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Living Near Oil Palm Plantations: Students' Environmental Literacy by Gender and Grade Level

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Abstract: Indonesia is the world's largest palm oil producer, but this industry presents environmental challenges such as deforestation, biodiversity loss, and pollution. Enhancing students' environmental literacy, particularly those living near oil palm plantations, is key in fostering ecological awareness. This study aims to analyze students' environmental literacy levels based on gender and grade level at Puspita Senior High School, South Sumatra. This research employs a descriptive design using a survey method with an environmental literacy questionnaire measuring knowledge and attitudes toward environmental issues. The study involved 244 students categorized by gender and grade level. Data were analyzed using descriptive statistical techniques and the Kruskal-Wallis test to determine differences in environmental literacy across variables. The findings indicate that students' overall environmental literacy is very good, with an average score of 54.36. There is no significant difference in environmental literacy between male and female students, although females scored slightly higher in attitude. Similarly, no significant difference was found based on grade level. Factors such as an inclusive curriculum, uniform learning experiences, and students' residential environment near oil palm plantations are believed to contribute to these findings. In conclusion, students living near oil palm plantations exhibit high environmental literacy, with no significant differences based on gender or grade level. These results highlight the importance of equitable environmental education in fostering ecological awareness among young generations.

Keywords: Attitude; Cognitive; Environmental literacy; Grade level; Gender.

Introduction

Indonesia is known as the largest palm oil-producing country in the world. However, the palm oil industry has presented several environmental challenges, such as deforestation, loss of biodiversity, and pollution, especially in areas around plantations (Supriyanto, 2023). Tropical wetlands have been converted to oil palm plantations, resulting in pollution, habitat fragmentation, damage to aquatic ecosystems, and decreased biodiversity (Camacho-Valdez et al., 2022). In a systematic review conducted by Savilaakso et al., significant impacts on the decline in species richness and community composition have been revealed due to oil palm production activities, which are very important for maintaining ecosystem functions (Savilaakso et al., 2014). Forest cover has been lost due to the expansion of oil palm plantations, and this condition has been cited as a major cause of biodiversity loss, which has the potential to disrupt the stability of the food web and reduce ecosystem resilience (Vijay et al., 2016). Biodiversity has not been adequately considered in palm oil production so that ecosystem functions can be significantly disrupted (Andriyanningsih et al., 2024). If this ecosystem damage continues to be allowed, all life on Earth will feel the negative impacts. Therefore, through the context of education, increasing environmental literacy for students as future agents of change needs to be done.

Environmental literacy is associated with an understanding and awareness of the elements that influence the environment, the basic principles that

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govern it, and the capacity to actively contribute to the preservation of environmental quality in everyday life (Indriyanti et al., 2024). Environmental literacy has been built on four interrelated components: knowledge of environmental issues, cognitive skills to solve problems, affective dispositions towards the environment, and responsible behaviour that reflects environmental management (Dias et al., 2021; Spinola, 2016). Environmental literacy is important because various global environmental problems, such as pollution, climate change, and biodiversity loss, can be addressed with it. Information about the environment can be analysed, the impact of an action can be evaluated, and sustainable practices in society can be supported by individuals with high environmental literacy (Ainin & Asafri, 2023; Incesu & Yas, 2023). Furthermore, a generation of environmentally conscious and proactive citizens committed to reducing environmental degradation has been born from an education system based on environmental literacy (Ainin & Asafri, 2023).

Integrating environmental education into the curriculum is believed to help students better understand the ecological issues associated with agricultural practices and support the formation of environmentally conscious behaviors. Basic concepts of environmental issues can be understood by students through environmental education (Yusup et al., 2021). Other researchers reported that there was a positive effect of the Adiwiyata program on increasing students' environmental knowledge and awareness (Syaifulloh et al., 2022). Furthermore, high environmental literacy was shown by students from Adiwiyata schools compared to students from non-Adiwiyata schools (Astuti & Aminatun, 2020). However, several other researchers have highlighted that many students still lack knowledge and concern for environmental issues even though schools have integrated environmental education into the curriculum (Mardiani et al., 2021; Wajdi et al., 2022). In addition, based on the PISA survey, it was found that Indonesia ranked low in science literacy, where there is a close relationship between science literacy and environmental literacy (Arsih et al., 2023).

