

The effect of the self-directed learning (SDL) model integrated with peer teaching on environmental literacy

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ABSTRACT

The escalating environmental issues in Indonesia highlight the need for early environmental education to cultivate environmental literacy, defined as a crucial attitude of environmental awareness, among students. An effective approach to cultivating environmental awareness through education is the Self-Directed Learning (SDL) model integrated with peer teaching, as this combined independent and collaborative method enhances students' sensitivity and independence in environmental problem-solving. This research aims to analyze the effect of implementing the SDL (Self-Directed Learning) model integrated with the peer teaching method on students' environmental literacy levels in the topic of environmental change. The research method employs a quantitative approach with a quasi-experimental design. The research sample consists of 36 students obtained through simple random sampling. The results of hypothesis testing indicate that the integration of SDL and peer teaching significantly contributes to improving students' environmental literacy. These findings imply that collaborative and independent approaches in learning can enhance students' understanding of environmental issues more effectively. Therefore, it can be concluded that the integrated SDL and peer teaching model can be applied to the topic of environmental change to foster students' environmental literacy. This study provides a foundation for future research to further develop the Self-Directed Learning (SDL) model integrated with peer teaching, exploring its application with diverse media and teaching materials across various subjects.



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INTRODUCTION

The environment is a crucial component that supports the sustainability of all life forms on Earth, which is where the interaction between biotic and abiotic components occurs. This creates an essential dependence between humans and the environment so that the two cannot be separated (Santi et al., 2018). Human activities that are not balanced with environmental awareness have been proven to significantly reduce the quality of the environment with a large level of concern (Prastiwi et al., 2020). Environmental issues are currently the focus that attracts the attention of many parties because of their potential threat to Indonesia (Santoso et al., 2021). However, the awareness of the Indonesian people on environmental issues is still low. Based on data from the Central Statistics Agency (2018),

the Environmental Indifference Behavior Index (IPKLH) in Indonesia was recorded at 0.51 in 2017, indicating a significant level of environmental indifference.

The habits of students who do not show concern for the environment can be assumed to indicate a low level of environmental literacy (Ahmadi, 2022). Environmental literacy is a very important ability for students in the 21st century, which should be instilled early in the school environment (Nariswari et al., 2022; Nugraha et al., 2021). Environmental literacy consists of 3 aspects, namely (1) cognitive, which includes knowledge of environmental issues and problems; (2) affective, regarding awareness and sensitivity to the environment; and (3) behavior, including the intention and ability to participate in determining responsible behavior in overcoming environmental problems (Fang et al., 2022).

The implementation of environmental literacy in learning activities in schools can be applied by providing knowledge about the environment and building awareness and sensitivity to the environment (Hayati, 2020). The implementation of environmental literacy in schools must also consider various essential aspects, including sensitivity to the surrounding environment, motivation, responsibility in decision-making, and active cooperation and involvement (Aswita et al., 2022). One of the learning models that can be chosen is the Self-Directed Learning (SDL) model, integrated with peer teaching methods to achieve independent and collaborative learning.

The Self-Directed Learning (SDL) model, according to Garrison, is a self-directed learning approach that requires initiative from students and, in practice, helps in developing self-management, monitoring, and student motivation (Palupi et al., 2023). The peer teaching method involves interaction between students in the exchange of information and opinions, which encourages collaboration between them (Kuslulat, 2023). According to research conducted by Kemp et al., (2022), the peer teaching method is known to support the implementation of the Self-Directed Learning model. The study shows that this approach can increase confidence and cooperation between students. In addition, research conducted by Yoo et al., (2017) stated that Self-Directed Learning using peer teaching can be effective in increasing confidence, performance, and learning satisfaction.

