

RESEARCH ARTICLE

Learning While Preserving: The Effectiveness of Project-Based Recycling Learning

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ABSTRACT

This study aims to examine the effectiveness of project-based learning in increasing environmental awareness of elementary school students. Through experimentation, students who participated in project-based learning were compared with a control group. The results showed that students in the experimental group experienced significant improvements in knowledge, positive attitudes, and recycling behavior compared to the control group. This finding indicates that project-based learning is not only effective in the transfer of knowledge about recycling, but also successfully fosters awareness of the importance of environmental conservation. This is in line with the concept of 'learning while preserving', where the learning process is integrated with real actions to protect the environment.

Keywords: *Project-based learning, Environmental awareness, Primary school students*

INTRODUCTION

From an early age, children should be instilled with attitudes and actions that love the environment. Children should be accustomed to maintaining a healthy environment when they become teenagers and adults. Love for the environment can be shown by doing things or activities that support sustainability rather than destroying the environment.

Especially elementary school students, do not realize the importance of protecting the environment, as shown by the number of students who do not take good care of their environment. Such as littering plastic waste. Due to the almost uncontrollable use of plastic, cleaning up plastic waste in schools takes a long time (Nurazizah 2021, P.139). Basically, one of the factors that help the success of education is the school environment. A good school can help education by providing a clean environment, which makes students and teachers feel comfortable and makes learning activities run smoothly. However, schools must also pay attention to their environment. Therefore, as citizens of the school, they are expected to help maintain the environment around them.

According to (Wahyuningtiyas, 2020.P 79) in teaching and learning, there is a student relationship between teachers and learning resources. Teachers do learning to help students learn. Learning is the process of interaction between students and other students in the learning environment (Selegi F S.2023.P 10). The learning model that has the characteristics of producing a product and can help solve the problem is the project-based learning (PJBL) model. Lucas (2005) stated that the learning steps in the Project Based Learning (PJBL) model are start with the essential question, create a schedule, monitor the students and the progress of the project, assess the outcome, evaluate the experience. The learning process begins by providing real problems that exist around students, one of which is plastic waste and so on. Reuse, Reduce, Recycle (3R) is one of the waste management strategies that have been widely practiced by the community (Puspitawati & Rahdriawan, 2012; Trisnawati & Agustana; 2018; Hazam et al.). Reuse is the concept of reusing waste before disposal. Reduce is an effort to reduce the number of products that produce waste, especially waste that is difficult to decompose. And Recycle is the process of turning waste into new products

that can be used. Examples of recycling include crafts, children's toys, wickerwork and so on (Tiandho et al, 2021; Harnovinsah et al, 2017; Rahman and Tuharea, 2021; Febrianta and Fauzan, 2017). Through recycling projects, students can hone their creativity, problem-solving skills and ability to work together.

Through interesting and challenging projects, students can develop various important skills, such as creativity, critical thinking, and cooperation. This article will discuss the effectiveness of project-based recycling learning in raising students' awareness of the importance of recycling and encouraging behavior change towards a more environmentally friendly lifestyle.

METHOD

Research design

This research is an experimental study with a randomized pretest and posttest control group design. Research participants will be divided into experimental and control groups randomly.

Study subjects

This study involved 35 participants who met the following criteria: 1) elementary school students in grade 4 and 5; 2) aged between 10-11 years old. Then, each participant was randomly divided into an experimental group (n = 16) and a control group (n = 19).

Research instruments

A multiple choice achievement test was used in this study. This test was used for students' knowledge of the importance of waste management and ways to recycle before and after project learning. This adapted test has 28 items and after being tested, it obtained Cronbach's alpha reliability of 0.740.

Research procedure

While the treatment started on October 25, 2024, the search for participants was conducted through online form distribution. For seven days prior to the treatment, the researcher administered an online pretest and confirmed the participants' ability to participate in the entire study.

The treatment took place at SDN Lemujut, Krembung Subdistrict, on October 25, 2024. The pretest was conducted online by each participant, while the experimental group was directed to the classroom for two hours (120 minutes) of project-based recycling learning, which was then followed by taking the posttest in the Computer Laboratory. The control group was directed to the Computer Laboratory for the posttest.

Mixed ANOVA was used to analyze the pretest and posttest results. This was done to see how the test scores changed with time and group (Field, 2007).

RESULTS

The study was attended by 35 students in grades 4 and 5. Participants were divided into groups randomly. Details of participant distribution can be found in Table 1.

Table.1 Description of Research Participants

Group	Number (n)	Gender	
		Male	Female
Experiment	16	7	9
Control	19	8	11
Total	35	15	20

Table 2. Description of Research Data

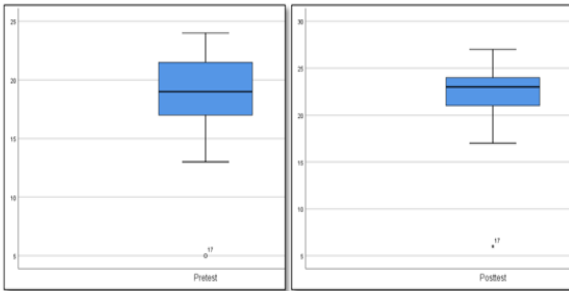
Skor	Experiment				Control			
	Mean	SD	Max	Min	Mean	SD	Max	Min
Pre Test	19.19	3.27	31	24	19.56	3.03	13	24
Post Test	23.88	1.93	20	27	21.23	2.52	17	26

Description of study data

There was no significant difference in the data of the two groups at pretest (see Table 2). However, after the treatment (posttest), it can be seen that the experimental group has a higher mean than the control group.

