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The effect of nearpod-assisted problem-based learning on environmental literacy

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ABSTRACT

The lack of interactive and contextual learning models further weakens student engagement with environmental issues. This study aims to determine the effect of the Problem-Based Learning (PBL) model assisted by Nearpod on students' environmental literacy regarding climate change material in Grade 10 at SMA Negeri 10 Tasikmalaya. The research method used is a Quasi-Experimental design. The research population consists of 10 classes, with a purposive sampling method yielding a sample size of 2 classes, comprising an experimental class and a control class. The research instruments used tests and non-tests in the form of multiple-choice questions and questionnaires. The results of the ANCOVA test showed that the Nearpod-assisted PBL model had a significant partial effect on environmental literacy in the cognitive and affective indicators, with a significance value of 0.000, but did not show an effect on the behavioral indicator, which obtained a significance value of 0.874. Meanwhile, the simultaneous test results for the combined three environmental literacy indicators yielded a significance of 0.184 (p-value > 0.05), indicating that the implementation of the Nearpod-assisted PBL model has not yet been able to provide a comprehensive impact on environmental literacy among students at SMAN 10 Tasikmalaya.

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INTRODUCTION

Global industrial development has exacerbated environmental pollution and accelerated climate change, which has led to natural destruction and resource scarcity (Ahmadi, 2022; Liu & Tobias, 2024). This situation is exacerbated by low levels of environmental literacy among individuals, reflecting a lack of awareness and concern about the impact of human activities on nature (Aini et al., 2020; Lestari et al., 2024).

Environmental literacy is an important competency that encompasses awareness, knowledge, and actions to maintain environmental balance (Karmana, 2023). However, the results of the PISA (Programme for International Student Assessment) test in science showed a score of 396, far below the OECD average (2018) of 489, reflecting the low ability of students to understand and apply scientific concepts, including environmental issues. Although the test results did not explicitly mention environmental literacy, there were several components that were still related to environmental literacy. In addition, the results of Rokhmah & Fauziah's (2021) research also show that the level of environmental literacy among students is still low, especially in the cognitive aspect, which is 36.7%.

Meanwhile, based on observations at SMAN 10 Tasikmalaya, it appears that students' environmental literacy is not yet optimal. This can be seen from the fact that there are still students who litter and do not separate organic and inorganic waste even though trash bins are provided. Additionally, preliminary test results previously conducted indicate that the average environmental literacy score is 40%, which falls into the "poor" category (Rokhmah & Fauziah, 2021).

Low environmental literacy is influenced by several factors, one of which is the use of teacher-centered learning models, which hinder students' critical thinking skills (Apriani et al., 2025). In addition to the use of models, the lack of student participation in the learning process also affects the development of problem-solving skills related to environmental issues (Santoso et al., 2021). The Problem-Based Learning (PBL) model offers an interactive and contextual learning alternative, encouraging students to actively engage in solving real-world problems (Meilasari et al., 2020). Recent research also shows that the application of PBL, especially when integrated with socio-scientific issues (SSI), significantly improves students' environmental literacy (Fadilla & Ulfa, 2025; Naibaho et al., 2025; Yusrolana et al., 2025). The use of learning media in the PBL model reflects efforts to create learning that is more adaptive to the needs of students in the digital age, with the aim of creating a more relevant, interesting, and effective learning experience (Rahayu, 2023). Therefore, to optimize its effectiveness, the application of the PBL model needs to be supported by technology-based learning media.

One of the learning media that can be used to optimize teaching and learning activities is the Nearpod application (Aslami, 2021). Nearpod makes it easier for teachers to provide interesting stimuli, presented in the form of videos and images, thereby helping students better understand a problem (Nabilah, 2024). With Nearpod, students can learn independently and interactively, making learning more contextual and relevant in the digital age. The integration of Nearpod and Problem-Based Learning not only enriches the learning experience but also stimulates cognitive development and critical thinking among students. Therefore, the purpose of this study is to determine the effect of the Nearpod-assisted PBL model on the environmental literacy of students at SMAN 10 Tasikmalaya.

