

Effectiveness Of Science Experimental Methods On Students' Learning Outcomes At Mi Sirojul Mutallimin Limbangan Brebes

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Abstract

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Science learning which is oriented towards higher order thinking skills, students are expected to be able to become quality human beings, namely to be able to survive and develop to prepare themselves to face the challenges of today's global world. Therefore, to answer the challenges of the global world, students need to be trained to build and improve these high-order thinking skills. This study aims to determine the effectiveness of the science subject experimental method in improving the learning outcomes of fifth grade students at MI Sirojul Mutaallimin Limbangan Losari Brebes. This type of research is a Quasi Experimental design with the form of a Nonequivalent control group design. The population in this study were all 21 students of class 5 A MI Sirojul Muta'allimin Limbangan Village. The research data was obtained through test questions, questionnaires and observation. The results showed that: 1) The students used the discovery learning method in the 1st trial the students got a percentage of 75.9% with the criteria of "very good" and in the 2nd experiment they got a percentage of 83.5% with the criteria of "very good", 2) Value the average experimental 1 and 2 control class Pretest to Posttest results can only increase by 5% and 8%. While the average value of the 1st and 2nd experiment class from the Pretest to the posttest results increased by 26% and 28%. From this statement it means that in experiments 1 and 2 the experimental class experienced a greater increase than the control class, 3) Based on the Mann-Whitney hypothesis test in experiments 1 and 2 the sig. (0.000) < α (0.05) which means that H₀ is rejected and H_a is accepted. So it can be concluded that there is the effectiveness of the use of hots-oriented discovery learning methods on student learning outcomes in science material for classV MI Sirojul Mutaalimin Limbangan with a large influence of 66% in experiment 1 and in experiment 2 obtaining a magnitude of influence of 73%..

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Introduction

Education is a process of interaction between teachers and students, designed to help students realize their potential in teaching and learning activities. Basically, learning and teaching are two things that cannot be separated and are closely related. The 2013 curriculum is a competency-based curriculum designed to anticipate the needs of 21st century competencies (Nasihah et al., 2020; Pawero & Vangino, 2018). In the 2013 curriculum, the education and teaching process not only focuses on developing knowledge, but also on developing students' attitudes and skills. Natural Sciences (IPA) is part of the curriculum in schools. IPA equips students with knowledge, ideas and understanding of the natural environment, which are obtained from experience through various scientific processes, including research, preparation and idea generation (Pangabean et al., 2021). One of the subjects that develops students' thinking skills is IPA. Science learning in elementary schools not only emphasizes understanding facts, concepts and science, but also develops skills in applying scientific methods and knowledge to solve everyday problems (Fitrianingtyas & Radia, 2017; Narut & Supardi, 2019).

Because science education is closely related to everyday life, science is taught in elementary schools with an emphasis on the learning process that is centered on direct experience to develop the ability to explore and understand the natural environment systematically. (Fatimah, 2017). However, in its implementation, science learning in elementary schools still lacks experiments and direct involvement of students in conducting experiments (Wirdawati, 2017). Natural Sciences (IPA) can also help someone develop habits of understanding and thinking, and provide students with the opportunity to master many life skills. These skills are observation, prediction and scientific attitudes. Science has a long history of creating new knowledge and applying it to human life in general, including advancing technological development (Yuniati, 2018).

Science education aims to develop and teach scientific thinking, working and acting as part of life skills so that students can act and understand the environment more deeply (Nur Jannah, 2020; Nurzaenah & Pratama, 2021). The use of conventional learning methods in science learning does not make students active in learning. This makes students less able to develop process skills in understanding science concepts or scientific literacy. Therefore, efforts are needed to improve students' skills in science learning. As stated in the Curriculum Content Standards for Educational Units (National Education Standards Agency, 2006), science learning in elementary schools/Islamic elementary schools aims for students to develop process skills to investigate the environment, solve problems and make decisions. Therefore, teachers must be able to use other methods in learning that can develop students' process skills.

Science learning or IPA essentially has dimensions of thinking ability processes, dimensions of results (products), and dimensions of attitude development. These three dimensions are interrelated. The relationship between these three dimensions causes a paradigm shift in the implementation of learning, learning that was initially centered on the teacher (teacher centered) has changed to being centered on students (student centered). The change in paradigm must be balanced with the creativity of teachers in combining Discovery learning models that are oriented to HOTS (Higher Order Thinking skills) (Umi, 2015).

