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ENVIRONMENTAL DECISION-MAKING SKILLS THROUGH LITERACY WORKSHEETS IN MADRASAH: AN ESD PERSPECTIVE

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Abstract: This study aimed to examine and analyze the impact of learning using environmental literacy-based worksheets on the development of environmental decision-making skills, as well as how these skills increase students' environmental awareness within the framework of Education for Sustainable Development (ESD). An experimental design was used in this study. Quantitative data were collected through improvements in students' environmental literacy using tests, observations, and questionnaires administered to 52 sixth-grade students in Indonesia, while qualitative data were obtained through interviews and classroom observations. Descriptive and correlation analyses were used to explore the relationship between the use of environmental literacy worksheets, decision-making skills, and environmental awareness. The results of the MANOVA effectiveness test showed a significance value of 0.000 < 0.05. These findings indicated that the use of environmental literacy worksheets has a significant effect on the development of environmental decision-making skills. This effect is evident in the aspects of resource use, energy conservation, and environmental problem solving. The findings imply that integrating environmental literacy-based worksheets into primary education can serve as an effective pedagogical strategy to foster sustainable decision-making competencies. Furthermore, this approach supports the practical implementation of ESD by equipping students with the skills needed to address real-world environmental challenges, thereby contributing to the development of environmentally responsible citizens.

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INTRODUCTION

The environment is the primary source of basic needs for all living organisms, including humans, animals, and plants (Ergogo et al., 2023 and Vioreza et al., 2023). The relationship between humans and the environment is reciprocal, indicating strong interdependence (Ainin & Asafri, 2023 and Algurén, 2025). Humans rely on the environment for survival and development, while the environment requires human responsibility for its preservation (Aulia & Aji, 2024 and Bennett & Reyers, 2024). This relationship highlights the importance of environmental literacy, which encompasses knowledge, attitudes, and actions aimed at maintaining environmental balance and addressing environmental problems (Bahtiar et al., 2025 and Lin et al., 2025). Environmental literacy is not only about understanding environmental concepts but also about the ability to make appropriate decisions regarding environmental issues. Therefore, environmental decision-making skills become a crucial component in achieving sustainable environmental behavior (Figueiredo et al., 2023 and Sánchez-García et al., 2025).

However, various phenomena indicated that environmental literacy among elementary school students remains low. This is reflected in students' limited participation in environmentally friendly behaviors, such as maintaining cleanliness, saving energy, and showing responsibility toward their surroundings. In classroom practice, environmental education is often treated as a separate activity rather than being integrated into daily learning, resulting in students having minimal opportunities to develop critical thinking and decision-making skills related to environmental issues. Based on preliminary observations conducted at MIN 1 Bantul, students were found to have low awareness in applying environmentally responsible behavior, such as improper waste disposal, excessive energy use, and limited involvement in environmental activities at school. Consequently, many students demonstrated a lack of awareness and responsibility toward environmental problems. This condition showed that students not only have limited environmental knowledge but also lack the ability to analyze environmental problems and make appropriate, responsible decisions in real-life situations.

One potential solution proposed in this study is the integration of Education for Sustainable Development (ESD) with Problem-Based Learning (PBL) supported by appropriate learning media. This solution is formulated by the researcher in response to the identified gap in students' environmental literacy and decision-making skills. Behaviorist theory highlights the importance of stimuli in facilitating learning responses, where instructional media play a key role in attracting attention and building understanding (Hatija et al., 2025 and Junaidah et al., 2025). The implementation of ESD and PBL requires appropriate learning media. Behaviorist theory emphasizes that learning requires stimuli and responses. Stimuli (teaching media, environment, concrete materials) help attract attention, build understanding, and facilitate learning responses (Meha et al., 2025 and MuhammedZein & Abdullateef, 2025). In order for the integration of ESD and PBL to be implemented effectively, learning media that facilitate

students to use more complex materials, more challenging tasks, real local frameworks, and direct experiences are needed. Stimuli help to provoke sensitivity and understanding of the environment. One relevant medium that can facilitate active and contextual activities is the Student Worksheet.