RESEARCH METHODS

Research Design

This study used a quasi-experimental method. It consisted of one dependent variable (x), namely the Nearpod-assisted PBL model, and one independent variable (y), namely environmental literacy. The research design used in this study was the nonequivalent pretest-posttest control group design. The research design can be seen in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Description:
O_1, O_3 : Initial measurement (*pretest*)
O_2, O_4 : Final Measurement (*posttest*)
X : Problem-Based Learning model treatment assisted by Nearpod

Population and Samples

The population in this study was all 10th-grade classes at SMAN 10 Tasikmalaya for the 2024/2025 academic year, consisting of 10 classes with a total of 370 students. The research sample consisted of 1 experimental class and 1 control class selected using purposive sampling. The samples used were class X-1 (experimental) and class X-5 (control) with a total of 67 students. These two classes were selected based on their similar average daily test scores, namely 75.48 and 74.58. In addition, the selection of these two classes was also based on the recommendation of the biology teacher at SMAN 10 Tasikmalaya.

Instruments

The instrument used in this study was adapted from the environmental literacy instrument developed by Liang et al. (2018), consisting of cognitive, affective, and behavioral indicators. The instrument used for data collection had undergone a trial phase beforehand, making it suitable for use in research. Based on the pilot test results, 12 multiple-choice questions were obtained to measure cognitive indicators, 13 statements (on a Likert scale) to measure affective indicators, and 15 statements to measure behavioral indicators. The test and questionnaire forms given in the initial test were the same as those given in the final test. The initial test aimed to measure the students' initial environmental literacy skills, while the final test aimed to measure the students' environmental literacy skills after learning using the Nearpod-assisted PBL model on climate change material.

Procedures

This research procedure is divided into three stages, namely the planning stage, the implementation stage, and the final stage of research. In the planning stage, researchers conducted interviews with biology teachers to obtain an initial overview of the learning conditions and characteristics of students, as well as to ensure the relevance of the material to the school curriculum. In addition, the research instruments were validated by expert lecturers to ensure the feasibility and suitability of the environmental literacy measurement tools in terms of content, construct, and language. The implementation stage involved data collection at the school through learning activities during four meetings. At this stage, the experimental class applied the Nearpod-assisted PBL model, while the control class used PBL without technological support. During the learning process, students were given environmental literacy tests and questionnaires before and after the treatment (pre-test and post-test) to measure changes in environmental literacy. The final stage of the research included normality tests, homogeneity tests, and partial and simultaneous data analysis using ANCOVA tests to determine the effect of the learning model on each indicator and environmental literacy holistically.

Data Analysis

The data were analyzed using SPSS version 23 for Windows software. The data analysis techniques used in this study were descriptive statistics, prerequisite tests including normality and homogeneity tests, and parametric tests using ANCOVA. Then, the results of environmental literacy data processing were converted into environmental literacy criteria in Table 2.

Table 2. Environmental Literacy Criteria

Value Range	Criteria
81-100	Very High
61-80	High
41-60	Medium
21-40	Low
≤ 20	Very Low

Source : (Santoso et al., 2021)

RESULTS

Table 3 shows that the average value of cognitive indicators in the experimental class increased from 52.94 in the pretest to 78.51 in the posttest. Meanwhile, the control class increased from 38.93 to 57.58. The ANCOVA test results showed a significance value of 0.000. A summary of the statistical data on environmental literacy cognitive indicators is presented in Table 3.

Table 3. Recapitulation of Environmental Literacy Statistics Data on Cognitive Indicators

Description	Pre-test Score		Post-test Score	
	Experiment	Control	Experimen	Control
Number of Students	34	33	34	33
Minimal Value	31	23	54	38
Maximal Value	69	54	100	85
Average	52.94	38.93	78.51	57.58
St. Deviation	14.76	9.98	15.71	11.56
ANCOVA Test	0.000			

Table 4 shows that the average value of the affective indicator in the experimental class increased from 61.52 in the pretest to 72.96 in the posttest. Meanwhile, the control class increased from 51.01 to 63.64. The ANCOVA test results showed a significance value of 0.000. A summary of the environmental literacy affective indicator statistical data is presented in Table 4.

Table 4. Recapitulation of Environmental Literacy Statistics Data on Affective Indicators

Description	Pre-test Score		Post-test Score	
	Experiment	Control	Experiment	Control
Number of Students	34	33	34	33
Minimal Value	33	33	67	58
Maximal Value	78	64	83	72
Average	61.52	51.01	72.96	63.64
St. Deviation	10.08	8.64	3.81	3.57
ANCOVA Test	0.000			

Table 5 shows that the average value of the behavior indicator in the experimental class increased from 59.02 in the pretest to 69.02 in the posttest. Meanwhile, the control class increased from 47.47 to 60.81. The ANCOVA test results showed a significance value of 0.874. A summary of the environmental literacy statistical data for the behavior indicator is presented in Table 5.