Based on previous research, the application of the SDL model integrated with peer teaching methods can increase deep understanding, awareness, independence, motivation, sense of responsibility, active participation, and critical thinking skills in solving problems (Baharuddin et al., 2022; Kuslulat, 2023; Purwaningsih & Widodo, 2023). However, no study has explicitly investigated the synergy between self-directed learning models and peer collaboration, specifically within the context of enhancing students' environmental literacy. This research will apply the SDL model that is integrated with peer teaching methods in learning about environmental change. This approach is expected to be able to encourage increased awareness and independent ability of students to explore the topics they want to learn in the context of solving environmental problems. In addition, through this process, it is hoped that it can also increase the motivation and responsibility of students to collaborate in dealing with environmental problems. By applying the SDL model that integrates peer teaching methods, it is hoped that students' environmental literacy can increase.

METHOD

This research was conducted by the quasi-experimental method with a nonequivalent control group design. The research process involves the provision of pre-test and post-test using environmental literacy test instruments, which are applied to the experimental class and control class. The design of the study is presented in Table 1.

Table 1. Nonequivalent Control Group Design

No.	Class	Pre-test	Treatment	Post-test
1	Experiment	O1	X	O2
2	Control	O3	C	O4

(Sugiyono, 2019)

O1-O3 is the value of the Pre-test Environmental literacy of students in the experimental class and control on environmental change materials. O2-O4 is the value post-test Environmental literacy of students in the experimental class and control on environmental change materials. X is the treatment of experimental classes with the SDL model integrated with peer teaching methods. C is the treatment of control classes with the SDL learning model.

The research, which was carried out from January 2024 to July 2024 at Senior High School 18, Bekasi City, was given to 72 students in class X, with 36 students in class X-1 as the experimental class and 36 students in class X-2 as the control class. This research began by providing a pre-test to students to measure their initial ability in environmental literacy related to environmental change materials. Then, the learning process of environmental change material was carried out by applying the SDL model integrated peer teaching method in the experimental class and applying the Self-Directed Learning (SDL) model only in the control class. After being given treatment, students will then be given a post-test to measure their environmental literacy skills after learning has taken place.

Pre-test and post-test have been tested for validity and reliability calculations previously. The environmental literacy instrument's validity was tested using Pearson's Product-Moment Correlation, comparing the calculated r-count with the table r-table. The validity test criterion was: if r-count > r-table, the research instrument was considered valid; if r-count < r-table, the research instrument was considered invalid (Darma, 2021). Based on the results of the validity test it shows that all questions on the tested instrument are valid. The environmental literacy instrument's reliability was tested using Cronbach's Alpha formula:

$$r_{11} = \left[\frac{k}{k-1} \right] \left[1 - \frac{\sum \sigma_b^2}{\sigma_t^2} \right] \quad (1)$$

Information:

r_{11} : Instrument reliability coefficient

k : Number of valid question items

$\sum \sigma_b^2$: Number of question item variants

σ_t^2 : Total number of variants

According to Saputra et al., (2022), reliability values can be observed using the reliability index presented in Table 2. Based on the results of the reliability test, it shows that the questions on the tested instrument are reliable with a very high reliability index.

Table 2. Reliability Index

No.	r_{11} value	Information
1	0.00 – 0.20	Very low
2	0.21 – 0.40	Low
3	0.41 – 0.70	Enough
4	0.71 – 0.90	High
5	0.91 – 1.00	Very high

The data obtained from the pre-test and post-test results were analyzed to evaluate the effect of the SDL model integrated with the peer teaching method on environmental literacy. The analysis process involves prerequisite tests, namely normality tests and homogeneity tests, before proceeding to hypothesis tests at a significance level of 0.05. In addition, the improvement of environmental literacy was also analyzed using the normalized gain test.

RESULTS AND DISCUSSION

Results

Students' environmental literacy was measured based on data obtained from the results of pre-tests and post-tests conducted in the experimental class and control class. The description of the environmental literacy test data can be seen in Table 3.

