Comparison of the Effectiveness of Learner Learning Outcomes between the Inquiry Approach and the Verification Approach with the Experiment Method

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Abstract. The purpose of the study was to compare the effectiveness of inquiry and verification experimental methods in science learning. Quasi experiment with pretest-posttest design is the type of this research. The population consisted of all grade VI elementary schools in the Tapestry cluster totaling 229. The research samples were 26 students of grade VI SDN 2 Purwojati and 26 students of grade VI SDN 3 Gerduren. Learning outcomes were obtained using tests, namely pretest and posttest. Hypothesis testing using Paired Sample T-Test with SPSS 26, shows 1) there are differences in learning outcomes obtained by experimental group I using inquiry experiments and experimental group II using verification experiments. The average posttest value of experimental group I was 75.00 while experimental group II was 66.15, 2) The results of hypothesis testing using paired sample t-test, two tailed sig value is 0.000 <0.05, this indicates that H0 is rejected and Ha is accepted. The indication is that the science learning of the inquiry approach experimental class is more effective than the verification approach experimental class learning.

Keywords: experiment, inquiry, verification, learning outcomes.

1. Introduction

Education must be able to facilitate the growth and development of 21st century skills of future generations. The skills in question are "the 4Cs", namely the skills to construct their knowledge to be critical in thinking and solving problems, creative in thinking, communication skills, and the ability to collaborate. There are demands on the quality of human resources as an effort to face technological advances accompanied by increasingly uncontrollable scientific developments that occur in the global era[1].

Expectations regarding the realization of the 4Cs are in accordance with the contents of Law No. 20 of 2003 which states that education is more defined as an activity that is deliberately planned to be able to realize active learning with the aim that students are facilitated by educators

to develop their potential and guide student behavior to be in accordance with spiritual guidance, able to control themselves, have personality, intelligence and noble character, and skills that will be useful for themselves, as well as for society, nation and state [2].

Implies a message that education is not only developing students' intellectuals, but more than that, education is an effort to be able to build a person's abilities in the cognitive, psychomotor, affective and personality aspects they have[3]. In line with this also mentioned that education is interpreted as an effort to be able to realize the learning process where students are given the opportunity so that their potential can develop[4]. This implies a message that every learner has the opportunity to be able to develop their potential so that education through the learning process must be able to realize this. One of them is the quality of learning that must be improved and improved.

Efforts to improve the quality of education have actually been made by the government, including; a curriculum that is improved from period to period, fulfilling educational facilities and infrastructure, improving the quality of teachers through various programs such as PPG, serving requests for procurement of learning resources, and holding various trainings with the aim of supporting teacher skills. These efforts aim to bridge teachers in order to educate and guide students to have sufficient capital to face the times. Teachers must strive so that the learning activities carried out have good quality including in Science learning.

Natural science learning in SD / MI basically aims to make students not only understand the theory but can apply it in their daily lives. Science learning is also directed so that students can foster their curiosity, show a responsive attitude towards the relationship between natural science, technology, the environment, and also society, construct good practical skills in order to identify the surrounding environment, carry out problem-solving strategies, decide on something, play a role in efforts to maintain and protect the surrounding environment, and also appreciate God's creation. These skills are in line with the efforts he makes to get the concept and understanding of science which is used as a basis in order to support his ability at the junior high school / MTs level [5].

This goal can be achieved if the science process is emphasized in learning activities. Learning activities are more directed at the process, because this will support students' skills through direct learning experiences or direct practice in which there is a process of understanding the activities carried out. This experience is obtained through direct interaction with the environment [6]. The application of Bruner's theory will help students to carry out the scientific process so that they can improve their scientific abilities, besides that, students are also given the freedom to express their thoughts and creativity in learning through experimental methods to acquire mental abilities and scientific abilities.

Through the experimental method, students will be involved in activities that provide challenges because they can be directly involved in experimental activities that lead to critical thinking skills in solving problems. Problem-solving abilities can train children to develop skills, construct knowledge, discover (inquiry) on the problems given, as well as independent students and raise their self-confidence [7]. The experimental method requires the teacher to be able to create problematic learning situations, stimulate students with questions, encourage students to find their own answers, and conduct experiments. So, in learning, students must be active not just receiving explanations from the teacher.

Learning with experimental methods has several classifications, namely the inquiry approach (inductive), verification approach (deductive), process and technical skills, and question and answer[8]. Experimental methods that emphasize verification are defined as experiments that have the aim of proving a theory/law/concept. For its implementation, this verification approach is carried out by presenting the main idea, discussing it, presenting, then practicing experiments to strengthen the results of the discussion. Meanwhile, inquiry experiments emphasize experimental activities with the aim of laying the foundation and process of developing students' scientific thinking. This approach places students to develop their creativity in solving problems. The with more or less this meaning: the inquiry approach can train students to carry out an investigative process, which allows children to be able to collect and process experimental data and build conclusions independently[9]. The statement also supports through their statement which is interpreted as follows: inquiry-based practicum develops problem-solving and critical thinking skills[10].