Table 5. Recapitulation of Environmental Literacy Statistics Data on Behavior Indicators

Description	Pre-test Score		Post-test Score	
	Experiment	Control	Experiment	Control
Number of Students	34	33	34	33
Minimal Value	42	33	44	36
Maximal Value	78	56	91	80
Average	59.02	47.47	69.02	60.81
St. Deviation	10.53	5.21	15.40	12.47
ANCOVA Test	0.874			

Table 6 shows that the average environmental literacy score in the experimental class increased from 57.83 in the pretest to 73.50 in the posttest. Meanwhile, the control class increased from 45.80 to 60.68. The ANCOVA test results show a significance value of 0.184. A holistic recapitulation of environmental literacy statistical data is presented in Table 6.

Table 6. Recapitulation of Environmental Literacy Statistics Data

Description	Pre-test Score		Post-test Score	
	Experiment	Control	Experiment	Control
Number of Students	34	33	34	33
Minimal Value	42	35	55	47
Maximal Value	72	56	89	74
Average	57.83	45.80	73.50	60.68
St. Deviation	8.65	6.37	9.94	9.11
ANCOVA Test	0.184			

Figure 1 shows a comparison of the average environmental literacy scores between the experimental class and the control class. The experimental class obtained an average score of 73.50, while the control class obtained an average score of 60.68. A comparison of the overall average environmental literacy scores obtained by the experimental class and the control class is presented in Figure 1.

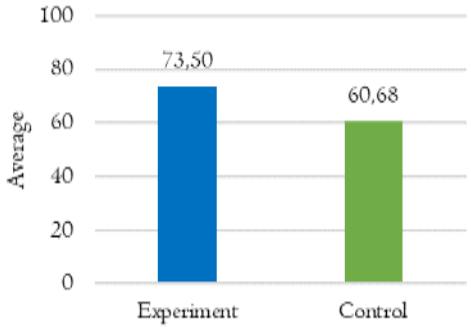

Figure 1. Comparison of Environmental Literacy Scores

DISCUSSION

This study was conducted in four learning sessions for both groups, namely the experimental class and the control class. The first session began with a pretest, followed by the learning process according to the prepared implementation plan, and ended with a posttest in the fourth session. Students' environmental literacy was measured using a combination of instruments in the form of multiple-choice questions and a Likert scale questionnaire based on environmental literacy indicators. Measurements were taken before and after the learning intervention, both in the

experimental group that applied the Problem-Based Learning model assisted by Nearpod and in the control group that only used the Problem-Based Learning model without technological assistance. The data obtained were analyzed using statistical tests and presented based on each environmental literacy indicator that was the focus of the study.

The Effect of Problem-Based Learning Model Implementation on Environmental Literacy Cognitive Indicators

Based on Table 3, there was a significant increase in cognitive environmental literacy in the experimental class after the implementation of the Nearpod-assisted PBL model. The average score of the experimental class increased from 52.94 in the pretest to 78.51 in the posttest. The results of the partial test showed a significance value of 0.000, indicating that the implementation of the Nearpod-assisted PBL model had a significant effect on improving students' cognitive abilities in understanding environmental issues.

Contextual learning based on *Problem-Based* Learning helps students develop critical thinking skills and solve real problems around them (Selamat et al., 2023). Students are confronted with real issues related to climate change, which encourages them to seek and process information so that they can find solutions to the problems they face. This is in line with research (Suryawati et al., 2020) that issue-based PBL can strengthen students' environmental literacy, especially in terms of knowledge and attitudes toward ecological issues. The use of Nearpod facilitates access to various learning resources such as videos, images, and articles, enhancing students' cognitive understanding of environmental issues. In line with (Liang et al., 2018), who stated that cognitive environmental literacy includes knowledge about environmental issues and appropriate action strategies.