Student worksheets, as structured learning media, can provide real-life environmental problems, encourage active participation, and support students in developing decision-making skills through direct experience. In addition, sustainable education emphasizes the integration of environmental, social, and economic aspects in real-life contexts, which can enhance students' environmental decision-making skills (Mukaromah et al., 2025 and Rakesh et al., 2024). According to Reichherzer et al., 2022 and Sánchez-García et al., 2025), primary school students are in a critical stage of cognitive development, where learning experiences can shape long-term thinking patterns and behaviors. Therefore, environmental education in *madrasah ibtidaiyah* should not only focus on awareness but also on developing students' abilities to analyze environmental problems, evaluate alternatives, and make responsible and sustainable decisions.

Previous studies have demonstrated that student worksheets are effective in improving learning outcomes, particularly in enhancing students' cognitive abilities, engagement, and active participation in the learning process. Worksheets that are designed with contextual and problem-based approaches have also been shown to facilitate students' understanding of real-life issues and support the development of critical thinking skills (Sigit et al., 2024; Takyi et al., 2023). Furthermore, several studies indicate that the integration of environmental content into learning activities can significantly improve students' environmental literacy and awareness. The use of structured and interactive worksheets enables students to explore environmental problems, analyze possible solutions, and make informed decisions (Parent-Lamarche & Saade, 2024; Slimi & Carballido, 2023; Takyi et al., 2023). These findings suggest that worksheets have strong potential not only as instructional tools but also as effective media for fostering environmental literacy and supporting the development of environmental decision-making skills within an Education for Sustainable Development (ESD) framework, especially at the elementary school level.

This study identifies a clear gap in the existing literature, where previous research has predominantly focused on the use of worksheets to improve cognitive learning outcomes, with limited attention to their role in fostering integrated environmental competencies. In particular, studies rarely combine environmental literacy, environmental awareness, and decision-making skills within a single, structured learning framework, especially in the context of madrasah ibtidaiyah. Therefore, the uniqueness of this research lies in its integrative approach, which positions student worksheets not only as instructional media but also as tools to simultaneously develop environmental literacy and environmental decision-making skills through an Education for Sustainable Development (ESD) perspective. This study also introduces a contextualized learning design that aligns ESD principles with Problem-Based

Learning (PBL) to support higher-order thinking at the elementary level. Accordingly, the objective of this study is to analyze environmental literacy from an ESD perspective and examine its role in developing environmental decision-making skills among elementary school students through the implementation of student worksheets, while also proposing an integrative learning model that bridges these key competencies in primary education. The focus of this study is to develop an integrative learning model that supports sustainable decision-making skills at the primary education level.

RESEARCH METHOD

This study employed an experimental approach with a pretest-posttest design, focusing on the development of environmental literacy skills in sixth-grade students. The population consisted of 252 students from four Madrasah Ibtidaiyah schools in Indonesia, with 52 selected participants using purposive sampling. The selection of the four schools was based on specific criteria, including similarities in curriculum implementation, student characteristics, and school environment, as well as their relevance to the research focus on environmental literacy and decision-making skills. Additionally, these schools had not yet optimally integrated environmental education into classroom learning, making them suitable contexts for implementing the proposed intervention.

Figure 1. Environmental Literacy Worksheet

These students were divided into experimental and control groups. The experimental group used ESD-based student worksheets integrated with PBL, while the control group followed standard teaching methods. The main data collection methods included cognitive tests and observation sheets designed to measure students' attitudes during the learning process. The measurement was carried out by providing 28 multiple-choice questions that had been validated by validator lecturers and through validity and reliability tests. In addition, unstructured interviews were conducted to gain deeper insights into students'

responses and learning experiences, allowing flexibility in exploring participants' perspectives. Documentation was also used to support and validate the data obtained during the research process. The researcher conducted eight learning sessions with both groups.

Table 1 Reliability Test for Research Instrument Questionnaire

Variabel	Cronbach's Alpha	N of Items	Information
Multiple Choice	0.874	46	Reliabel
Questionnaire	0.737	20	Reliabel

Based on the results of the reliability test in the table above, it can be seen that the research questionnaire Variables, Multiple Choice 0.874, Questionnaire 0.737, has a Cronbach's Alpha value greater than 0.60. Based on this, the research questionnaire is declared to meet the reliability assumption and is declared reliable.