In reality, learning science is not yet optimal in the aspect of developing scientific thinking because so far experiments have only been carried out to prove a concept or theory. Students have not been trained to be able to experiment by finding a concept. Science learning cannot be said to be a meaningful activity because the implementation of learning is not yet at the stage of constructing understanding even though it has conducted an experiment, as happened in grade 6 SDN 2 Purwojati. Students have not been directed to develop and construct the concepts they learn. The learning process has not led to the acquisition of direct experience for students.

The research was conducted to compare the inquiry experiment method with verification. Based on the conclusion, it can be seen that there is a significant difference in the results obtained by students based on the learning activities they do. More about the results of the study, about the existence of a class that is used as a control and a class that is given different treatments, where the experimental class is treated with the inquiry and verification experimental method. While the control class received learning using an informative approach. The difference was seen by comparing the average value of understanding. Where for the class that received the inquiry experiment treatment was better than the average value obtained by the class that received learning using the verification method or the informative approach.

Researchers see the phenomenon that occurs as a problem that should be sought for a solution. The proposed solution is to apply the inquiry experiment method to learning. Researchers then conducted research to analyze the comparison of learning outcomes between classes that received learning with the inquiry experiment method and classes that received learning treatment with the verification experiment method.

2. Research Methods

2.1 Research Design

This research uses quantitative methods. The research design used was pretest - posttest one group design. This type of research is a quasi experimental design.

2.2 Subject of the Study

The research population was sixth grade students from public schools in the area of the Tapestry Cluster Purwojati district which amounted to 229 students. The research sample was the sixth grade of SDN 2 Purwojati which amounted to 26 students and the sixth grade of SDN

3 Gerduren which amounted to 26. The technique used for sampling was purposive sampling. The purposive sampling is a sampling technique with certain considerations. Researchers chose to use purposive sampling technique because it is suitable for quantitative research or research that does not generalize and researchers are looking for students with equal cognitive abilities[11].

2.3 Instruments of the Study

The instrument used in data collection was a test, observation, and documentation.

1) Test. The use of tests aims to measure students' learning achievements, namely during pretest and posttest. This is so that researchers can analyze the acquisition of learning outcomes between the two groups. Test questions in the form of essays are tested for validation and reliability first.

2) Observation is used to support the test in describing the learning process of students when the teacher uses the inquiry experiment method and verification of the scientific performance of students adjusted to the syntax of inquiry experiment learning and verification. The observation sheet was filled in by the observer. Experimental group I and experimental group II were each given one scientific performance test so that the two could be compared. Both groups get the same material, namely about heat transfer.

3) Documentation, used to obtain supporting data. The research results were processed using SPSS 26.

2.4 Research Procedure

The research procedure was as follows:

1) All test items were tested before administering the pretest to determine instrument and reliability.

2) Pretest and posttest were administered to analyze students' science learning outcomes.

3) Quantitative data was collected using pretest-posttest and analyzed using SPSS.

The following are the learning stages of the experimental method with an inquiry approach and the experimental method with verification[12], table in the below:

Table 1. Differences in the learning stages of inquiry experiments and verification experiments

Learning Stages	
Inquiry Experiments	**Verification Experiments**
1. Early activity	1. Early activity
2.Presenting problems (working on problems given by the teacher as well as designing experiments)	2. Presenting problems (working
3. State the hypothesis	3. Analyze the teacher's explanation
4. Testing the hypothesis (experiment)	4. Conduct experiments prepared by the teacher
5. Collecting data	5. Verifying the teacher's explanation with the experimental results (conclusion)
6. Analyze data	6. Final activity

The hypothesis that has been proposed is tested using the Paired Sample T-test which is part of the t test. Researchers used the t test because the sample used was less than 100. There are two hypotheses designed, namely:

H_0 : There is no difference in learning achievement between the sixth grade of SDN 2 Purwojati which received learning with the inquiry experiment method and the sixth grade of SDN 3 Gerduren which applied learning with the verification experiment method.

H_a : There is a difference in learning achievement obtained by the class that uses the syntax of the inquiry experiment method and the class that applies the learning flow with the verification experiment method.

3. Results and Discussion

3.1 Validity and reliability test

The validity of the learning outcomes test was calculated using SPSS 26. The validity results obtained were in the moderately high and high categories. The reliability test results are in the high category. The resulting Guttman Split-Half Coefficient value is 0.816. Based on these results, questions for the pretest and posttest can be used as instruments in this study.

3.2 Data Normality Test

This research hypothesis test uses the t test. Therefore, the data must be tested for normality and homogeneity first. The following are the results of the normality test & homogeneity test with SPSS 26.

