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The Influence of Solar Cell Teaching Kit on Student Learning Outcomes on Energy Concepts

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ABSTRACT

Teaching aids are learning media that can make it easier for students to understand material concepts. So far, the media used in learning is limited, especially in energy. This study aimed to determine how much influence the Solar Cell Teaching Kit has on students' learning outcomes on energy concepts. The method used in the study was an experimental class with a pretest-posttest control group design. The results of the test data analysis show that the average value of student learning outcomes in the experimental class reached 73.33, while in the control class, it was 62.5. This conclusion was obtained based on the hypothesis test results through the t-test on posttest data with a sample of 12 and a significance level of 5%. The result is a calculated t value = 5.613 while t table = 1.782. Because the calculated t value exceeds the t table, it can be concluded that the Solar Cell Teaching Kit significantly influences student learning outcomes on energy concepts.

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1. INTRODUCTION

Interesting learning is learning that is able to create a sense of comfort for students so that they enjoy the teaching and learning process. The use of media in learning needs to be the focus of attention in every implementation (Pratama, 2024). One approach that can be done is to utilize teaching aids in learning. The use of teaching aids or teaching kits can help change abstract concepts into something easier for students to understand. (Sidiq, 2022). Teaching aids are a type of learning media that function to help students understand the concept of the material (Hazairin, 2023).

The subject of Natural and Social Sciences (IPAS), especially on the topic of energy and its changes, is very suitable if the learning process uses a teaching kit. The use of teaching kits can provide students with a concrete picture of the understanding of energy changes, especially solar energy (Lestari, 2023). Solar energy is unlimited energy and will not run out as long as there is still sun. Solar energy is an alternative energy source with great potential to be developed in Indonesia. Located on the equator, Indonesia receives sunlight all day with an average solar radiation intensity of 4.8 kWh/m2 daily (Septiyanto, 2024). The continuously changing energy conditions accompanied by increasing energy consumption cause one of the energy sources, fossil energy, to continue decreasing (Rohim, 2024). Solar

energy is very helpful in daily human life activities. Solar power plants (PLTS) are currently an alternative energy source that is widely used in Indonesia.

The presence of solar cell technology adds to the variety of uses of solar energy. Solar cell technology is a breakthrough that converts sunlight energy into electricity. Solar cells are electrical devices that utilize photovoltaic cells to convert sunlight energy directly into electrical energy using the principle of the photovoltaic effect (Purnomo, 2024). PLTS is a clean energy source, does not cause pollution, and is able to generate electricity without solid, liquid, or gas waste such as that produced by conventional power plants, which produce ash, emissions, or hazardous by-products. In addition, PLTS is relatively easy to install, operate, and maintain. Solar energy systems can be easily integrated into existing infrastructure and installed simply without requiring technical knowledge or experience compared to other energy sources (Erduman, 2020). The photovoltaic (PV) technology used in PLTS utilizes solar energy to generate electricity effectively (Herdyana, 2024). The use of electricity for human life is currently in great demand due to the presence of electronic devices.

Although Indonesia has a huge potential for renewable energy, this potential has not been utilized optimally. One of the contributing factors is the lack of learning about new and renewable energy in schools (Ali, 2020). Students, as the next generation, must understand how to convert sunlight into electrical energy. In the Natural and Social Sciences subjects, it is very appropriate to study energy, especially solar energy. The study tried to evaluate the effect of the solar cell teaching kit on student learning outcomes in the concept of energy. This study aimed to determine how much influence the Solar Cell Teaching Kit has on students' learning outcomes on energy concepts.

2. METHODS

The research method used is quantitative, which studies the relationship between variables in the object being studied with a causal approach, where there are independent and dependent variables. This study aims to measure how much influence the independent variable has on the dependent variable. This study uses a quasi-experimental design to examine the cause-and-effect relationship. The quasi-experimental method was chosen to find out how the treatment or experiment affects the characteristics of the subject desired by the researcher. (Nashiroh, 2024).