The differences in findings are believed to be caused by several factors that influence environmental literacy. Research conducted by Waqidah et al. showed that school type and gender affect students' environmental literacy (Waqidah et al., 2020). Specifically, in several studies, female students had better environmental literacy than male students (Daraz, 2023; Koruoğlu et al., 2015; Svobodová, 2023). The results of Parwati et al.'s study showed that gender affects students' awareness and attitudes towards the environment (Parwati et al., 2021). This finding is supported by Kapan and Gürel, who reported that female nursing students generally showed greater environmental awareness (Kapan & Gürel, 2022). On the other hand, no significant differences in environmental literacy were found based on gender in a study of prospective social studies teachers (Yilmaz, 2021; Zafar, 2024). Additionally, in a study of 5–6-year-old students in Turkey, no differences were observed in the environmental behaviors of children of different genders (Gülay, 2011). This inconsistency suggests that although environmental literacy may be influenced by gender, the extent of that influence may be determined by the specific demographic characteristics of the participants, such as their grade or educational level.

Several previous studies have stated that class level plays a role in shaping students' environmental literacy. Studies such as those conducted by Demirtaş Akbulut and Özşen show that vocational high school students demonstrate high levels of environmental literacy (Kapan & Gürel, 2022). Similarly, in Svobodová's study of Polish students, grade level was identified as a determining factor in learning, with higher levels of environmental literacy being demonstrated by younger students compared to older ones (Svobodová, 2023). This trend may be attributed to the increasing emphasis on environmental education in the curriculum at the early stages of education, which fosters a fundamental understanding of ecological issues. However, according to another study, there was no discernible variation in literacy levels between class classes, even though female pupils demonstrated greater environmental literacy than their male counterparts (Akçay & ŞENGÜL, 2023).

Puspita Senior High School is one of the private high schools in Cinta Manis Baru Village, Air Kumbang District, Banyuasin Regency, South Sumatra Province. Based on interviews with biology teachers at the high school, it was obtained that most students work on oil palm plantations near the school. This means that these students economically depend on the oil palm plantation. However, as agents of future change, it is hoped that these students will see not only it from an economic perspective but also an ecological perspective related to the impact of the existence of the oil palm plantation. Thus, it is necessary to analyse environmental literacy for students.

In the present study, the environmental literacy of students living in areas affected by the palm oil industry is aimed to be investigated by examining the influence of two key demographic factors: gender and grade level. Specifically, the research seeks to answer three main questions: (1) how gender influences students' environmental literacy in the context of proximity to palm oil plantations; (2) what differences in environmental literacy exist among students based on their grade level; and (3) how the interaction between gender and grade level affects students' environmental

literacy in regions impacted by the palm oil industry. Through this investigation, it is expected that a deeper understanding will be gained regarding the variation in environmental literacy among students, which can inform the development of more targeted and context-sensitive environmental education strategies.

Although there have been several studies related to students' environmental literacy based on gender and grade level. However, research on the environmental literacy of students living near oil palm plantations is considered a novelty. The factors influencing students' environmental literacy, if well understood, can be used to provide effective solutions for the development of more effective education programs.

This research is expected to provide significant contributions to science-biology education, especially in strengthening environmental literacy through a contextual approach that is relevant to students' lives around oil palm plantations. By exploring the influence of gender and class level on students' environmental literacy levels, new insights can be gained to design biology learning strategies that are more responsive to local socio-ecological conditions. The results of this study can also be used as a basis for developing learning based on real environmental issues. Thus, science-biology education is not only directed at mastering theoretical concepts, but also at forming a deep environmental concern attitude as part of 21st century competencies.

Method

This study was conducted using a descriptive research design. The level of environmental literacy among students of different genders and grade levels is being assessed in this descriptive study. The subjects of this study were students from Puspita Senior High School, South SumatraThe students are reported to live near and carry out their daily activities around oil palm plantations. The demographic characteristics of the research subjects are shown in Table 1.

Table 1. Demographics of Participant

	Variable	Total Participant	Percentage (%)
Gender	Female	159	65.16
	Male	85	34.84
	Total	244	100
Grade Level	1st Grade	60	24.59
	2nd Grade	119	48.77
	3rd Grade	65	26.64
	Total	244	100

Environmental literacy data were collected using an environmental literacy questionnaire. The questionnaire measured two aspects, including: knowledge and attitudes related to environmental issues (Chacko, 2000; Farida & Hadiansah, 2018). Knowledge aspect include: artificial ecosystem, factors affecting oil palm growth, biotic and abiotic factors of oil palm plantations, types of epiphytic plants on oil palm trunks, benefits of oil palm plantations and the role of oil palm epiphytic plants. Attitude related to environmental issues aspect include concern for the environment. The researcher also collected demographic information regarding the gender and grade level of students to analyze the correlation with the level of environmental literacy. The data collection process was carried out by distributing questionnaires to students at one time.

The collected data will then be analyzed using descriptive statistical techniques. Correlation analysis will also be used to identify the relationship between environmental literacy and gender and grade level variables. SPSS was used as a tool for data analysis.