Table 2. Research Design Used

Group	***Pretest***	**Treatment**	***Postest***
EG	O_1	X_1	O_2
CG	O_3	-	O_4

Data analysis was carried out using multivariate statistical tests, including normality and homogeneity tests, to ensure the data met the assumptions of normality and homogeneity. A MANOVA test was used to assess the effectiveness of the intervention in improving students' environmental literacy. The hypotheses tested in this study included whether the application of ESD-based PBL worksheets significantly improved students' cognitive and affective environmental literacy.

RESULT AND DISCUSSION

Result

Environmental Literacy Measurement of Students in Cognitive Skills

Environmental literacy measured in this study was in the dimension of cognitive skills, which consisted of the aspects of environmental issue identification, environmental issue analysis, and problem-solving planning. A summary of the environmental literacy measurement results in the cognitive skills dimension can be seen in the following table:

Table 3. Results of Environmental Literacy Measurements in the Cognitive Skills Dimension

No	**Component**	**Eksperimen Class**		**Control Class**	
		Pretest	Posttest	Pretest	Posttest
1	Number of Students	26	26	26	26
2	Average Score	61.13	88.46	64.42	83.52
3	Highest Score	78.57	100.00	85.71	96.43
4	Lowest Value	35.71	71.43	32.14	57.14

Table 3 showed the results of environmental literacy measurements in terms of cognitive skills. The average cognitive skills of students in the experimental class on the pretest were 61.13 and on the posttest were 88.46. This indicates an increase in environmental literacy in terms of cognitive skills. Measurements in terms of cognitive skills include students' ability to make and choose decisions in solving problems related to the environment. Meanwhile, in the control class, the average pretest score was 64.42 and the average posttest score was 83.52. Of course, this indicates that students' environmental literacy in the cognitive aspect is higher in the experimental class, where students learn using environment-based worksheets and problem-based learning.

Environmental Literacy Measurement of Students in Attitude

Environmental literacy measured in this study was in the dimension of attitude, which consisted of verbal commitment, intention to act, environmental sensitivity, and personal responsibility. The measurement was carried out by observing the environmental literacy attitudes of students using an observation sheet. The observation of environmental literacy attitudes was carried out by observers who had received prior training. There were two observers in each class: elementary school teacher education students and the classroom teacher. In addition, the researchers also used video cameras to ensure documentation and to cross-check the validity of the data.

Table 4. Summary of Environmental Literacy Measurement Results on Attitude Aspects

No	Component	Eksperiment Class		Control Class	
		Pretest	Posttest	Pretest	Posttest
1	Number of Students	26	26	26	26
2	Average Score	67.63	86.70	66.35	79.41
3	Highest Score	81.25	100	81.25	89.58
4	Lowest Value	54.17	75.00	50.00	68.75
5	Standard deviation	7.46	7.48	6.37	6.02

Table 4 showed the results of environmental literacy measurements in terms of attitude. The average pretest score for the experimental class was 67.63, while the average posttest score for the experimental class was 86.70. This shows a significant increase between the pretest and posttest scores of students in terms of environmental literacy attitude. Meanwhile, in the control class, the average pretest score was 66.35 and the average posttest score was 79.41, indicating an increase but not a significant one. These results are supported by the researcher's documentation that the environmental literacy attitudes of students in the experimental class showed more positive responses and sensitivity to the environment. Pro-environmental decision-making and attitudes were also more evident in the experimental class, such as being active in responding and asking questions, actively participating in experiments on alternative energy, and many more.

Table 5. N-Gain Test Results

	Control Class		Experiment Class	
	Kognitif	Afektif	Kognitif	Afektif
Pretest	64.42	66.34	61.12	67.62
Posttest	83.51	79.4	88.46	86.69
N-Gain	0.53	0.38	0.7	0.58
Category	Medium	Low	High	Medium

The N-Gain test was conducted to determine the increase in students' environmental literacy after the implementation of the student worksheet media, taking into account their initial abilities (pre-test). N-Gain was analyzed in two aspects, namely cognitive and attitude (affective), and compared between the control group and the experimental group.