Table 2. Normality Test of Data

	Class	Kolmogorov-Smirnov			Saphiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Learning outcomes	Pretest of Experiment Group I	.191	26	.016	.928	26	.069
	Posttest of Experiment Group I	.190	26	.017	.922	26	.049
	Pretest of Experiment Group II	.187	26	.020	.916	26	.037
	Posttest of Experiment Group II	.217	26	.003	.922	26	.049

The normality test table shows that for the Saphiro-Wilk column, the sig value is> 0.05. Therefore, the distribution of data in this study can be categorized as normal.

3.3 Description of Student Learning Outcome Analysis

The results of the final analysis of data in this study are testing temporary answers to the provision of different treatments to two groups. Both groups were given two tests, namely pretest and posttest. The acquisition of values from the two groups is described through the table of acquisition of value results. These results are presented in the following table below:

Table 2. Table of Learning Outcomes

Number	Experiment Group I (inquiry experiment)		Experiment Group II (verification experiment)	
	Pretest	Post-test	Pretest	Post-test
1	30	50	40	50
2	40	50	50	70
3	50	60	40	50
4	50	60	50	90
5	50	70	60	50
6	40	70	30	60
7	40	70	40	70
8	30	70	50	70
9	40	70	30	70
10	40	70	40	60
11	70	70	60	70
12	50	70	70	80
13	50	70	60	70
14	40	80	50	70
15	50	80	40	70
16	60	80	70	70
17	60	80	50	70
18	70	80	60	80
19	40	80	40	60
20	40	80	50	60
21	40	80	50	60
22	60	80	50	90
23	50	90	40	60
24	50	90	30	70
25	20	100	30	40

| 26 | 50 | 100 | 40 | 60 |

The scores of the two classes were then processed through the SPSS 26 application and analyzed descriptively. The results are presented in Table 4:

Table 4. Statistical Description Of Learning Outcomes

	N	Minimum	Maximum	Average
Pretest of Experiment Group I	26	20	70	46.54
Posttest of Experiment Group I	26	50	100	75.00
Pretest of Experiment Group II	26	30	70	46.92
Posttest of Experiment Group II	26	40	90	66.15

The table above shows that the acquisition of student learning outcomes in experimental group I and experiment II is categorized into pretest and posttest. The acquisition of cognitive scores of experimental group I (inquiry) is seen to experience positive changes, namely from the average pretest score which was originally 46.54 increased to 75.00. The learning outcomes of experimental class II (verification), namely the pretest average which was originally 46.92, increased to 66.15, but this increase was lower than experimental group I. The experimental group I was faster in terms of analyzing the cognitive skills of the students. Experimental group I was faster in terms of constructing a concept so that their understanding was better. Students also received guidance from the teacher and they had the opportunity to be able to analyze concepts, principles, and laws in science and then developed by them after conducting experiments directly. Learners get a direct learning experience that makes it easier for them to develop the basic knowledge they understand.

Students in experimental group I received learning treatment using the inquiry approach experimental method. Learners are involved and given a stimulus to be active in learning activities. This will certainly help them in an effort to sharpen their skills, especially in designing and utilizing their discovery process so that their knowledge and application of concepts can be better than before. Basically, this statement proves the statement of a figure, namely Gagne. The inquiry approach is problem solving or the focus lies on solving problems. Problem solving usually uses principles so that goals can be achieved[13]. Everything that is learned during the process of students solving problems is a principle that has a higher level of understanding. Problem solving is an activity that can actively shape students' scientific thinking.

The discovery approach (inquiry) helps our learners to be able to develop a method and technique of processing information that they get from the environment. The theory that supports this statement is stated by Niles that the inquiry approach is a strategy that processes information by focusing on prior knowledge which is then developed through process skills. In addition, this approach can also be referred to as a tool to develop students' intellectual skills.

In experimental group II, namely grade 6 students of SDN 3 Gerduren received learning with the verification approach experimental method. Learners in this group apply scientific

principles and concepts through more directed experiments. Learners in experimental group II were trained to analyze and verify the experiments delivered by the teacher. They have taken advantage of the good opportunities provided by the teacher to be active subjects in learning, express reasons, and understand concepts more purposefully and systematically. Although in the verification experiment method, students only test a concept, but students must be able to prove the concept based on their understanding.

This means that the distribution of data values for the pretest and posttest learning outcomes of students in both experimental group I and experimental group II is not too lame. Researchers use the results of this normality test as a basis for continuing hypothesis testing. The researcher then tested the hypothesis using the t test, namely the paired sample t-test. The results of the t test can be seen from the table below:

Table 5. Hypothesis Test Results (Paired Sample T-test)

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pretest Eksp Inkuiri - Posttest Eksp Inkuiri	-28.462	16.418	3.220	-35.093	-21.830	-8.840	25	.000
Pair 2	Pretest Eksp Verifikasi - Posttest Eksp Verifikai	-19.231	12.625	2.476	-24.330	-14.132	-7.767	25	.000

There are rules that can be used as a basis for making decisions on the t test when viewed from the significance value[14].

a. H_0 is accepted if the two tailed sig value> 0.05.

b. Ha is accepted if the significance value is <0.05.