The Effect of Problem-Based Learning Model Implementation on Affective Indicators of Environmental Literacy

Based on Table 4, in terms of environmental literacy affective indicators, the application of the Nearpod-assisted PBL model shows that the treatment was successful in fostering positive attitudes and values towards the environment. The average score of the experimental class increased from 61.52 in the pretest to 72.96 in the posttest. The results of the partial test showed a significance value of 0.000, indicating that the application of the Nearpod-assisted PBL model had a significant effect on increasing students' awareness of environmental issues around them.

When students are actively involved in solving climate change-related problems, they tend to develop a sense of concern and responsibility. Group discussions and interactive activities such as reflection on Nearpod can help them express their feelings and build a sense of community. Firsthand experience in understanding the impact of climate change encourages attitude change, motivates action, and fosters a sense of concern for environmental issues. This is i line with research (Laelasari & Rahmawati, 2020) which states that the application of the PBL model has a positive effect and can develop students' environmental awareness.

The Effect of Problem-Based Learning Model Implementation on Environmental Literacy Behavior Indicators

Based on Table 5 it shows that the Nearpod-assisted PBL model does not have a significant effect on environmental literacy behavior indicators. This can be seen from the significance value obtained of 0.874, indicating that the treatment does not have a statistical effect. Although there was an increase in the average score of the experimental class, the change was not strong enough to be considered a direct impact of the treatment. This indicates that behavioral changes require more

time, consistent practice, and strong support from the environment outside the classroom learning context.

Several factors may contribute to the insignificant effect of the Nearpod-assisted PBL model on behavioral indicators. The relatively short duration of the treatment in this study appears to be insufficient for internalizing knowledge and attitudes into behavioral habits. In accordance (Asri & Suharni, 2021), which states that a person's behavior is very complex, so it requires precision and accuracy in analyzing its changes. In addition, activities outside of learning, such as extracurricular activities, also play an important role in shaping students' responsible behavior towards the environment. This is in line with research (Suryanda et al., 2020) that student participation in extracurricular activities in nature clubs has a positive impact on environmentally responsible behavior.

In addition, student behavior can also be influenced by external factors such as social environment, school culture, and support from parents and peers. A positive social environment, such as healthy interactions at home and in the community, and the role of parents in instilling environmental values, can help children become environmentally conscious (Maresi & Basoeki, 2024). A supportive school culture, such as environmental projects and regular clean-up days on Fridays, can improve students' environmental literacy (Akmalia et al., 2023). Meanwhile, peers act as social agents that can strengthen or weaken environmentally friendly behavior. Students tend to imitate and follow the habits of their friends, so a good peer environment will encourage pro-environmental behavior (Pratama et al., 2024).

The Effect of Implementing the Problem-Based Learning Model on Environmental Literacy

Based on Table 6, the results of the analysis of the combination of the three environmental literacy indicators, namely cognitive, affective, and behavioral, show that the application of the Nearpod-assisted Problem-Based Learning (PBL) model has not had a statistically significant effect on the overall environmental literacy of students. Statistical tests show a significance value of 0.184 (p-value> 0.05). Although the simultaneous test did not show a significant effect, the data indicate that the experimental class still achieved higher environmental literacy scores than the control class. This comparison can be seen in Figure 1.

Figure 1 shows that the average environmental literacy score for the experimental class was 73.50, which is classified as high, while the control class had an average score of 60.68, which is classified as moderate. These findings indicate that while the implementation of Nearpod-assisted PBL has a positive impact on cognitive and affective indicators, its simultaneous effect on environmental literacy is not yet strong enough to significantly influence it. This presents an opportunity for future researchers to analyze other factors that could promote environmental literacy, particularly behavioral indicators, by developing practice-based learning strategies outside the classroom using more adaptive media tailored to students' needs.

CONCLUSION

Based on the research conducted, the partial application of the Nearpod-assisted Problem-Based Learning (PBL) model had a significant effect on environmental literacy cognitive and affective indicators, with a significance value of 0.000 (p value < 0.05), but did not show an effect on behavioral indicators, which had a significance value of 0.874 (p value > 0.05). Meanwhile, the simultaneous test results for the combined three environmental literacy indicators yielded a significance of 0.184 (p-value > 0.05), indicating that the implementation of the PBL model assisted by Nearpod has not yet been able to provide a comprehensive impact on the environmental literacy of students at SMAN 10 Tasikmalaya. In the future, it is hoped that the development of learning strategies based on direct practice, cross-subject collaboration, and support from the

school and family environment can strengthen behavioral indicators and encourage holistic improvement in environmental literacy.

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