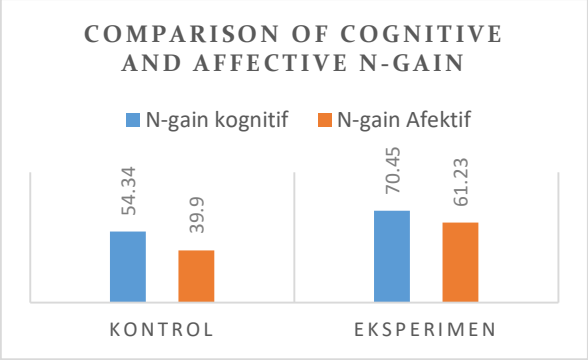

Figure 1. Comparison of Cognitive and Affective N-gain

Figure 1 clearly showed that both the control class and the experimental class experienced significant improvements in both cognitive and attitudinal aspects. The experimental class experienced a more significant improvement in attitudinal aspects. Meanwhile, there was also an improvement in cognitive aspects, but it was not very significant. This supports the discussion that the use of student worksheets has a significant implication and impact on students' attitudes in making decisions.

Table 6. Result of Multivariate Test

Effect	Test	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.995	2177.326	4	47	0.000
	Wilks' Lambda	0.005	2177.326	4	47	0.000
	Hotelling's Trace	185.304	2177.326	4	47	0.000
	Roy's Largest Root	185.304	2177.326	4	47	0.000
Group	Pillai's Trace	0.559	14.881	4	47	0.000
	Wilks' Lambda	0.441	14.881	4	47	0.000
	Hotelling's Trace	1.266	14.881	4	47	0.000
	Roy's Largest Root	1.266	14.881	4	47	0.000

The results of the effectiveness test using Manova show that the sig value in all tests obtained a significant value of 0.000, indicating that the ESD-based PBL integrated student worksheet media developed by the researcher is effective in improving students' environmental literacy in both cognitive skills and

attitudes. This is a new finding that the development of environmental literacy skills in elementary school students is not sufficient with only the programs that have been implemented by schools.

Table 7. Environmental Literacy Skills in Daily Environmental Management

No	Description	Percentage %
1.	Children's knowledge of environmental literacy	90
2.	Recognizing natural resources and their use	98
3.	Understanding the threat of environmental crisis	91
4.	Aware of the need for natural resources in the future	90
5.	Understanding the impact of natural resource use	90
6.	Skilled in the use of natural resources	86
7.	Environmental issue analysis	80
8.	Understanding the importance of environmental management from an early age	89

The results presented in Table 7 provide data related to environmental literacy in environmental management and children's environmental knowledge. Based on the quantitative findings above, it was found that the highest percentage of understanding was related to recognizing natural resources and their use (98%), followed by understanding the threats of environmental crisis (91%). Furthermore, the results show that children's knowledge of environmental literacy, awareness of the need for natural resources in the future, and knowledge of the impact of natural resource utilization have the same percentage, namely 90%. Lower scores were found in students' ability to analyze environmental problems (80%), indicating a relative gap in high-level decision-making processes related to environmental problem solving.

Table 8. Environmental Decision-Making Tendencies Related to Environmental Literacy

No	Statement	Percentage
1.	Environmental education	93
2.	Consistency in environmental management	90
3.	The potential for environmental independence in the future	98
4.	Good environmental management and literacy	90

Based on the results of collective data analysis in Table 2, elementary *madrasah* students have a good percentage in terms of environmental management. The data on environmental education teaching (93%) shows fairly good results, while consistency in environmental management (90%) has good stability support. The findings show that elementary *madrasah* students demonstrate a strong tendency to make responsible decisions regarding the environment, especially in their potential to independently maintain responsible behavior towards the environment in the future (98%). The presentation of quantitative data from the questionnaire above shows a dominant and fairly good percentage scale. The scope of the points raised provides supporting data as a basis for studying decision-making abilities in elementary *madrasah* students. Qualitative analysis identified three main themes: (1) understanding of

environmental consequences, (2) application of environmental decision-making in daily life, and (3) motivation to maintain environmental sustainability.

Figure 2. Classroom Learning Process Using Environmental Literacy Worksheets

Figure 4. Making Candles from Used Cooking Oil

Figure 3. Experiment on Processing Used Cooking Oil

One student expressed that environmental literacy materials help them better understand how to manage nature and its various natural resources. Another student mentioned that they strive to be wise in using natural resources by turning off the lights during the day and choosing to ride their bike to school, as a way to conserve energy and protect its availability in the future. Several students showed interest in understanding environmental management, with one student stating that they are currently learning how to manage the environment in a balanced way. They mentioned that managing the environment is not difficult and can even be enjoyable if one understands its impact. During the interview, one student imagined that if the earth ran out of energy, the world would be pitch black, which strengthens their motivation to manage the environment responsibly.

