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The Effect Of Discovery Learning Assisted With Heat Transfer Intructions On Improving Student Learning Outcomes

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Abstrak. The background to this research is the low of the students' study results on physic subject, especially on the heat transfer material. This is due to conventional learning methods and the lack of practical tools that support the learning process. To overcome this, researchers applied a discovery learning model assisted by heat transfer teaching aids. This research aimed to see whether the application of discovery learning model assisted by heat transfer has an effect in improving the students; learning results at XI-B class. The research was conducted at SMA Swasta Pondok Daun on Jl. Pekapuran no.78A, Curug, Depok, West Java. A quasi-experimental method was used in this research. The sample in this study was class XI-B as the experimental class and XI-A as the control class for the 2023/2024 academic year. The total number of samples in this study was 52 students. Data was collected using tests which were divided into two: a pretest was carried out to find out how far students had mastered heat transfer before the treatment and a posttest was carried out to find out whether there was an increase in students' mastery of heat transfer material after the treatment. Apart from that, data was also collected through questionnaires to determine the suitability of teaching media tools and the effectiveness of applying the discovery learning model assisted by heat transfer in learning process at the experimental class. Based on the result finding, it can be concluded that, the student's study results on the heat transfer material in the experimental class has increased as much as 35.77% and 15.97% for the control class. This case can be shown by the students' mean scores of the pretest as much as 49.04 and 38.46 for the posttest. Meanwhile, in the class control, the students' mean scores of the pretest as much as 38.46 and 54.43 for the posttest. It means that the application of the discovery learning model assisted by heat transfer is influential and effective in improving the students' study result.

Keywords: discovery learning, iInstructional Aids, heat transfer

I. Introduction

The choice of learning model that the teacher will use in the learning process can influence students' understanding of the material being taught so as to obtain satisfactory learning outcomes [1]. There are several learning models that are student centered learning in the learning process, including; project based learning, discovery learning, small group discussion, case study, self directed learning, cooperative learning, collaborative learning, and problem based learning [2]. Apart from learning models that are student centered

learning, there are also learning models that are teacher centered learning, namely those that are teacher centered, including; lecture method, direct instruction, and concept achievement [3].

Based on the results of observations made at Pondok Daun High School, researchers found several problems that often occur in the learning process, including; The teaching method is conventional where learning is only dominated by the teacher so that students quickly feel bored and fed up. Apart from that, students never do practicums because of limited laboratory space and practicum equipment so that their learning outcomes are in the low category. To overcome what has been explained, a learning model is needed that can help students understand the material being taught. A learning model that involves students playing an active role in the learning process, for example discovering principles, concepts and solving their own problems that are relevant to learning physics. One learning model that is student-centered is the discovery learning model.

Discovery learning is discovery learning that directs students to discover something through the learning process they carry out [4] . In the learning process, the discovery learning model is centered on students, not teachers. The role of the teacher in discovery learning is only as a facilitator who explains the problem, then guides students to find a solution to the problem by understanding the concepts of the subject matter that has been studied and following the instructions of the Student Worksheet or known by the abbreviation LKPD [5].

The discovery learning model assisted by teaching aids will make it easier for students to understand the concepts of the material being taught. Teaching aids are tools, methods, techniques used in order to make communication and interaction between teachers and students more effective in the education and learning process at school [6]. Props are used so that the teaching process can take place well, in order to facilitate the achievement of planned learning objectives [7].

Based on research conducted by Jayadiningrat, et al (2019) with the title "Application of the Discovery Learning Learning Model to Improve Student Activities and Learning Outcomes". The results of this research show that there is an increase in the average percentage of student learning outcomes by 13% from 75% in the quite good category in cycle I to 88% or in the very good category in cycle II. Thus, it can be concluded that the application of the discovery learning model can improve student learning outcomes in the chemistry subject class XI MIPA 2 SMA Negeri 2 Singaraja odd semester of the 2018/2019 academic year.