The significance value for this research hypothesis test shown in the table is 0.000. This means that the significance value is <0.05 which indicates that Ha is accepted. Ha in this study is the difference in learning achievement obtained by experimental group I which uses the syntax of the inquiry experiment method with group II, namely the class that applies the learning flow with the verification experiment method. Researchers can conclude that this research proves that the learning outcomes obtained by students whose learning activities use the inquiry experiment method are better than classes that use the verification experiment method.

3.4 Discussion

In experimental group I, namely the teacher applying inquiry-based experimental learning, it can be seen that the acquisition of student learning outcomes has increased. This is evidenced by the acquisition of posttest scores which reached an average of 75.00, while the average pretest score was 46.54. In experimental group II, namely the teacher applying verification-based experimental learning, the pretest average value was 46.92 and experienced an increase in the average posttest value to 66.15. Although the difference between the average posttest scores between experimental group I and experimental group II is not too lame, this proves that experimental group I obtained a better average posttest score than experimental group II. Some things that might cause an increase in the acquisition of learning outcomes in experimental group I are that students are shown how to learn logically, critically and analytically towards an appropriate conclusion. The Inquiry experimental method demands higher mental processes through a systematic system of thought. The systematic process that is passed is at the beginning the teacher gives a problem then students design experiments, conduct experiments, collect and analyze data and draw a conclusion from the problem.

Experiments with an inquiry approach require students to be able to think scientifically in solving problems, and foster the habit of creativity and reasoning. At the beginning of the lesson the teacher lures students so that they are interested and motivated to not only think but also want to take action through an experiment. Then the teacher directs the course of an experiment that can lead students to a conclusion that leads to the achievement of learning objectives.

As for experimental group II which was given learning with verification-based experiments, students practiced experiments to prove the laws or theories that the teacher had taught in the book. So students have found the theory first before finding the proof through practicum. Most of the activities carried out by students in the laboratory are used to obtain data that support the learning materials that have been given by the teacher in the classroom or the materials listed in the textbook. So that students' thinking patterns have been formed from the beginning of learning through the teacher, this can cause students not to think flexibly or not creatively in finding an alternative problem solving.

Besides being able to be seen from the acquisition of average values for the two different groups, the results of this study are also reinforced by SPSS calculations using the t test. That the acquisition of sig value <0.05 indicates that Ha is accepted. This indicates that there are differences in learning achievement obtained by classes that use the syntax of the inquiry experiment method with classes that apply the learning flow with the verification experiment method. The factors causing the difference in learning outcomes or learning achievement between experimental group I and experimental group II have been mentioned above.

4. Conclusion

The researcher has analyzed the results of data processing and tested the provisional answers, so that the conclusions of the research can be obtained. Both experimental groups in this study received different science learning treatments. However, experimental group I and experimental group II were given two tests, namely pretest and posttest. Students in experimental group I received learning treatment with an inquiry approach. Learners are guided

to be able to construct understanding and find a concept based on the experiments they do. Learners in experimental group II received learning treatment with a verification approach. They prove a concept or theory.

The average posttest score in experimental group I was better than the pretest score. The learning outcomes of experimental group II also changed from the pretest and posttest scores, but not significantly. The results of the hypothesis test obtained a significance value of 0.000, which means sig <0.05 which indicates that H_0 is rejected. The results of the study can be concluded as follows: 1) there are differences in learning outcomes obtained by experimental group I and experimental group II. Where in experimental group I, the average posttest value is 75.00 while the average posttest value of experimental group II is 66.15, 2) the results of testing the hypothesis of this study using the t test. Where the t test used is a paired sample t test which shows the two tailed sig value is 0.000, meaning sig <0.05, this indicates that H0 is rejected and Ha is accepted. The conclusion drawn from this study is that learning in classes that use the inquiry approach experimental method is more effective than learning in classes that use the verification approach experimental method.

The implication of this research is to contribute to education about the effectiveness of experimental methods for science learning in elementary schools. Until finally there is a positive correlation between theoretical and practical science learning. In line with Bruner's learning theory which argues that experiments can help students to carry out scientific processes so as to improve scientific abilities, besides that students are also given the freedom to pour their thoughts and creativity in learning through experimental methods to gain mental abilities and scientific abilities. Learners are also given the opportunity to be able to develop thinking skills and creativity because they are given the opportunity to try or conduct experiments to prove a point or theory or even to be able to discover a theory.

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