The method that can develop students' abilities in the process by looking at facts is the experimental method. The experimental method is a development of the scientific method found in science. This method helps students understand the material according to the actual facts, because students can directly observe the facts that exist in an object or a process. The implementation of this learning method can be done in the classroom or outside (laboratory or school environment) (Kumala, 2016). By applying the experimental method through science literacy in science learning, students not only receive information from the teacher but students

can experience learning directly, can develop process skills, and can develop abilities in science literacy. Based on these considerations and also efforts so that students can learn happily and gain meaningful knowledge for students, the researcher chose to conduct research on "The Effectiveness of the Science Subject Experiment Method on the Learning Outcomes of MI Sirojul Mutaalimin Limbangan Brebes Students".

Methods

This study aims to (1) Determine the use of experimental methods in improving learning outcomes of fifth grade students at MI Sirojul Mutaalimin Limbangan Losari Brebes. (2) Determine the learning outcomes of experimental methods at MI Sirojul Mutaalimin Limbangan Losari Brebes. (3) Determine the experimental method in improving learning outcomes of fifth grade students at MI Sirojul Mutaalimin Limbangan Losari Brebes. The design of this study is Nonequivalent Control Group Design (Quasi Experiment) because the researcher did not select students randomly as samples and will conduct a Pretest to determine the initial abilities of fifth grade students and then conduct a Posttest to determine learning outcomes after being given treatment to determine the effect of variable X on variable Y. The population in this study were all 21 fifth grade students at MI Sirojul Muta'allimin Limbangan Village. Research data were obtained through observation, questionnaire sheets and test questions. The observation data collection technique was carried out to see directly how the application of the experimental method in science learning in class. The questionnaire sheet was given to find out how students responded to the science learning process with the experimental method. The test is used to obtain data on students' science learning outcomes.

The data analysis technique used in this study is to use statistical data. The data obtained are significant data between the effectiveness of the experimental method on the learning outcomes of grade V students at MI Sirojul Mutaalimin Limbangan Losari Brebes. Data processing is carried out with the intention of determining the effectiveness of the experimental method in improving the learning outcomes of grade V students at MI Sirojul Mutaalimin Limbangan Losari Brebes. The analysis used is quantitative analysis.

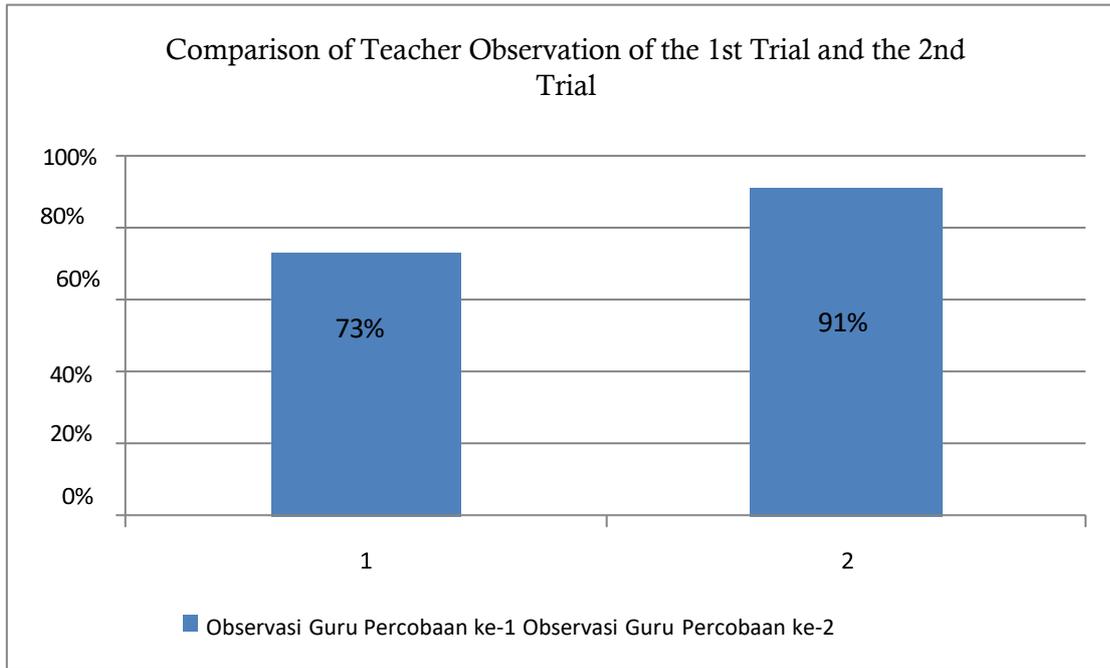
After the data is obtained, the data is analyzed through the prerequisite test, the Mann-Whitney test and the Determination test. Data processing in this study is assisted by the SPSS program.