Research conducted by Mardiyah and Kamariyah (2022) entitled "The Influence of the Virtual PHET-Based Discovery Learning Model on Student Learning Outcomes on Heat Transfer Material". These results indicate that the PhET Virtual Based Discovery Learning learning model has an effect on improving the physics learning outcomes of class XI MA Miftahul Ulum Bettet Pamekasan students. This can be seen from the difference between the average score of pretest and posttest learning outcomes. The pretest score shows an average score of 50 and the posttest score shows an average learning outcome of 86.25. Based on the problems described above, the researcher will apply the discovery learning model assisted by teaching aids to heat transfer material, with the title "Application of the Discovery Learning Model Assisted by Heat Transfer Props to Improve Student Learning Outcomes in Heat Transfer Material at Pondok Daun Private High School."

II. Method

The method used is the quasi-experimental method which is a quantitative method carried out to find the effect of certain independent variables (treatment) on the dependent variable (outcome) under controlled conditions. Meanwhile, the research design used in the control class was given treatment, which means that the control class used conventional methods (lecture method) while the experimental class was given treatment using discovery learning. Before and after the treatment, both classes were given tests, namely, a pretest to measure the extent of student learning outcomes before being given treatment and a posttest to measure student learning outcomes after being given treatment from a cognitive perspective. Apart from tests, students were also given a questionnaire to assess the effectiveness of the teaching aids used by researchers. This research was conducted at the Pondok Daun Private High School which is located on Jalan Pekapuran no. 78A, Curug, Kec. Cimanggis, Depok City, West Java 16453, in the even semester of the 2023/2024 academic year. The time required for this research process is from early February to July 2024. The samples in this research were taken from classes XI-A and XI-B, totaling 52 students.

The methods used by researchers to determine improvements in student learning outcomes through the application of discovery learning models assisted by teaching aids are defined as data collection techniques. Data collection techniques were carried out in two stages, including;

1) Test

At this stage, the researcher gave an initial test (pretest) and final test (posttest) to the experimental class to determine the learning outcomes of students before being given treatment through discovery learning assisted by teaching aids, while the control class used conventional methods. The test is in the form of multiple choice questions with 20 questions and is distributed via Google Form. (Test attached)

2) Questionnaire

After the test was carried out, the researcher distributed a questionnaire regarding students' responses to the application of the discovery learning model assisted by teaching aids in the learning process via Google Form. The assessment scores used in the questionnaire are: Strongly Disagree (1), Disagree (2), Somewhat Agree (3), Agree (4), and Strongly Agree (5). Data obtained from student response questionnaires will be analyzed by calculating the percentage of student response scores. . (Questionnaire attached)

$$P = \frac{\sum R}{N} \; X \; 100\%$$

Information: $\sum R$ = The total value of respondents' answers to each question

P = Respondent values

N = The highest score from the respondent's answer to each question

The stages carried out by researchers while carrying out research include:

1) Preparation Stage
    a. Develop learning tools that include teaching modules, teaching materials/PPT, and Student Worksheets (LKPD).
    b. Create evaluation questions that are relevant to the teaching material to measure students' learning outcomes/initial knowledge.
    c. Create a questionnaire on student learning outcomes based on the application of discovery learning assisted by teaching aids in the learning process.
2) Implementation Stage
    a. Distribute the pretest first to the control and experimental classes before carrying out the learning.
    b. Carrying out the learning process, where the experimental class applies discovery learning assisted by teaching aids.
    c. Distribute posttests to control and experimental classes to see whether there are differences in the learning outcomes of students who have been given treatment and students who have not been given treatment.
    d. Distribute a questionnaire regarding perceptions of the application of the discovery learning model assisted by teaching aids in the learning process to class IX students in the experimental class.
3) Final Stage
    a. Process the results of research data from both classes.
    b. Analyze and interpret the results of.

Make research conclusions based on the data obtained.

