out of a maximum score of 868, and behavior scored 775 out of a maximum score of 992. The formula used to calculate environmental literacy is adopted from Rokhmah et al. (2021) resulted environmental literacy score 77.08% which falls into the good category. It is necessary to implement more interactive and experience-based learning strategies, such as environmental observation activities, disaster mitigation simulations, and project-based approaches, to enhance students' understanding of these aspects and encourage them to become agents of change in disaster mitigation and environmental preservation.

Table 3. The Average Score for Each Indicator

Instrument	Indicator	Total Score	Average Percentage	Number of Question
Test	Ecological Knowledge	220	78.85 %	9
	Cognitive Skills	213	76.34 %	9
Non Test	Environmental Affect	671	77.30 %	8
	Behavior	775	78.13 %	9

Discussion

Environmental literacy is an individual's ability to understand environmental issues and to behave effectively in a pro-environmental manner. It encompasses the knowledge, skills, and attitudes necessary to make wise decisions related to the environment (Fetiana et al., 2022). Cultural and social factors play an important role in shaping environmental literacy competencies (Hermawan et al., 2024). Environmental literacy also includes awareness of sustainability values and actions that support them. To improve students' environmental literacy skills, various methods can be employed, such as project-based learning (Kuswendi & Arga, 2020) and the development of learning modules aimed at enhancing students' knowledge and attitudes towards the environment (Nuswowati et al., 2024).

Environmental literacy refers to the ability to understand, manage, and solve environmental issues effectively. It involves not only understanding environmental issues but also the ability to adapt, actively participate, and take action in supporting environmental sustainability. In the context of education, environmental literacy is essential for fostering students' awareness of environmental issues and enhancing their ability to participate in disaster mitigation efforts (Partini & Pinoa, 2023). The indicators of environmental literacy were measured using validated and tested instruments, and the results demonstrated that these instruments are reliable for assessing students' cognitive skills in the context of environmental literacy. The assessment was

tailored to the context of the students' residential and school environment in Rogo, Dolo Selatan District.

Table 3 shows the results obtained from the respondents, in this case, the students, regarding environmental literacy, which consists of four indicators: ecological knowledge, cognitive skills, environmental affect, and behavior. Ecological knowledge in environmental literacy refers to the understanding of basic ecological concepts, including knowledge of ecosystems, energy flow, material cycles, and the relationships between organisms and their environments. This knowledge is essential for identifying environmental issues such as climate change, pollution, and biodiversity, as well as for planning mitigation and environmental recovery actions (McBeth & Volk, 2010). Based on Table 3, it can be seen that for the indicator of ecological knowledge, there are 9 multiple-choice test questions. Each correct answer is given a score of 1, and the test was administered to 31 students. Therefore, the maximum score that can be obtained for this indicator is 31, if all students answer all questions correctly. When expressed as a percentage, the overall achievement for this indicator is 78.85%.

The next indicator is cognitive skills. In environmental literacy, cognitive skills refer to the ability of students to identify environmental problems, analyze environmental conditions, and plan solutions for the environmental issues they face. These skills include critical thinking, analytical thinking, and planning in the context of environmental problems relevant to their lives (Kusumaningrum, 2020). The knowledge gained through these cognitive skills helps students to connect local and global environmental issues and take appropriate actions to address those issues, including in their preparedness for disaster mitigation, particularly flood disasters. Based on table 3, it can be seen that for the indicator of cognitive skills, there are 9 multiple-choice test questions. Similar to the ecological knowledge indicator, each correct answer is awarded a score of 1, and the test was administered to 31 students. Therefore, the maximum score that can be obtained for this indicator is 31, if all students answer every question correctly. When expressed as a percentage, the overall achievement for this indicator is 76.34%. The next indicator is environmental affect. Environmental affect is described as an individual's emotional connection and response to the environment, which influences their awareness and actions toward preserving and protecting it. This environmental affect is important in shaping students' character and their responsibility for environmental sustainability. Environmental affect not only includes understanding the importance of protecting nature but also involves taking concrete actions in daily activities, such as maintaining environmental cleanliness, using natural resources wisely, and participating in conservation efforts (Khoerunisa, 2024).

In another research, it was also explained that environmental concern refers to verbal commitment and sensitivity to environmental issues, which includes students' feelings and attention to environmental issues, as well as their willingness to act for the benefit of the environment. This attitude also involves appreciation for nature, awareness of the importance of sustainability, and the conservation of natural resources (Nurhakim & Anita, 2024). As part of the environmental literacy indicator, environmental affect is measured through a questionnaire or attitude scale assessment specifically designed for this research. This assessment consists of 7 statements with response options ranging from strongly disagree, disagree, agree, to strongly agree, with scores of 1, 2, 3, and 4, respectively. table 1 shows that each statement fluctuated in results, with a total score of 671. If students strongly agree with all the statements in this indicator, each statement would receive a score of 27, so the maximum score for all statements is 868, as

there are 31 respondents or students. The total average percentage for this indicator is 77.30%. The scores obtained for each indicator were then added together and divided by the total maximum score, then multiplied by 100%. Using this formula, the students' environmental literacy result is obtained.