Result

1. *The Use of Experimental Methods in Improving the Learning Outcomes of Class V Students at MI Sirojul Mutaalimin Limbangan Losari Brebes*

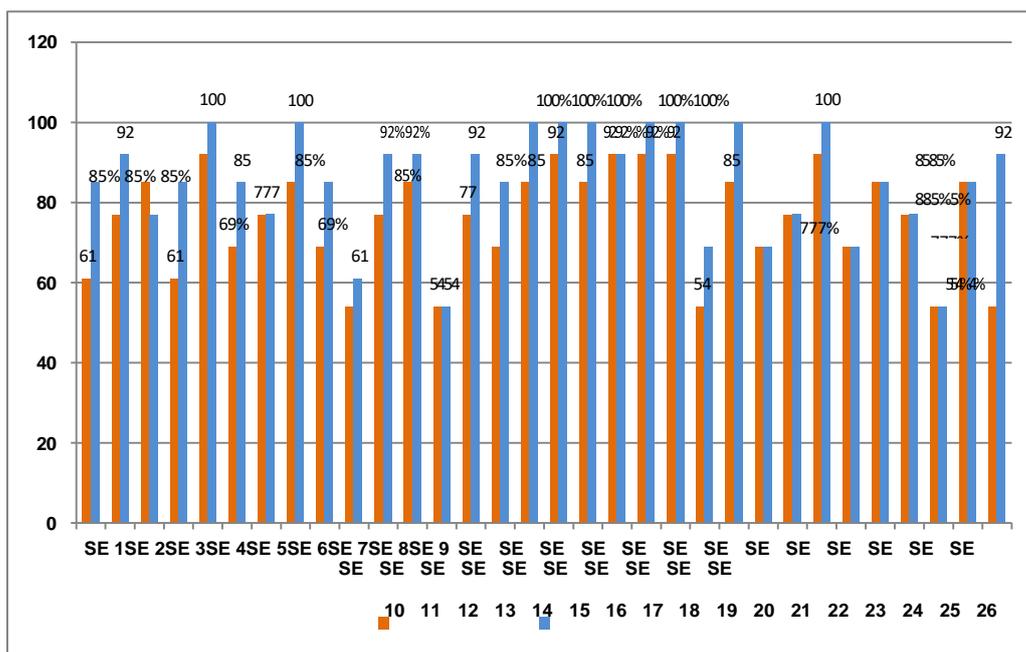
The indicators of the use of experimental methods in teacher observation consist of 11 assessment indicator points. Observations will be given a score of 1 for "Yes" which means the teacher carries out one of the indicators of the use of experimental methods and a score of 0 for "No" which means the teacher does not carry out one of the indicators of the use of experimental methods.

Graph 1 Comparison of Teacher Observation



Based on graph 1, it can be seen that the observation of the use of experimental methods by teachers in the 1st and 2nd experiments increased from 73% in the 1st experiment with the category "quite good" to 91% in the 2nd experiment with the category "very good". The indicators for the use of experimental methods in student observations consist of 13 assessment indicator points. Observations will be given a score of 1 for "Yes" which means that students carry out one of the indicators of the use of experimental methods and a score of 0 for "No" which means that students do not carry out one of the indicators of the use of experimental methods.