Table 2. Environmental Literacy Score Range

Formula	Range Score	Level
X ≥Yi + 1.Sbi	X ≥ 54	Very Good
Yi + 1.Sbi > X ≥Yi	54 > X ≥ 45	Good
Yi > X ≥ Yi – 1.Sbi	45 > X ≥ 36	Bad
X < Yi – 1.Sbi	X < 36	Very Bad

Result and Discussion

Measurement of environmental literacy based on gender and grade level variables has been conducted. Before collecting data, the researcher verified the validity and reliability of the questionnaire by administering it to 200 students. The results of these tests are presented in Table 3 and Table 4. The findings indicate that the questionnaire is both valid and reliable.

Table 3. Test of Validity

Items	R count	R table	Category
Item 1	0.300	0.138	Valid
Item 2	0.262		
Item 3	0.481		
Item 4	0.377		
Item 5	0.205		
Item 6	0.363		
Item 7	0.343		
Item 8	0.468		
Item 9	0.348		
Item 10	0.524		
Item 11	0.477		
Item 12	0.229		
Item 13	0.316		
Item 14	0.342		
Item 15	0.455		
Item 16	0.373		
Item 17	0.188		
Item 18	0.407		

Table 4. Test of Reliability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
0.674	0.699

Then, based on the results of the analysis with descriptive statistics, information was obtained that the average total score of students' environmental literacy was 54.3648 (Table 5). This shows that in general students' environmental literacy is in the very good category. These data are interpreted as providing an initial indication that a fairly good understanding of environmental literacy, particularly those related to the palm oil plantation ecosystem, is possessed by the student

Table 5. Descriptive Statistics for Student Environmental Literacy

	N	Min.	Max.	Mean	Std. Deviation
Student Environmental Literacy	244	38.00	68.00	54.3648	5.26442

Table 6. Student Environmental Literacy based on Gender and Grade Level

	Variable	Mean	Category	Chi Square	P
Gender	Female	54.81	Very Good	3.513	0.61
	Male	53.53			
Grade Level	1st Grade	55.07			
	2nd Grade	54.11	Very Good	0.932	0.627
	3rd Grade	54.18			

Furthermore, in Table 6, based on the mean value, higher environmental literacy is shown by female students compared to male students. However, based on the Kruskal-Wallis Test, there is no difference in environmental literacy between female and male students (P > 0,05), where both are in the very good category. This finding is echoed in research involving students from modern Islamic boarding schools, which also concluded that there were no significant differences in environmental literacy levels based on gender (Mardiani et al., 2021). Further supporting this perspective, it was found in a study on high school students in Bali that the overall environmental literacy levels of male and female students were statistically indistinguishable (Parwati et al., 2021). Thus, it can be inferred that when educational opportunities are equitably distributed, gender may not significantly impact environmental literacy.

In Table 6 also, based on the mean value, it is obtained that 1st-grade students have the highest environmental literacy scores. However, no difference in environmental literacy between students of different grades was found based on the results of the Kruskal-Wallis test. The Kruskal-Wallis test was conducted because the data did not meet the assumption of normality but were homogeneous (Table 7). This finding indicates that students' environmental literacy is relatively consistent among grades X, XI, and XII. This consistency was also reported in a study, in which higher environmental literacy was demonstrated by female students, while no significant difference was observed across grade levels (Akçay & Şengül, 2023). However, contrasting results have been reported by other researchers, where differences in environmental literacy between students at different grade levels were found (Kapan & Gürel, 2022; Svobodová, 2023).

Table 7. Tests of Assumption

	Sig
Test of Normality	0.118
Test of Homogenity	0.013

Table 8. Student Environmental Literacy based on Aspect, Gender, and Grade School

Aspect	Variable	Means Score	Category
Knowledge	Female	45.76	Very Good
	Male	45.10	
Attitude	Female	9.05	Very Good
	Male	8.42	Good
Knowledge	1st Grade	46.27	
	2nd Grade	45.21	Very Good
	3rd Grade	45.43	
Attitude	1st Grade	8.80	
	2nd Grade	8.89	Good
	3rd Grade	8.75	

The absence of differences in environmental literacy between female and male students also includes aspects of knowledge and attitudes (Table 8). However, from the mean value of environmental literacy, female students' attitudes towards the environment were categorised as very good, while male students were categorised as good. A study conducted on pre-service science teachers in Indonesia revealed that both male and female students exhibited similar levels of environmental literacy in terms of knowledge and cognitive skills, although differences were noted in attitudes and behaviors towards the environment (Vilmala, 2023). Similarly, research focused on social studies teacher candidates indicated that gender did not significantly influence environmental literacy levels, reinforcing the notion that both genders possess comparable knowledge and skills in this are it was indicated by research focused on social studies teacher

candidates that environmental literacy levels were not significantly influenced by gender, reinforcing the notion that comparable knowledge and skills in this area are possessed by both genders (Yilmaz, 2021). This was aligned with findings from a broader survey of undergraduate students in Taiwan, in which no significant gender differences in environmental knowledge and attitudes were reported, although higher performance by females in certain categories was noted (Liang et al., 2018). Although a greater sense of environmental care has been reported to be shown by female students in certain contexts, higher levels of knowledge have not necessarily been demonstrated compared to their male counterparts (Sigit et al., 2023).