III. Result and Discussion

1. Data Description

This research was carried out at SMA S Pondok Daun using two classes which were divided into control and experimental classes. Where the control class uses a regular learning system, while the experimental class receives discovery learning model learning treatment. The research instrument consists of 30 statement items to measure the effectiveness of the learning model along with teaching aids as aids and tests (pre-test and post-test) totaling 20 multiple choice questions. The pre-test is given before the lesson begins to see students' understanding before the lesson is taught, while the post-test is given after the lesson is finished to test students' understanding of the lesson that was

given previously. Meanwhile, questionnaire instruments were distributed to samples after learning was completed to test students' understanding and effectiveness of learning using assistive devices.

The population in this study was class XI with a total of 7 students, then the samples used were 2 classes, namely XI-A and XI-B, each class was divided into 26 students. With this, students will learn to follow the learning stages in the learning method so that students can then receive the information that has been given.

a. Description of Pre-test Data Analysis Results of Student Learning Results in Experimental and Control Classes

From the results of the research that has been carried out, data analysis of the pre-test results from the experimental class and the control class can be seen that the average value of students' first skills in the evaluation class is 49.04, while in the control class it is 38.46 with an average difference of 10.58.

b. Description of Pre-test Data Analysis Results of Student Learning Results in Experimental and Control Classes

From the results of the research that has been carried out, calculation data has been obtained and even post-test analysis results can be concluded that there are quite significant differences between the experimental class with the highest score of 95 and the lowest score of 75 with an average score of 84.81 while the control class with the highest score of 40 or even the lowest score of 65 with an average score of 54.43. Apart from that, the increase in data distribution after being given a simulation can be seen in the highest average value obtained by the experimental class, namely 84.81 from the control class, namely 54.43. This proves that there was a very high increase after the simulation using the learning model in both classes with an increase of 35.77% compared to the experimental class while in the control class it was 16.37% from the previous condition. With these results, it can be concluded that the two classes have significant differences in learning outcomes after being given a simulation, namely the experimental class with discovery learning model assisted by teaching aids and the control with lecture learning, the difference in average value is 30.38 between the two classes used in the research sample.

2. Description of Prerequisite Test Results

a. Normality Test Results

In the data normality test, researchers used the Kolmogorov-Smirnov test using SPSS version 29 with the condition that the Sign value was> 0.05, so the class had a normal distribution. Meanwhile, if the Sign value <0.05 then the class is said to be not normally distributed.

Table 1. Normality test results of pre-test and post-test data on student learning outcomes in the experimental and control classes

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
PretestEksperimen	.161	26	.081
PosttestEksperimen	.153	26	.120
PretestKontrol	.108	26	.200*
PosttestKontrol	.162	26	.078

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

According to these data, the results of calculating the pre-test and post-test data on student learning outcomes before and after treatment in the experimental and control classes using the Kolmogrov-Smirnov test were obtained, namely the significant number in the pre-test for the experimental class was 0.081, even the significant post-test score in the experimental class was 0.120, while in the control class the significant pre-test score was 0.200 and the significant post-test score was 0.078. Based on the decisions that have been determined, if the sig score is > 0.05 then the data is normally distributed.

b. Homogeneity Test Results

The homogeneity test is designed to determine whether the samples have the same variance between the groups being compared using the Levene statistical test in the SPSS application. The test criteria are based on: if the significance value is <0.05 it means there is no homogeneity of variance and if the significance is sig > 0.05 it means that the data has a homogeneous variance.

Table 2. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
HasilBelajar	Based on Mean	.521	1	50	.474
	Based on Median	.440	1	50	.510
	Based on Median and with adjusted df	.440	1	48.970	.510
	Based on trimmed mean	.482	1	50	.491

Based on the data that has been obtained which is shown in table 4.4, it can be seen from the significance that the mean value shows 0.474, which means it is greater than 0.05, so this research data is homogeneous data.