The final indicator of environmental literacy is behavior. Environmental behavior refers to the real actions taken by individuals to protect, preserve, and maintain the environment around them. This behavior is not limited to understanding or attitudes toward the environment, but also includes visible activities, such as reducing waste, using natural resources wisely, participating in reforestation programs, or implementing environmentally friendly policies in daily life (Nurmu'minah et al., 2024). Behavior is shaped by various factors, such as knowledge, personal experiences, social relationships, and influences from the social environment. When students have a good understanding of environmental issues, they are more likely to act in ways that support environmental sustainability. Environmental behavior is not just about knowing what should be done, but also about the willingness to take action and make lifestyle changes to preserve and protect the environment (Nurmu'minah et al., 2024). Other research also explains that pro-environmental behavior refers to the actual actions taken to protect and preserve the environment. This aspect includes practices that are directly related to reducing negative environmental impacts, such as recycling, energy conservation, and organic gardening activities. This behavior is a tangible manifestation of environmental literacy, demonstrating an individual's commitment to environmental sustainability (Zahrani et al., 2024).

Based on Table 1, the assessment of behavior consists of 8 statements with choices ranging from never, rarely, often, to always, with scores of 1, 2, 3, and 4. Table 2 shows that each statement received varying results, with a total score of 775 and the maximum score for all statements being 992 because there were 31 respondents or students. The overall average percentage for this indicator is 78.13%. To obtain the overall environmental literacy score of students, the total scores of all indicators are summed, then divided by the maximum score of all indicators and multiplied by 100% (Labudasari & Rochmah, 2020). From this formula, the environmental literacy knowledge score is 77.08%. Based on the categorization according to Igbokwe (2016), the environmental literacy ability of SDN Rogo students falls into the "good" category. This achievement is the overall result from each indicator, meaning that the average achievement of each indicator is in the "good" category. The detailed results are shown in figure 1.

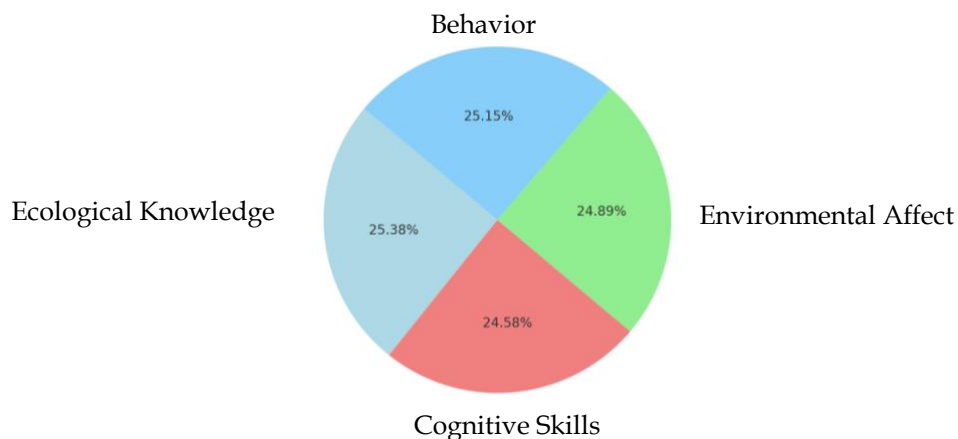


Figure 1. Percentage of Results for Each Indicator

The diagram in Figure 1 displays the distribution of the average percentage of the four indicators related to students' environmental literacy. Each sector in the diagram shows the contribution of each indicator to the overall result, with nearly equal figures across all four. Ecological Knowledge contributes 25.38%, reflecting students' understanding of ecosystems and the environment. Cognitive Skills, related to critical thinking and problem-solving abilities, contribute 24.58%. Environmental affect reflecting students' awareness of environmental issues, including flood disasters, contributes 24.89%. Finally, Behavior, which reflects students' real actions in applying environmental knowledge, including efforts to prevent flood disasters, contributes 25.15%. Overall, this diagram shows that the four indicators contribute almost equally to the overall level of students' environmental literacy.