Table 3. Description of Environmental Literacy Test Data

No.	Data	Experimental Classes		Control Classes	
		Pre-Test	Post-Test	Pre-Test	Post-Test
1	Maximum Value	74.00	100.00	71.00	99.00
2	Minimum Values	42.00	77.00	41.00	71.00
3	Average	57.50	90.14	56.56	84.75
4	Standard Deviation	7.15	6.22	7.15	7.10
5	Average Gain Score		32.64		28.19

Based on the data in [Table 3](#), the experimental class showed a more significant increase in values compared to the control class. The average score of the pre-test of the experimental class was recorded at 57.50 and increased to 90.14 in the post-test. Meanwhile, the control class had a pre-test average of 56.56, with an increase in the post-test average to 84.75. The average environmental literacy of students based on various aspects of environmental literacy can be seen in detail in [Table 4](#).

Table 4. Average Score Criteria Based on Environmental Literacy Aspects

No.	Aspects	Experimental Classes				Control Classes			
		Pre-Test	Criterion	Post-Test	Criterion	Pre-Test	Criterion	Post-Test	Criterion
1	Cognitive	60.86	Enough	91.83	Very High	60.83	Enough	87.11	Very High
2	Affective	50.62	Very Low	86.33	Very High	49.26	Very Low	78.92	Tall
3	Behavior	66.11	Enough	96.11	Very High	62.04	Enough	93.70	Very High

Based on the data in [Table 4](#), it is known that in both classes, the environmental literacy aspect that obtained the highest results was the behavior aspect. Meanwhile, the environmental literacy aspect that obtained the lowest results was the affective aspect. However, based on these data, the experimental class showed a significant improvement. This can be seen in the affective aspect of the experimental class in the post-test result of 86.33, which is categorized as very high.

The data obtained was then tested and analyzed to determine the effect of the SDL model integrated with the peer teaching method. The analysis test was carried out using a hypothesis test with an independent sample t-test. The results of hypothesis testing can be seen in [Table 5](#).

Table 5. Independent Sample T-Test Results

	t Independent	Sig. (2-tailed)	Interpretation
Gain Score	2.814	0.006	The value of Sig. (2-tailed) < 0.05,

Based on [Table 5](#). The results of the Independent Sample T-Test in the post-test result data were obtained, $0.006 < \alpha$ value of 0.05, which can be assumed that the SDL model integrated with the peer teaching method significantly affects students' environmental literacy. Then, to determine the effectiveness of the integrated SDL model of the peer teaching method, a normalized gain test was carried out, which can be seen in [Table 6](#).

Table 6. Normalized Gain Test Results

No.	Class	N-Gain	Criteria
1	Experiment	0.78	High
2	Control	0.65	Medium

Based on [Table 6](#), the normalized gain test result in the experimental class was 0.78, which was greater than the normalized gain test result in the control class, which was 0.65. These results can mean that the SDL model integrated with the peer teaching method used in the experimental class is effective with a high category of students' environmental literacy. Meanwhile, the control class that uses the SDL model alone is less effective against students' environmental literacy.

Discussion

Based on the results of the study, the pre-test score showed that the initial ability of both classes was low but balanced. After the treatment was given, the experimental class experienced a significant increase in post-test scores compared to the control class. These findings indicate that the SDL model integrated with peer teaching methods is more effective in improving environmental literacy, especially in the aspects of cognitive, affective, and behavioral. The results of data analysis through an independent sample t-test and a normalized gain test support this conclusion, with the rejection of H_0 and the N-Gain value of the experimental class of 0.78, which is higher than the control class of 0.65. Thus, it can be concluded that the application of the SDL learning model integrated with the peer teaching method has a positive and effective effect on improving students' environmental literacy.

Based on the cognitive aspect of environmental literacy, the application of the SDL model integrated with the peer teaching method can increase students' understanding of the concepts and issues of environmental change. The planning, monitoring, and evaluation stages of learning increase students' activeness in searching, analyzing, and interpreting knowledge about environmental issues and problems (Putri et al., 2019). Interaction and giving feedback between students also contribute to supporting a deeper and more comprehensive understanding of various environmental issues (Aswat, 2019; Putri et al., 2023).