Graph 2 Comparison of observation results using the discovery learning method of students in the 1st experiment with the 2nd experiment

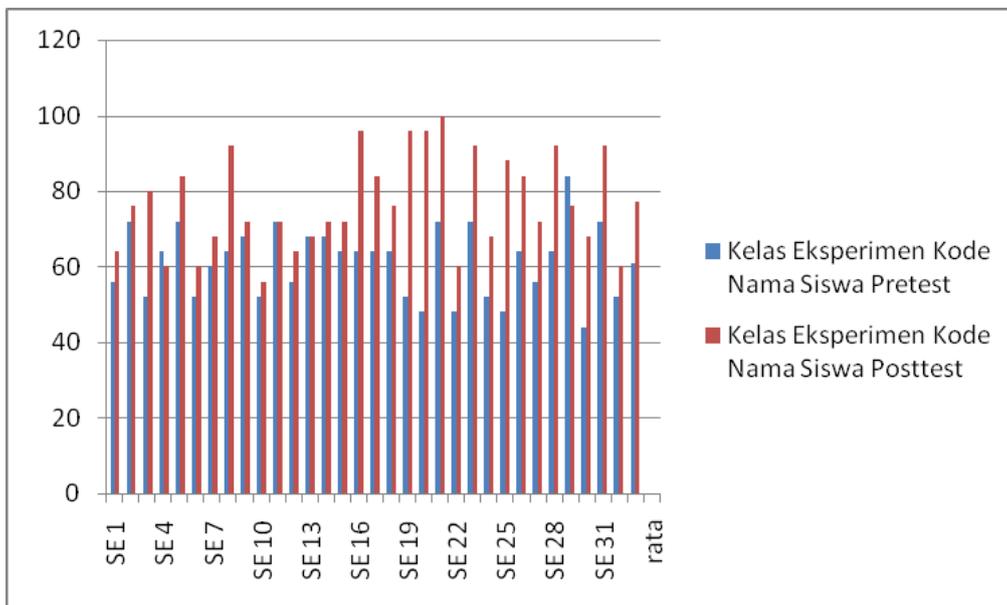


Based on the comparison graph above, the use of the discovery learning method for students in the 2nd experiment has increased both for each student and on average. By looking at the diagram above, it can be seen that most of the blue bars are higher than the red bars, which shows that many students have increased in using the discovery learning method. The average percentage of the 2nd experiment, which is 85%, increased by 9% from the use of the experiment for students in the 1st experiment, which is 76%.

1. Learning Outcomes of Experimental Methods at MI Sirojul Mutaalimin Limbangan Losari Brebes

The researcher conducted a Pretest and Posttest test on both classes, namely the control class and the experimental class. The Pretest test was conducted to measure the dependent variable (HOTS high order thinking skill) before being given treatment and to prove that the abilities of students in the two classes did not have significant differences in abilities. The Posttest test was conducted to determine whether there was an effect of variable X on Y by comparing the results of the Posttest test of the control class that was not given treatment with the experimental class that was given treatment.

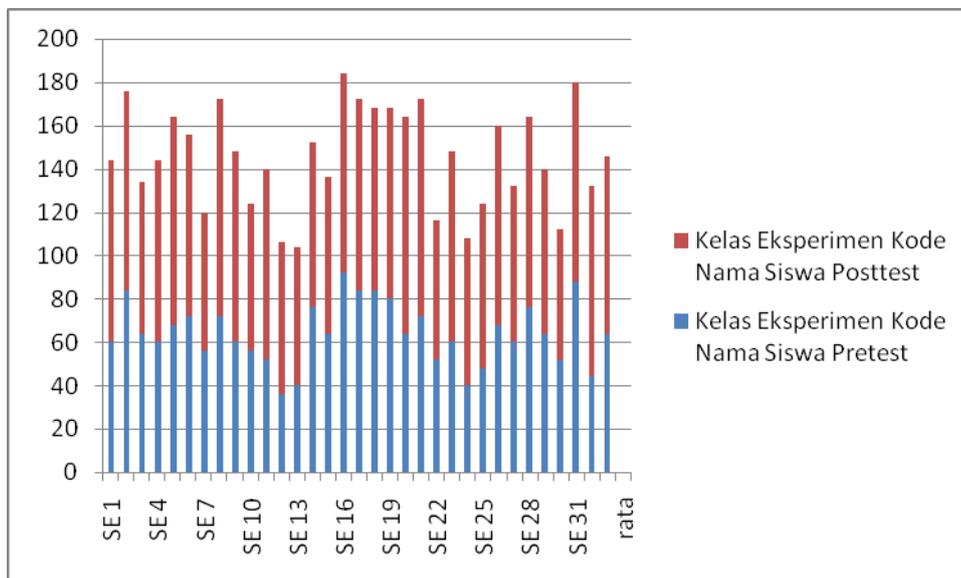
Graph 3
List of Pretest and Posttest Scores of the 1st Experimental Experiment Class