Understanding the basic concepts and principles of the environment enables individuals to recognize existing environmental issues. This knowledge forms the foundation for effective analysis and problem-solving in environmental matters. The four indicators support each other and help shape individuals who not only understand environmental issues but also possess the ability to analyze, a positive attitude, and take real action toward environmental conservation. Environmental literacy plays a crucial role, especially in increasing public awareness and understanding of the increasingly complex environmental issues. Environmental literacy education can encourage individuals to take real actions for environmental sustainability, such as reducing energy consumption, recycling, and supporting eco-friendly policies. The application of environmental literacy also helps raise awareness of the negative impacts of human activities on the environment and encourages behavior change toward more environmentally friendly practices. By enhancing environmental literacy, individuals are expected to make more environmentally conscious decisions, which, in turn, can contribute to the preservation of nature and sustainable development (Miterianifa & Mawarni, 2024).

This research provides a clear picture of students' understanding and skills in environmental literacy. The environmental literacy instrument used in this research was designed contextually according to the environmental conditions around the students, especially in understanding and preparedness for flood disaster mitigation. Environmental literacy is considered capable of increasing students' awareness of the importance of environmental conservation and disaster risk mitigation. This is important because flood disaster mitigation heavily depends on the knowledge and actions of the community, which can start with education in schools (Aini et al., 2023). An important aspect needed in flood disaster mitigation preparedness involves three main dimensions: knowledge, affect, and skills. Knowledge about disasters, including the causes of floods, prevention measures, and response methods, is crucial in reducing disaster risks. In addition, the affect toward disaster reduction also needs to be developed, including sensitivity to disaster prevention, values related to risk reduction, and a sense of responsibility for mitigation. Practical skills in preparedness, such as the ability to respond to emergencies, are necessary so that individuals can act quickly and appropriately when a disaster occurs. Integrated disaster mitigation education within the school curriculum also plays a key role, as it can equip students with the knowledge and skills needed to face disasters, including floods (Prihantini et al., 2020).

Good knowledge and affect about disasters, including floods, are factors that can improve disaster preparedness and mitigation capacity, which are part of mitigation efforts. Environmental literacy is essential in preventing and reducing the impact of recurring and periodic flood disasters. The concept of literacy has evolved, initially limited to the ability to read and write, but

now transformed into a new paradigm closely related to community life. Environmental literacy is defined as an individual's ability to understand and interpret the environmental conditions around them. Based on their understanding and interpretation, they can decide on the appropriate actions to preserve, restore, and enhance the environmental condition (Subhan, 2017). Good environmental literacy encourages students not only to understand environmental issues but also to take proactive actions for disaster mitigation. This shows that enhancing environmental literacy is directly related to students' disaster mitigation preparedness, especially in facing floods, which frequently occur in the region. Good environmental literacy involves more than just understanding ecological concepts—it encourages students to adopt a proactive stance, making informed decisions that contribute to disaster mitigation efforts. This aligns with the idea that when students are well-versed in environmental issues, they are more likely to participate in preventive measures.

Environmental literacy needs to be integrated into the curriculum to ensure that students not only acquire theoretical knowledge but also develop the cognitive and behavioral competencies required for disaster preparedness. Research indicates that integrating disaster education into subjects like geography can enhance students' awareness and preparedness for disaster risks. By incorporating disaster literacy into the curriculum, students can develop essential mitigation skills and a culture of preparedness.

CONCLUSION

Conclusion

The environmental literacy of students at SDN Rogo, Dolo Selatan, Central Sulawesi, shows good results, with an average score of 77.08%. This reflects that students possess adequate understanding of environmental issues, analytical skills to address environmental problems, as well as environmental affect and pro-environmental behavior that support environmental conservation. Good environmental literacy plays a significant role in enhancing flood disaster mitigation skills, as students who understand basic ecological concepts and possess cognitive skills and pro-environmental affect are better equipped to recognize disaster risks and take appropriate preventive measures. The findings of this study also indicate that students' environmental literacy directly influences their preparedness for flood disaster mitigation. Their understanding of ecosystems and environmental phenomena, combined with cognitive skills, enables them to identify and analyze flood risks. Furthermore, environmental affect and pro-environmental behavior encourage preventive actions that help reduce the impact of flood disasters.

Suggestions

Environmental literacy education should continue to be strengthened in schools, particularly in disaster-prone areas, by integrating more disaster mitigation-related content into the curriculum. Schools can implement project-based learning that involves simulations or disaster mitigation exercises to enhance students' practical skills in managing disaster risks. Additionally, collaboration between schools, local governments, and relevant organizations is essential to provide resources and training to support the improvement of environmental literacy and disaster preparedness among students. For future research, it is recommended to assess the

long-term impact of environmental literacy programs on students' real actions in disaster mitigation. This evaluation could examine how their understanding develops over time and how environmental literacy influences their decision-making and responses to disaster threats. Thus, the research findings can provide more targeted recommendations for curriculum development, learning strategies, and educational policies that effectively build disaster preparedness from an early age.

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