The research design used is the Pretest-Posttest Control Group Design, where the pretest instrument is given before special treatment, and the posttest is given after the treatment. The purpose is to identify whether or not the use of the Solar Cell Teaching Kit affects student learning outcomes, as well as to determine the differences in abilities between students in the experimental class using the experimental method and the control class using the conventional method. The following is the formula for Pretest-Posttest Control Group Design, with the following details:

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	X1	Y1	X2
Control	X1	Y0	X2

Description:

Y1: The treatment given to the experimental class is in the form of learning with an experimental method using the Solar Cell Teaching Kit.

Y0: The treatment given to the control class is in the form of learning without an experimental method, namely with a conventional approach.

X1: Pretest given to the experimental class and control class before the application of the treatment.

X2: Posttest conducted on the experimental class and control class after the treatment is given.

3. FINDINGS AND DISCUSSION

The study obtained data in the form of pretest and posttest scores from a total of 24 students, consisting of 12 students in the experimental class who were taught using the Solar Cell Teaching Kit experimental method and 12 students in the control class who were taught using the conventional method. The instrument used was a cognitive test of 25 multiple-choice questions that underwent a trial and analysis process. The following is a recapitulation table of the research data.

Table 2. Data Recapitulation

Data	Pretest		Posttest	
	Experiment	control	Experiment	control
Highest Score	65	65	85	70
Lowest Score	35	50	70	55
Average	53,75	54,17	73,33	62,5
Standard Deviation	7,4239	5,1493	4,9237	4,5227

From this table, a bar chart can be made which is shown in Figure 1 below:

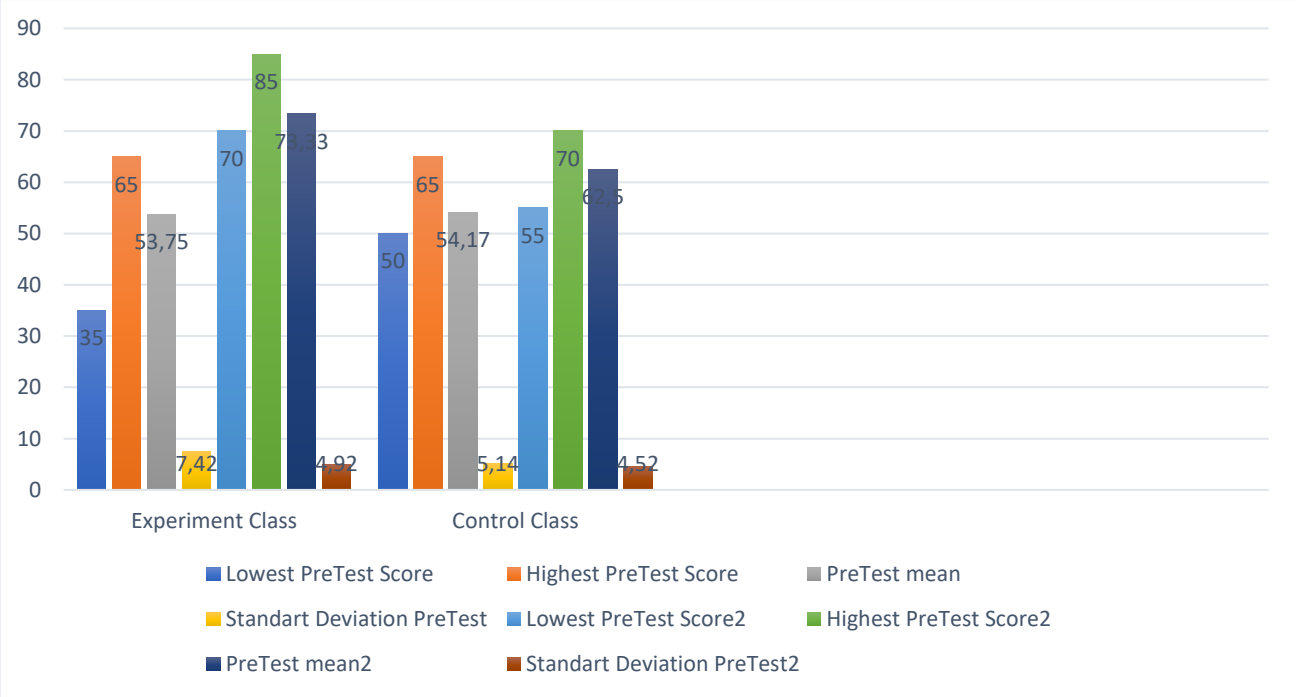

Figure 1. Data Recapitulation Graph

Figure 1 shows a recap of the pretest and posttest results from both classes, namely the experimental class and the control class. In the experimental class, the lowest pretest score was recorded at 35; the highest score was 65, with an average of 53.75 and a standard deviation of 7.42. In the control class, the lowest pretest score was 50, and the highest was 65, averaging 54.17 and a standard deviation of 5.14.

In the posttest results of the experimental class, the lowest score was recorded at 70, the highest at 85, with an average of 73.33 and a standard deviation of 4.92. Meanwhile, in the control class, the lowest

posttest score obtained by students was 55, and the highest at 70, with an average of 62.5 and a standard deviation of 4.52.

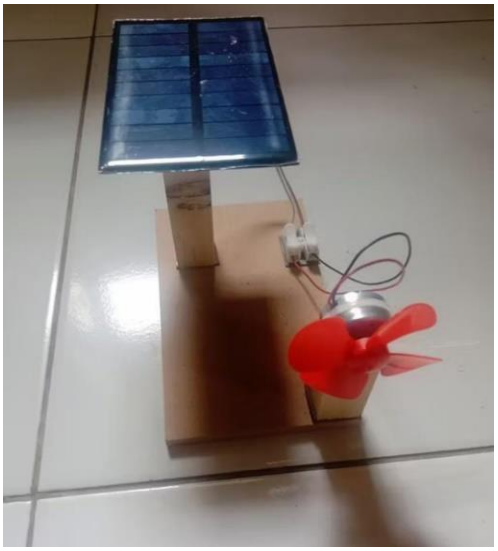

Figure 2. Experimental Tools

Figure 3. Experimental Class

The research prerequisite test in the form of a normality test was conducted to determine whether the data distribution was normal. This test uses the Lilliefors Test at a significance level of 0.05, where H_0 is rejected if the L count exceeds the L table and accepted otherwise. The results showed L count pretest experimental class 0.44, posttest 0.09 (N = 12), and in the control class pretest 0.184, posttest 0.183 (N = 12). With an L table value of 0.242, it is concluded that the data of both classes are normally distributed.

After it is known that the data is normally distributed, the next step is to conduct a homogeneity test using the F test (Fisher). Based on the provisions, if Fcount ≤ Ftable, then both data are considered to have homogeneous variance, while if Fcount > Ftable, then the variance is declared non-

homogeneous. The calculation results show that Fcount pretest = 0.235, posttest = 0.018, and Ftable = 0.973. Because Fcount ≤ Ftable, it can be concluded that both learning outcome data from both samples have the same or homogeneous variance.

The prerequisite test results showed that both groups' learning outcome data were normal and homogeneous, so it was continued with a hypothesis test using the t-test. The test criteria are: if t count < t table, H_0 is accepted; if t count > t table, H_0 is rejected. Based on the calculation, the t count was 5.613 and the t table was 1.782 at a significance level of 5%. Because the t count is greater than the t table (5.613 > 1.782), then H_0 is rejected, and H_a is accepted. Thus, it can be concluded that the use of the Solar Cell Teaching Kit has a significant effect on student learning outcomes.

Previous research conducted by Hazairin Nikmatul Lukma and colleagues on the 2023 Solar Cell Teaching Kit was still limited to development and had not been implemented in schools. The research followed up by applying it in schools, and after implementation, it could improve student learning outcomes.

4. CONCLUSION

The results of the research and discussion concluded that the Solar Cell Teaching Kit had a significant effect on student learning outcomes in energy material. Data interpretation showed that the t-count value of 5.613 was greater than the t-table of 1.782. This difference was also reflected in the average posttest score: the experimental class reached 73.33, while the control class was only 62.5. The weakness of the research is that the procurement of the number of teaching aids is still limited, thus showing the existence of fat groups in practice. The suggestion for further research is to increase the number of tools so that two or three students can use one tool.

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