One of the primary reasons why gender disparity in environmental literacy is not observed is the increasingly inclusive nature of educational curricula. The importance of environmental education has been recognized by many educational systems, and it has been integrated into their curricula to ensure that equal exposure to environmental concepts and issues is received by both male and female students. This is particularly reflected in science education, where engagement with environmental topics through hands-on activities, discussions, and projects is encouraged for both genders. It has been shown by research that when environmental education is effectively implemented, similar levels of knowledge and understanding can be achieved by students, regardless of gender. For instance, it has been indicated by studies that comparable outcomes in environmental literacy assessments tend to be achieved when both genders are involved in collaborative learning environments (Mardiani et al., 2021; Vilmala, 2023). Traditional gender biases in educational settings may be diminished by the emphasis placed on cooperative learning strategies, thereby fostering an environment in which both male and female students are enabled to thrive equally.

The absence of differences in students' environmental literacy across grades is thought to be influenced by the teachers themselves. An important role in shaping students' environmental literacy is played by teachers through the knowledge they possess and the teaching practices they apply. Weak acquisition of environmental literacy among students—particularly in critical skills such as problem identification, which is frequently the lowest-scoring aspect—can be caused by inadequate teacher preparation (Roshayanti et al., 2020). Furthermore, if the same teaching strategies are used by teachers across different grade levels and comparable levels of environmental knowledge are held by them, then it is reasonable that no significant differences in students' environmental literacy by grade level would be observed. The levels of students' environmental literacy are strongly associated with the literacy possessed by their teachers, emphasizing the importance of training in environmental education to be provided for teachers (Pastorelli et al., 2020). It was found by Ginting et al. that students' environmental literacy can be improved by integrating project-based learning (PjBL) with STEM education (Ginting et al., 2023). This suggests that teaching methods may have a greater impact than students' grade levels.

Another factor that is no less important and is believed to influence the high and no difference in environmental literacy of students with different genders and classes is the students' residential environment. The residential environment is considered to play an important role in the shaping of students' ecological literacy, which encompasses knowledge, attitudes, and behaviors towards the environment. As previously mentioned, the participants in this study were situated and largely engaged in part-time work on oil palm plantations. It has been highlighted in several studies that various aspects of the residential environment significantly influence students' environmental awareness and behavior. It was emphasized by Ahn (2020) that relationships with the natural surroundings can be strengthened through local environmental experiences, fostering a sense of responsibility for environmental management. Similarly, it was asserted by Sasea et al., (2023) that the understanding and application of ecological knowledge by students are crucial to environmental improvement, suggesting that practical experience can be used to bridge the gap between knowledge and action. Furthermore, it was shown by Pham & Nguyen (2022) that students' environmental awareness is closely tied to residential conditions and community engagement, underlining the importance of a supportive environment in fostering such awareness. Therefore, it is reasonable that high environmental literacy has been developed by students. It is hoped that the high level of environmental literacy possessed by students can be utilized as a foundation for becoming agents of environmental change in the future.

Important directions for enhancing environmental education are suggested by the findings of this study. Given the observed homogeneity of literacy levels across grades, it is recommended that a more structured, scaffolded approach to environmental literacy be adopted by educational practitioners. A more advanced understanding of environmental issues—aligned with students' cognitive development—could be fostered by educators through the introduction of progressively challenging material at each grade level.

This study was subject to limitations, including the reliance on quantitative measures, which may have prevented the full capture of nuances in students' environmental literacy. For future research, the use of

mixed-methods approaches is encouraged, so that a more comprehensive view of students' environmental understanding can be obtained through the incorporation of qualitative data from interviews or focus groups.

Conclusion

Based on the research that has been conducted, it can be concluded that the level of environmental literacy among students who interact with oil palm plantations in their daily lives is categorized as very good. From further analysis related to the influence of gender, it was found that very good environmental literacy is possessed by both female and male students. Similarly, no differences in environmental literacy levels were found in the analysis related to differences in class levels. Several factors are believed to have influenced these findings, including the inclusiveness of the curriculum, the teaching experience and practices applied by teachers, and the environment in which the students are situated. Through these findings, it is confirmed that both educational and environmental factors play important roles in shaping students' awareness and understanding of environmental issues, regardless of gender or class level differences.

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Conflicts of Interest
The authors declare no conflict of interest.

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