



The Influence of Project Based Learning (PjBL) on Student Learning Outcomes Related to Environmental Pollution

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Abstract:

Project-based learning (PjBL) is a form of student-centered learning characterized by student autonomy, constructive investigation, goal setting, collaboration, communication, and reflection in real-world practice. This study aims to determine the effect of Project Based Learning (PjBL) on student learning outcomes related to environmental pollution. The method used was pre-experimental with a one group pretest-posttest design. The subjects were fifth-grade students at an elementary school in East Java. The research instrument used in this study was a learning outcome test instrument in the cognitive domain in the form of 20 multiple-choice questions. The results of the normalized gain analysis show a value of 0.78, meaning that students' learning outcomes are in the high category. The results of the Wilcoxon analysis obtained an *asymptotic* (2-tailed) value of 0.000 which is smaller than 0.005, meaning there is a significant difference between students' learning outcomes before and after treatment project based learning related environmental pollution. Thus, there is an influence of project based learning related environmental pollution on students' learning outcomes

Keywords: Project Based Learning, Student Learning Outcomes, Environmental Pollution

Abstrak:

Pembelajaran berbasis proyek (Project-based learning/PjBL) adalah bentuk pembelajaran yang berpusat pada siswa, ditandai dengan adanya kemandirian siswa, investigasi konstruktif, penetapan tujuan, kolaborasi, komunikasi, serta refleksi dalam praktik nyata. Penelitian ini bertujuan untuk mengetahui pengaruh Project Based Learning (PjBL) terhadap hasil belajar siswa terkait pencemaran lingkungan. Metode yang digunakan adalah pra-eksperimen dengan desain *one group pretest-posttest*. Subjek penelitian adalah siswa kelas V di salah satu sekolah dasar di Jawa Timur. Instrumen penelitian yang digunakan berupa tes hasil belajar ranah kognitif dalam bentuk 20 soal pilihan ganda. Hasil analisis *normalized gain* menunjukkan nilai sebesar 0,78 yang berarti hasil belajar siswa berada pada kategori tinggi. Hasil analisis Wilcoxon diperoleh nilai *asymptotic* (2-tailed) sebesar 0,000 yang lebih kecil dari 0,005, yang berarti terdapat perbedaan signifikan antara hasil belajar siswa sebelum dan sesudah perlakuan pembelajaran berbasis proyek terkait pencemaran lingkungan. Dengan demikian, terdapat pengaruh pembelajaran berbasis proyek terkait pencemaran lingkungan terhadap hasil belajar siswa.

Kata kunci: Pembelajaran Berbasis Proyek, Hasil Belajar Siswa, Pencemaran Lingkungan

INTRODUCTION

Enhancing the caliber of human resources to compete in the twenty-first century requires education (Stevens, 2012). In order to maximize learning quality, the government has implemented initiatives that have permeated practically every aspect of education, including curriculum reform, teacher quality enhancement, and learning quality enhancement. These initiatives include strategies, models, methodologies, and media updates.

Student-centered learning, which is now a learning difficulty, is supported by the Project-Based Learning (PjBL) approach. According to (Kim, 2021) and (Rees Lewis et al., 2019) the PjBL model develops assignments based on challenging issues for students to research in groups. Because PjBL encourages students to ask questions, research, explain, and engage with the topic, it also gives them the chance to be more active learners. Students are also expected to create and showcase products based on the findings of their research. PjBL is a project that may be completed by an individual or a group over a predetermined amount of time in order to produce a product and communicate the findings (Lesman et al., 2023) (Darmawan et al., 2024). An active or student-centered learning method is necessary in addition to creating and utilizing a variety of learning tools.

A technique called project-based learning (PjBL) can enhance a number of abilities, including academic performance, critical thinking, problem-solving abilities, creativity, independence, and the capacity to view circumstances more objectively (Buchman, 2024) (Williamson, 2023)(Wijayati et al., 2019). Additionally, PjBL promotes learning motivation, a more positive attitude toward learning, supportive peer interactions, communicative flexibility, and a better understanding of learning (Shin, 2018) (Nugroho et al., 2025).

The concept of environmental pollution is suggested for learning activities including reading, observing, discussing, and analyzing various media environmental cases regarding environmental damage and recycled products, conducting environmental pollution experiments, discussing the results of experiments and their causes (Rickinson, 2001)(Robelia et al., 2011)(Karahana & Roehrig, 2015). Students discuss and create products to solve problems, how to prevent, how to overcome ozone layer depletion, greenhouse effects, and global warming and conducting campaigns about the impacts of climate change, efforts that can be made and presenting the results of recycled products

(Rickinson, 2001);(Fahmi et al., 2021). Thus, project based learning is suitable to be applied to environmental pollution material.

Based on the background outlined above, the researcher is interested in conducting research on the application of project-based learning to students' physics learning outcomes. This study aims to determine the effect of Project Based Learning (PjBL) on student learning outcomes related to environmental pollution. This study describes the process and results of research conducted regarding the application of project-based learning to students' physics learning outcomes.

METHOD

The research method used in this study was a pre-experimental one-group pretest-posttest design. This design began with a pretest administered to subjects to determine their initial learning outcomes before treatment. Next, treatment was administered through the implementation of project-based learning related to environmental pollution. Afterward, a posttest was administered to subjects to determine their learning outcomes after treatment. The research design used is as shown in Table 1.