The interview results indicated that students demonstrate a growing understanding of environmental literacy and its application in daily life. One student stated that *"environmental literacy materials help us understand more about how to manage nature and its contents, such as various natural resources,"* which is further supported by other students who expressed similar views regarding

wisdom in environmental management. In practice, students also reported efforts to apply this understanding, as reflected in the statement, *"every day I try to be wise in using natural resources, for example, I always turn off the lights during the day and choose to ride my bike to madrasah,"* indicating their commitment to energy conservation for future sustainability.

Moreover, students acknowledged their learning progress, with one noting that *"we understand environmental management, how to care for the environment, and are currently learning how to manage the environment in a balanced way,"* suggesting an increasing interest in applying environmental literacy concepts within a balanced lifestyle. Students also expressed positive attitudes toward environmental management, as illustrated by the statement, *"managing the environment is not difficult, and it is enjoyable if you understand its impact,"* highlighting their ability to analyze environmental issues critically. This awareness is further strengthened by imaginative reflections, such as *"one day I imagined that if the earth ran out of energy, the world would be pitch black,"* which serve as motivational drivers for adopting environmentally responsible behavior among *madrasah ibtidaiyah* students.

Based on the above findings, elementary *madrasah* students reported that environmental literacy materials helped them understand the consequences of poor environmental management: "Environmental literacy materials help us understand how to manage nature and its resources wisely." Students also demonstrated practical decision-making behaviors related to energy conservation: "I turn off the lights during the day and choose to ride my bike to *madrasah* to save energy." In addition, students expressed awareness of long-term environmental consequences, which influenced their decision-making: "If the Earth runs out of energy, everything will be dark." These findings show that students not only have environmental knowledge but also apply environmental decision-making skills in their daily activities, in line with the principles of Education for Sustainable Development (ESD).

Discussion

Effectiveness of Environmental Literacy-Based Worksheets

The findings of this study show that environmental literacy-based worksheets are effective in improving the environmental literacy of sixth-grade madrasah students, as indicated by the increase in pre-test and post-test scores in the experimental group compared to the control group, as well as the MANOVA significance value of 0.000. This result is consistent with Sánchez-García et al. (2025); Takyi et al. (2023); and Vaio et al. (2024) who found that environmental education interventions in madrasahs positively affect students' environmental knowledge. It also supports the view that active and contextual learning environments are essential for fostering meaningful environmental understanding. These findings reveal that green managerial awareness significantly influences environmentally responsible production, both directly and indirectly, being found that green human resource management is a vital mechanism for translating managerial awareness into effective sustainable

practices, while environmentally friendly employee behavior played a crucial role in embedding sustainability into daily operations

This effectiveness occurs because worksheets function as structured and interactive learning media that encourage students to engage actively in problem-solving and contextual learning. By integrating environmental issues into classroom activities, the worksheets enable students to connect concepts with real-life situations. As a result, students develop not only cognitive understanding but also affective awareness related to environmental literacy. This study attended by providing empirical evidence that environmental literacy-based worksheets are an effective instructional medium for elementary madrasah students. It strengthens the argument that contextual and student-centered learning tools can significantly enhance environmental literacy in basic education.

Environmental Literacy as a Basis for Decision-Making Skills

The findings indicate that students show relatively strong abilities in recognizing environmental issues, but weaker performance in analyzing and solving them. This is in line with Erdogdu (2024); Mhlongo et al. (2023); Mukaromah et al. (2025); and Rakesh et al.(2024) who argued that environmental literacy among students often emphasizes knowledge acquisition rather than higher-order thinking skills. Thus, previous literature (Chai-Arayalert et al., 2023 and Chaw & Tang, 2023) suggests that environmental literacy is often limited to understanding concepts without sufficiently developing analytical and evaluative competencies. The platform facilitates extensive opportunities for collaborative participation and the exchange of knowledge, allowing participants to gain a comprehensive understanding of the processes involved in handicraft design.