Based on graph 3, the average value of the experimental class Pretest test is 61.25, which shows that there is no significant difference in students' initial scientific literacy abilities between the control class and the experimental class. After being given treatment, namely in the Posttest column, the average result of the experimental class is 76.88.

The following is a summary table of the results of the experimental class test in the 2nd experiment. :

Graph 4
List of Pretest and Posttest Scores of the 2nd Experimental Experimental Class



Based on Graph 4, the results of the experimental class Pretest were 64, which showed that there was no significant difference in the initial HOTS high order thinking skill abilities between the control class and the experimental class. After being given treatment, namely in the Posttest column, the average result of the experimental class was 81.75.

2. The Effectiveness of Experimental Methods in Improving Learning Outcomes of Fifth Grade Students at MI Sirojul Mutaallimin Limbangan Losari Brebes

The effectiveness of the experimental method in improving the learning outcomes of fifth grade students at MI Sirojul Mutaallimin Limbangan Losari Brebes can be seen by using the Mann-Whitney test analysis. For data processing using the SPSS program.

Table 1 Normality Test

Uji Normalitas Pretest Kelas Eksperimen 1	0,068
Uji Normalitas Posttest Kelas Eksperimen 1	0,150
Uji Normalitas Pretest Kelas Eksperimen 2	0,768
Uji Normalitas Posttest Kelas Eksperimen 2	0,059

Based on the normality test table, the data from the pretest and posttest normality tests for the experimental class 1 are normally distributed because the sig value of the data is greater than 0.05. Similar to the results of the normality test for experiment 1, the results of the pretest and posttest normality tests for the experimental class 2 are normally distributed because the sig value of the data is greater than 0.05.

Tabel 2
Uji Homogenitas

Uji Homogenitas Pretest Kelas Kontrol dan Eksperimen 1	0,222
Uji Homogenitas Posttestt Kelas Kontrol dan Eksperimen 1	0,042
Uji Homogenitas Pretest Kelas Kontrol dan Eksperimen 2	0,000
Uji Homogenitas Posttest Kelas Kontrol dan Eksperimen 2	0,001

Based on the results of the homogeneity test of the pretest of the control class and the experimental class of experiment 1, the data has a homogeneous variance because the sig value of the data is greater than 0.05. While the value of the homogeneity test results of the posttest of the control class and the experimental class of experiments 1 and 2 and the value of the homogeneity test of the pretest of the control class and the experimental class of experiment 2 do not have a homogeneous variance because the sig value of the data is less than 0.05.

After the prerequisite test was carried out, namely the normality and homogeneity tests, the hypothesis test was then carried out using the Mann-Whitney test. With the results obtained as follows:

Tabel 3
Uji Mann-Whitney Percobaan ke 1

	Hasil Uji Tes Kemampuan Literasi Sains
Mann-Whitney U	183.000
Wilcoxon W	618.000
Z	-4.081
Asymp. Sig. (2-tailed)	.000

Based on table 5, the results of the Mann-Whitney test on Asymp. Sig (2-tailed) get a value of 0.000 < 0.05, it can be seen that H_a is accepted and H_0 is rejected, meaning that in the results of the HOTS ability test of grade V students in the 1st experiment, there is a significant difference between the experimental class whose learning process uses the Discovery learning method and the control class that does not apply the Discovery learning method in its HOTS-oriented learning process towards the learning outcomes of grade V students of MI Sirojul Mutaalimin Limbangan.