3. Description of Hypothesis Test Results

To analyze hypothesis testing on the influence of discovery learning model learning variables on improving student learning outcomes, researchers used the Independent Sample t-test with the help of SPSS Version 29 with the aim of seeing the difference in increasing learning outcomes between before and after being given treatment with a significant level (0.05), the alternative hypothesis (Ha) was accepted and the null hypothesis (H0) was rejected.

Table 3. Hypothesis Test Results

Independent Samples Test

		t-test for Equality of Means		
		T	Df	Sig. (2 tailed)
HasilBelajar	Equal variances assumed	15.523	50	.000
	Equal variances not assumed	15.523	49.073	.000

Based on the table results in table 4.5, a significant score (2-tailed) was obtained, namely 0.000 < 0.05. Then Ha can be accepted and H0 is rejected. This means that the application of the discovery learning model with the support of teaching aids has an effect on improving student learning outcomes.

4. Description of Improving N-Gain Learning Outcomes

The increase in student learning outcomes in the experimental class and control class utilizing differentiation learning can be seen using the percentage of N-Gain values in table 4.

Table 4. Data description N=Gain Pre-test and Post-test learning outcomes of students in the experimental class and control class

Class	Average N-Gain Score Percentage	Interpretation
Experiment	71.12	Quite Effective
Control	24.58	Ineffective

According to the N-Gain results, the score shows that the average value of student learning outcomes for the experimental class was 71.12%, mainly in the quite effective category, while for the control

class there was 24.58 in the ineffective category. So it can be concluded that the use of the learning system in the experimental class is good enough to support student learning outcomes in heat transfer material at SMA S Pondok Daun. While the average N-Gain score in the control class is in the ineffective category, it is assumed by researchers that the learning system used for the control class, namely the lecture method, makes students more passive in receiving subjects.

5. Description of Student Response Results

To see the response of students' satisfaction with the learning model assisted by teaching aids, the researchers distributed questionnaires to respondents, namely students in the experimental class. The questionnaire consists of 30 statements and the number of test responses in this study was 26 students. Table 4.6 shows the results of the assessment for each assessment indicator.

Table 5. Results of Trial Responses to Teaching Aided by Teaching Aids

No	**Indicator**	Presentation	Category
1.	There is passion and desire to succeed	83,39%	Very good
2.	There is help and need for learning	70,14%	Good
3.	There are desires and aspirations for the future	83,04%	Very good
4.	There are rewards in learning	84,64%	Very good
5.	There are interesting activities in learning	69,76%	Good
6.	The existence of a conducive learning environment and effective tools enable students to learn well	68,39%	Good
	Total Average	76,56%	Good

From the table, it can be seen that student respondents regarding the learning process assisted by teaching aids are said to be positive because the percentage results of all assessment measuring questions achieved an average percentage value of 65-100% from 26 respondents. The percentage of responses to the trial was carried out on 6 indicators, namely the indicator of desire and desire to succeed, which received a score of 83.39% in the "very good" category, the indicator of assistance and need, which received a score of 70.14% in the "good" category, the indicator of hope and aspirations for the future, which obtained a score of 83.04% in the "very positive" category, the indicator of appreciation in learning, which received a score of 84.64% in the "very positive" category, the indicator of unique activities when studying, which obtained a score of 68.39% with the

"good" indicator. as well as indicators of a thriving learning environment and the effectiveness of tools which then enable students to learn well, getting 68.39% in the "good" category.

IV. Conclusion

Based on the results and discussion above, it can be concluded that: 1) Student learning outcomes in heat transfer material in the experimental class are relatively lower than the control before treatment. This can be seen from the students' pretest average score of 38.46. in the experimental class and control class it was 49.04 2) When there was treatment given in the experimental class, student learning outcomes in the experimental class were relatively greater than those in the control class. This is evident from the experimental class's average posttest score of 84.81 and the control class's score of 54.43. 3) The results of the hypothesis test show that the application of the discovery learning model assisted by simple teaching aids has an effect on student learning outcomes in class XI of Pondok Daun Private High School.

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