Based on the affective aspect, the application of the SDL learning model integrated with the peer teaching method can develop students' attitudes and concerns about the environment. The learning process that involves students actively in designing and evaluating learning, as well as interaction and feedback from fellow students, can train a sense of responsibility and trigger a sense of concern and a positive attitude towards the environment. This indicates that applying the SDL model integrated with peer teaching methods can develop students' emotions and attitudes toward the environment in the form of a sense of responsibility and environmental concern (Sumarno, 2020; Wali et al., 2020). Then, based on the behavioral aspect, this learning model can encourage the application of knowledge and positive attitudes that have been learned towards the environment in daily life. This stage can help students in identifying and overcoming environmental problems, and interactions between students can support and inspire each other in implementing pro-environmental behavior (Amaliyah et al., 2019; Ardhiyansyah et al., 2023).

The application of the SDL learning model integrated with the peer teaching method in the experimental class was carried out very well. The syntax of the SDL learning model integrated with the peer teaching method is divided into 5 stages, namely readiness trigger, setting goals, group tutor discussion, peer teaching, and learning evaluation. At the readiness trigger stage, students are given stimuli in the form of articles about news about environmental change issues that are happening. According to the research of Laine et al., (2021), readiness to conduct Self-Directed Learning is indispensable to determine the level of initiative, independence, responsibility, confidence, and motivation of students. In addition, in the implementation of the integrated SDL model, the peer teaching method requires self-management, self-monitoring, and motivation. Providing articles in the form of news on environmental change issues can trigger students' readiness to see problems as challenges so that they can find solutions and be more motivated to learn about it (Riyaningrum & Kusumawati, 2019).

Students will be divided into small groups to make a learning contract at the goal-setting stage. The learning contract includes the preparation of learning objectives, material selection, tutor determination, scheduling, and the search for learning resources. The readiness built in the previous stage can hone students' prior understanding (Laine et al., 2021). This stage trains students to take initiative and be responsible in managing their own learning (Putra et al., 2017; Suroto et al., 2022). The opportunity to design their learning can also encourage the improvement of students' critical thinking skills (Baharuddin et al., 2022). So, at this stage, students can be trained in terms of taking responsibility for solving environmental problems.

The learning objectives in the learning contract that have been made by the students will be realized in the third and fourth stages. In the third stage, namely the group tutor discussion stage, students will gather with the tutor group. The tutor group consists of students who are tutors on the

same material. In the group discussion of tutors, students will be given worksheets that need to be filled out by everyone by discussing together (Pratama et al., 2021). In addition, with tutor group discussions, students who act as tutors can convey ideas and explore information more freely and comfortably (Aswat, 2019). At this stage, students as tutors must understand the material that has been selected well in the group as a provision before delivering the material to the original group.

After the group discussion, students peer-teach the original group. In peer teaching, students convey the material they learn to their peers, increasing their deep understanding of the environment because the equality of language and communication created can help students receive material, and students are also freer to ask their tutors (Irfan et al., 2024). Peer teaching trains students' independence and responsibility, as well as improving abilities in the cognitive, affective, and psychomotor domains, in line with aspects of environmental literacy (Yusup & Sari, 2020). The final stage is the learning evaluation, which evaluates learning outcomes. Students fill out a self-reflection table based on the suitability of learning with the learning contract. This evaluation is to assess student achievement according to the learning contract. Self-evaluation and peer evaluation play a role in improving students' cognitive abilities and motivation (Nurhardini, 2017). This finding is in line with the research of Idrus (2019), which states that evaluation can significantly increase students' motivation to learn.

The conclusion of the discussion shows that the application of the SDL learning model integrated with the peer teaching method in the experimental classroom has a more effective effect on improving students' environmental literacy. This learning model allows students to design, implement, and evaluate the learning process. In addition, students can exchange knowledge, information, and experience, which allows them to understand environmental concepts in more depth.

CONCLUSION

Based on the result, it can be concluded that the SDL learning model integrated with the peer teaching method has an effect on students' environmental literacy. Thus, the implication of this research is that this learning model can be used as an effective alternative for teachers to enhance students' environmental literacy when teaching environmental change material. Additionally, this study can serve as a foundation for future research, developing the Self-Directed Learning (SDL) model integrated with peer teaching by incorporating more varied media and teaching materials, and applying it to other learning subjects.

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