Detection of outliers

Outliers are abnormal data that can interfere with the overall analysis and should be removed (Figure 1).



Gambar 1. Box plot data

Test assumptions of normality and homogeneity

This study used the Shapiro-Wilk normality test to evaluate whether the distribution of the data was normal (Mecklin, 2007). For homogeneity, the Levene and Mauchly tests were used to evaluate whether the data variances were homogeneous. Tables 3 and 4 show the results of the normality and homogeneity tests.

It can be seen in Table 3 and Table 4 that the data is homogeneous and normally distributed. Meanwhile, for the Mauchly Test, data can be said not to have high variation if it has a significance level above 0.05 or does not show numbers (.) (Field, 2012). From the table above, it can be said that the data in this study includes homogeneous data and is normally distributed. Thus, both assumptions are met.

Tabel 3.

Uji Normalitas		
Uji Data	Sumber	Sig. (p)
Levene	Pre Test	.682*
	Post Test	.683*
Mauchly	Sphericity	.

Tabel 4.

Uji Homogenitas			
Kelompok	Skor	Shapiro-Wilk	
		Statistik	Sig. (p)
Eksperimen	Pre Test	0.874	.008*
	Post Test	0.950	.291*
Kontrol	Pre Test	0.918	.068*
	Post Test	0.946	.260*

Ket : * = homogen ($p > 0.05$)

Hypothesis testing

Table 5 and Table 6 show the pretest-posttest data of both groups, which were used to test the hypothesis. This hypothesis test used the Mixed ANOVA technique.

Table 5. Results of Analysis of Variance of Knowledge Score

Source	SP	df	MS	F	Sig.	ETA ²
Within Group						
Knowledge Score	174.005	1	176.314	40.489	.000	.559
Knowledge Score*Group	37.240	1	39.171	8.665	.006	.213
Between Group						
Group	10.523	1	10.523	1.965	.171	.058

Table 6. Change in Knowledge Score

Group	Time	Time	Mean Difference	Sig.
Experiment	1	2	-4.688	.000
	1	2	-1.722	.018

Notes: 1 = pretest; 2 = posttest

Table 5 and Table 6 show the interaction between treatment and project-based recycling learning score results; the F value of 8.665 and the significance level of 0.006 ($p < 0.05$) indicate that there is a significant difference in project-based recycling learning scores between the two groups. In the group effect analysis, the F value was 1.965 and the significance level was 0.171 ($p < 0.05$) indicating that the results were not significant. All groups scored better, but the experimental group scored the highest, as shown in Table 6. The experimental group had a score of 4.688, while the control group had a score of 1.722. Thus, project-based recycling learning can be said to be able to increase awareness of school environmental conservation.

DISCUSSION

Project-based learning (PJBL) is an educational method in which students are directly involved in projects that are challenging and relevant to the real world. In this case, a project related to the recycling of unused materials, such as plastic, paper, and metal, aims to teach students recycling techniques as well as foster environmental awareness. With a lot of garbage scattered around the school, before the treatment, students were given an online pretest. After that, all participants were gathered at SDN Lemujut on October 25, 2024 for treatment and posttest data collection, with the division of the control group going directly to the Computer Laboratory for posttest collection and the experimental group going to the classroom for project-based recycling learning treatment for 2 hours. After treatment, the experimental group was directed to the Computer Laboratory for posttest data collection.

The results of Mixed ANOVA analysis showed that the group effect was not significant with $F 8.665$ and significance level 0.171 ($p > 0.05$), but the interaction effect was significant with $F 8.665$ and significance level 0.006 ($p < 0.05$). This shows that, although both groups showed improvement in project-based recycling learning, the experimental group experienced an increase of 4.688 , while the control group only experienced an increase of 1.722 . The change in the mean score after the treatment showed a significant difference between the two groups. So it can be said that project-based recycling learning can help students become more concerned with the school environment.

This study combines online and offline techniques. One of the disadvantages of online data collection is uncontrolled participation, which increases the possibility of falsification. In addition, researchers are less rigorous in selecting and supervising participants.

CONCLUSION

Using an experimental research method, project-based recycling learning was shown to be effective in improving students' understanding of the importance of waste management to preserve the environment. This method combines theory and

practice to give students the opportunity to actively learn and be directly involved in a process that can positively impact their environment. Therefore, it is imperative for educators to incorporate project-based learning into their curriculum to produce a generation that cares more about environmental sustainability. Recycling project-based learning is beneficial to society as a whole, as it is not only the students who benefit, but also the community as a whole who can feel the benefits of better and sustainable waste management. With experimental research, we can find out how effective this method is and apply it more widely across different levels

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DECLARATION OF POTENTIAL CONFLICT OF INTEREST

“[Vivi Yunita Sari] does not work for, consult, own shares in, or receive funding from any company or organization that would benefit from this manuscript, and has disclosed no affiliations other than those noted above.”

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