Table 1. Research Design

<i>Pretest</i>	<i>Perlakuan</i>	<i>Posttest</i>
O ₁	X	O ₂

Table 1 shows that X is the treatment in the form of project-based learning related environmental pollution, O₁ is the pretest of student learning outcomes before treatment, and O₂ is the posttest of student learning outcomes after treatment. The research instrument used in this study was a learning outcome test instrument in the cognitive domain in the form of 20 multiple-choice questions. The learning outcome instrument used in this study is a learning outcome test instrument used to identify student learning outcomes covered in environmental pollution material after the learning treatment was carried out. The learning outcome test instrument used in this study is a learning outcome test instrument in the cognitive domain that is measured, namely: knowledge (C1), understanding (C2), and application (C3).

The learning outcome instrument used was validated for construct validity, followed by criterion validity and reliability testing. Based on the construct validation analysis conducted by three experts, it was found that all of the 20 validated items were valid, with the conclusion that they could be used for research. Furthermore, criterion validity was

conducted on 20 respondents who had studied the expansion material. Based on the results of the validity test analysis, it was found that of the 20 validated items, 20 were valid. After that, the 20 valid items were tested for reliability. Based on the results of the reliability test analysis, it was shown that the valid research instrument had a moderate level of reliability.

Pre-test and post-test learning outcome data were analyzed using N-gain analysis and the Wilcoxon test. The N-gain analysis using Microsoft Excel was intended to determine the average N-gain of student learning outcomes before and after treatment. Furthermore, the Wilcoxon test was analyzed using the SPSS program to determine whether there was a significant difference between student learning outcome scores on the pre-test and post-test.

RESULTS AND DISCUSSION

Table 2 shows the average N-gain of learning outcomes after participating in the application of project based learning related environmental pollution.

Table 2. Improvement of students' learning outcomes after participating in the application of project based learning related environmental pollution

Average N-gain < <i>g</i> >	Category
0,78	High

The data analysis results in Table 1 show an average increase of 0.78. This indicates that student learning outcomes improved to the high category after implementing project-based learning related to environmental pollution. The research findings indicate that implementing project-based learning related to environmental pollution can improve student learning outcomes.

Table 3 shows the results of the normality test analysis for the pretest and posttest of student learning outcomes.

Table 3. Tests of Normality Pretest and Posttest of students' learning outcomes

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	,180	20	,089	,879	20	,017
Posttest	,177	20	,099	,909	20	,061

a. Lilliefors Significance Correction

Table 3 shows the results of the normality test analysis for the pretest and posttest. The pretest normality test obtained a Sig value of 0.00, which is less than 0.05, indicating

a non-normal distribution. The posttest normality test obtained a Sig value of 0.00, which is more than 0.05, indicating a normal distribution. Therefore, the pretest and posttest data for student learning outcomes are non-normally distributed.

Table 4 shows the results of the Wilcoxon test analysis for the pretest and posttest student outcomes.

Table 4. Results of the Wilcoxon test analysis on the pretest and posttest of students' learning outcomes

Test Statistics ^a	
	Hasil Posttest - Hasil Pretest
Z	-3,952 ^b
Asymp. Sig. (2-tailed)	,000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 4 shows the results of the Wilcoxon test on the pretest and posttest of student learning outcomes. Based on the results of the Wilcoxon test on the pretest and posttest, the asymp.sig.(2-tailed) value was 0.000. Thus, $\alpha = 0.05 > \text{asymp.sig. (2-tailed)} = 0.000$ so that H_0 is rejected and H_1 is accepted. This shows that the learning outcome scores on the pretest and posttest differ significantly.

Based on the results of data analysis, it was found that there was a significant difference between the learning outcomes of students before and after treatment project-based learning on environmental pollution material. In this case, project-based learning has an effect on student learning outcomes on environmental pollution material. This finding is in line with several previous findings, namely that project-based learning can significantly improve student learning outcomes (Syukriah et al., 2020). The project-based learning model can improve student learning outcomes Project-based learning can improve student learning (Guo et al., 2020).

In the proces project based learning, students are involved in exploring real-world problems through project. Students go through several stages, namely introduction, the teacher presents a challenging and meaningful question or problem. After that, students plan how to approach the project and the teacher acts as a facilitator. And then, students gather information and aplly academic knowledge. Students develop a tangible product or solution. Furthermore, presentation or sharing, students present their project outcomes to an audience. And the last evaluation and reflection, teacher and students evaluate the process and product. During the implementation of project based learning, students were

seen to be enthusiastic in carrying out learning and actively participating in discussions and producing effective products in solving problems.

Project-based learning is student-centered learning. The project-based learning (PjBL) model uses problems as the initial step in gathering and integrating new knowledge based on real-world experiences (AlAli, 2024). This model is designed to solve complex problems that require student investigation and understanding.

Project-based learning is a student-centered learning model. This is because students conduct research to find solutions to problems presented by the teacher, assuming the role of scientists. Students carry out this activity in groups or collaboratively, allowing for an exchange of ideas or opinions among students within the group, until a mutual agreement is reached on a solution to the problem (Barron, 2009); (Webb, 2009). Collaborative activities involve discussions during assignments to reach a consensus on the answer to the assigned task.

CONCLUSION

Based on the results of the Wilcoxon analysis, it shows that the sig. (2-tailed) value is 0.000 which is smaller than the significance of 0.05. Based on the criteria, H_0 is rejected and H_1 is accepted. This shows that there is a significant difference between the learning outcomes of students before and after treatment project-based learning on environmental pollution material. Thus, it can be concluded that project-based learning has an effect on student learning outcomes on environmental pollution material. Thus, project-based learning can be an alternative learning model in optimizing the quality of learning to improve student learning outcomes.

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