Tabel 4
Uji Mann-Whitney Percobaan ke 2

	Hasil Uji Tes Kemampuan Literasi Sains
Mann-Whitney U	128.500
Wilcoxon W	563.500
Z	-4.872
Asymp. Sig. (2-tailed)	.000



Based on table 6, the results of the Mann-Whitney test on Asymp. Sig (2-tailed) obtained a value of $0.000 < 0.05$. It can be seen that H_a is accepted and H_0 is rejected. This means that in the results of the HOTS test on the learning outcomes of class V students in the 2nd experiment, there is also a significant difference between the experimental class whose learning process uses the Discovery learning method and the control class that does not apply the Discovery learning method in its learning process which is oriented towards HOTS on the learning outcomes of class V students at MI Sirojul Mutaalimin Limbangan.

Tabel 5
Uji Koefisien Determinasi (R^2)

R Square Percobaan ke 1	0,657
R Square Percobaan ke 2	0,726

Table 7 shows the coefficient of determination (Rsquare) in experiment 1 of 0.810 and the coefficient of determination (R Square) of 0.657, which means that the influence of the HOTS-oriented Discovery Learning method on student learning outcomes is 66% if rounded up, while the remaining 34% is influenced by other factors. While the coefficient of determination (Rsquare) in experiment 2 is 0.852 and the coefficient of determination (R Square) of 0.726 is obtained, which means that the influence of HOTS-oriented Discovery Learning on learning outcomes is 73% if rounded up, while the remaining 27% is influenced by other factors.

Discussion

1. *The Use of Experimental Methods in Improving t*

The Learning Outcomes of Class V Students at MI Sirojul Mutaallimin Limbangan Losari Brebes Learning using experimental methods in science learning from the results of teacher observations showed that in the 1st experiment, the criteria for "quite good" were obtained with a percentage of 73%, while in the 2nd experiment, the use of the experimental method by the teacher obtained the criteria for "very good" with a percentage of 91%. In the use of the experimental method used by students, when the researcher conducted observations, students were very enthusiastic about carrying out a series of experimental method activities aimed at the results of the percentage of students' use of the experimental method in the 1st experiment, students got a percentage of 75.9% with the criteria for "very good" and in the 2nd experiment they got a percentage of 83.5% with the criteria for "very good".

The use of the experimental method by the teacher seeks to increase student activity in the teaching and learning process. So this experimental method has the following objectives: (Idrus Alwi, 2014). (1.) This technique is able to help students to develop, increase readiness and, mastery of skills in the cognitive process/student recognition. (2.) Students gain knowledge that is very personal/individual so that it can be solid or deeply left in the soul of the student. (3.) Can increase the enthusiasm of students to learn. Characteristics of Active Learning Learning Strategy experimental method According to Bonwell, Active Learning has the following characteristics:

1.) Student-centered learning. Students play a more active role in developing independent learning methods. Students participate in the planning, implementation and assessment of the learning process. Student experience is prioritized.

- 2.) Teachers guide the learning experience. Teachers are not the only source of learning. Teachers are one of the sources of learning, which provides opportunities for students to gain knowledge or skills themselves through their own efforts, can develop motivation from within themselves, and can develop experience to create a work.
- 3.) The purpose of learning activities is not only to pursue academic standards. In addition to achieving academic standards, activities are emphasized to develop students in a holistic and balanced way.
- 4.) Management of learning activities emphasizes student creativity, and pays attention to student progress in mastering concepts firmly. Assessments are carried out to measure and observe student activities and progress, as well as measure student skills and learning outcomes.
 - a) Student-centered learning. Students play a more active role in developing independent learning methods. Students participate in the planning, implementation and assessment of the learning process. Student experience is prioritized.
 - b) Teachers guide the learning experience. Teachers are not the only source of learning. Teachers are one of the sources of learning, which provides opportunities for students to gain knowledge or skills themselves through their own efforts, can develop motivation from within themselves, and can develop experience to create a work.
 - c) The purpose of learning activities is not only to pursue academic standards. In addition to achieving academic standards, activities are emphasized to develop students in a holistic and balanced manner.
 - d) Management of learning activities is emphasized on student creativity, and paying attention to student progress to master concepts steadily. (Riyadi, 2013).