This pattern occurs because decision-making requires more complex cognitive processes, such as analysis, evaluation, and problem-solving, which are not automatically developed through knowledge acquisition alone. While students may understand environmental concepts, they still need structured learning experiences to transform that knowledge into decision-making competence. By highlighting that environmental literacy should not be viewed solely as an end goal, but as a foundation for developing environmental decision-making skills. In the context of elementary madrasah education, this research emphasizes decision-making competence as a critical outcome of environmental learning.

Environmental Decision-Making Skills in the ESD Framework

The study found that students demonstrate environmentally responsible behaviors, such as conserving energy and using resources efficiently. This finding is consistent with Farrow et al. (2024) and John et al. (2023) who emphasized the importance of educational environments in fostering sustainable behavior through direct learning experiences. It also aligns with the principles of Education for Sustainable Development (ESD), which promote responsibility,

sustainability, and real-world problem-solving (Filho et al., 2023; John et al., 2023; and Rajalakshmi et al., 2023). PBL as an instructional approach has a significant role in the development of soft skills among students of various disciplines including; empirical evidence is predominantly conclusive in identifying the acquisitions of various soft skills including communication skills, conflict resolution skills, leadership skills, and interpersonal skills. Finally, several factors might influence the relationship of PBL and soft skills such as duration and process of PBL instruction, role of facilitator, and awareness and training of learners (Anggraeni et al., 2023 and Firawaty, Zainnur Wijayanto, Ana Fitrotun Nisa, 2025).

These behaviors emerge because the learning process integrates ESD principles and Problem-Based Learning (PBL), both of which encourage students to think critically about real environmental problems. The worksheets provide opportunities for students to participate actively in decision-making processes, which strengthens their ability to consider the environmental consequences of their actions. The integration of ESD and PBL into worksheet-based learning can effectively strengthen students' environmental decision-making skills. It confirms that instructional design grounded in sustainability principles can shape not only knowledge but also responsible behavior.

Integration of Learning and the Need for Instructional Support

Previous studies Manshur et al. (2024) and Sekarsari & Faizin (2026) have shown that environmental literacy in madrasahs is often not systematically integrated into classroom instruction and is instead limited to separate programs such as Adiwiyata. Harahap & Ritonga (2023) and Sukardi et al. (2024) in their studies also stated that extend this perspective by demonstrating that integrated learning media, such as environmental literacy-based worksheets, are more effective in developing students' competencies. Chuaichana, K., & Wutchana (2025) and Prendeville et al. (2023) said it was recommended that students need to be given the opportunity to conduct learning directly and teachers must perform innovative learning.

This occurs because elementary madrasah students are at a developmental stage where they require continuous, contextual, and practice-based learning. Worksheets designed around real-life environmental problems allow students to directly experience the process of analyzing problems and making decisions, making learning more meaningful and applicable. The importance of integrating environmental literacy directly into classroom learning rather than treating it as a separate program. It also provides practical insight for teachers by showing that contextual worksheets can serve as effective instructional support for developing environmental competencies.

This study also highlights the relevance of *tadabbur alam* (reflection on nature) in strengthening environmental literacy. This finding complements previous studies that have integrated spiritual or religious values into environmental education. In the madrasah context, this perspective is particularly relevant because environmental awareness can be developed not

only through scientific understanding but also through religious reflection. This study contributes by proposing an integrative model in which environmental decision-making skills act as a mediating variable between environmental literacy and environmental awareness within the ESD framework. Unlike previous studies that focus mainly on knowledge or attitudes, this research emphasizes decision-making competence as a key outcome and adds a spiritual dimension that is highly relevant to madrasah education**.**

CONCLUSION

Environmental literacy learning in elementary *madrasah*s is not sufficient with only the programs that have been implemented by *madrasahs*. However, the facts show that learning and developing decision-making skills regarding the environment need to be supported by environmental learning that is integrated into learning and not as a separate program. The student worksheets designed by researchers with an environmental basis have significant results in improving students' environmental literacy in both cognitive and affective aspects. These findings have a considerable impact on efforts to foster decision-making skills for elementary *madrasah* students in order to create a sustainable environment. However, this study is limited by its small sample size, short intervention duration, and focus on cognitive and affective aspects. Future research is recommended to involve larger samples, longer implementation periods, and more comprehensive assessments, including behavioral aspects, to strengthen the implementation of environmental literacy within the framework of Education for Sustainable Development (ESD).

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