2. *Learning Outcomes of Experimental Methods at MI Sirojul Mutaalimin Limbangan Losari Brebes*

In this study, experimental method learning in science material for class V MI Sirojul Mutaalimin Limbangan can be seen from the results of the questionnaire and the results of the Pretest Posttest test carried out by both classes, namely the control class and the experimental class. The pretest was given at the beginning of the meeting which aimed to determine the initial HOTS abilities possessed by students in the control class and the experimental class. The posttest was given at the end of the meeting to determine the HOTS abilities of students in the control class who were not given treatment, meaning that learning used the lecture or conventional learning method while students in the experimental class were given treatment, namely using the discovery learning method in their learning process. HOTS stimulates students to interpret, analyze or even be able to manipulate previous information so that it is not monotonous. HOTS is used when someone receives new information and stores it to be used or rearranged for problem solving purposes based on the situation. Thus, HOTS has a learning impact on students and teachers, namely:

- a. Learning will be more effective with higher order thinking
- b. Increasing the intellectual ability of teachers in developing higher order thinking
- c. In evaluating learning with this new concept, teachers must always prepare questions that will not be answered simply (W.P, 2015).

3. *The Effectiveness of Experimental Methods in Improving Learning Outcomes of Fifth Grade Students at MI Sirojul Mutaalimin Limbangan Losari Brebes*

The effectiveness of using the HOTS-oriented discovery learning method can be seen through the results of the hypothesis test. In this study, the hypothesis test used was the Mann-Whitney test. Before conducting the Mann-Whitney test, a normality test and a homogeneity test were needed as prerequisite tests as explained in the research results. In this study, the data used had a normal distribution, then in the homogeneity test, the results of the data were not homogeneous so that the next test used a nonparametric test with the Mann-Whitney test.



Based on the Mann-Whitney hypothesis test using the SPSS 16.0 program in the 1st and 2nd experiments, the sig value was obtained. $(0.000) < \alpha (0.05)$ which means that H_0 is rejected and H_a is accepted. From this statement, it can be concluded that there is an influence on the effectiveness of the HOTS-oriented discovery learning method in the science material of class V MI Sirojul Mutaallimin Limbangan.

Based on the determination test that calculates how much the effectiveness of the HOTS-oriented discovery learning method is, the results of the determination test of the 1st experiment obtained an R Square of 0.657, which means that there is an influence of the HOTS-oriented discovery learning method on experiment 1 of 66% and the remaining 34% is influenced by other factors. Then the determination test of the 2nd experiment obtained an R Square of 0.726, which means that there is an influence of the HOTS-oriented discovery learning method on experiment 2 of 73% and the remaining 27% is influenced by other factors.

Conclusion

Learning using the discovery learning method in science learning from the results of teacher observations showed that in the 1st experiment it had obtained the criteria of "quite good" with a percentage of 73% while in the 2nd experiment the use of the discovery learning method the teacher obtained the criteria of "very good" with a percentage of 91%. In the use of the discovery learning method used by students, when the researcher conducted observations, students were very enthusiastic about carrying out a series of discovery learning method activities aimed at the results of the percentage of the use of the discovery learning method by students in the 1st experiment, students got a percentage of 75.9% with the criteria of "very good" and in the 2nd experiment they got a percentage of 83.5% with the criteria of "very good". In the average value of experiment 1, the control class from the Pretest to Posttest results could only increase by 5%, while the average value of the experimental class from the Pretest to Posttest results experienced an increase in value of 26% with learning using the discovery learning method. From this statement, it means that the experimental class experienced a greater increase than the control class. In the average value of the 2 control class experiments, the results of the Pretest to Posttest can increase by 8%, while the average value of the experimental class from the Pretest to Posttest results increased by 28% with learning using the discovery learning method. From this statement, it means that in the 2nd experiment, the experimental class also experienced a greater increase than the control class. Based on the Mann-Whitney hypothesis test using the SPSS 16.0 program in the 1st and 2nd experiments, the sig value was obtained. $(0.000) < \alpha (0.05)$ which means that H_0 is rejected and H_a is accepted. From this statement, it can be concluded that there is an effectiveness of using the HOTS-oriented discovery learning method on student learning outcomes in science material for class V MI Sirojul Mutaalimin Limbangan with a large influence of 66% in experiment 1 and in experiment 2 obtained a large influence of 73%.

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