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Inquiry and Discovery Learning Model in Student's Mathematic Representation Ability

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ABSTRACT

Representational ability is a very important ability in learning mathematics, with representational ability students can solve mathematical problems. This study aims to compare the two Inquiry and Discovery learning models in overcoming students' representation abilities. This research was conducted at a school in NTB Province, Bima Regency with a total of 60 students with a sample of 30 participants from Science 1 and 30 participants from Science 2. Data collection techniques used observation and interviews. While the instrument uses a test. Data analysis techniques used Prerequisite test (Normality and Homogeneity) and Hypothesis Test (N-Gain, t-test). In terms of this research, it shows that during representation learning, these two models really help students to understand the use of mathematical representations.

1. Introduction

Mathematics is a subject that must be studied by students, more specifically for students who have entered high school. The goals of learning mathematics itself as stated by Permendiknas no. 59 of 2014 that the goals of students learning mathematics at school include: a) Instilling an understanding of students' mathematical concepts; b) Applying reasoning and manipulating mathematical properties and analyzing problem solving components; c) Have an attitude of appreciating the usefulness of mathematics in life. Furthermore, apart from these objectives, NTCM Maryati and Monica (2021) states that there are standards that must be achieved in learning mathematics, including: a) the ability to solve mathematical problems, the ability to communicate or communicate, the ability to make mathematical connections or connections, the ability reasoning or reasoning, and the ability to make representations or mathematical representations Ramanisa,

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Khairudin, and Netti (2020).

From the statement above, it can be understood that one of the standards for students' ability to learn mathematics is that students can use and have the ability to represent (Masriyah et al., 2018) Representational ability illustrates that students are able to communicate mathematical concepts, ideas and ideas by using various kinds of mathematical representations (Nurfitriyanti, Rita Kusumawardani, and Lestari 2020; Maryati and Monica 2021). Some experts such as (Herdiman et al. 2018) in their articles state that Representational ability is a student's skill in creating a new form either verbally, in writing, graphically, table or image of the given mathematical problem.

Maryati and Monica (2021) explained that students are able to choose and apply good strategies in solving mathematical problems if they have good mathematical representation skills. Furthermore, Wijaya Effendi et al., (2020) explained that mathematical representation is very important and becomes a student's need because in every problem solving and mathematical problems requires mathematical representation. In line with this, (Kusumawardani et al., 2020) explained that mathematical representation is closely related to topics mathematics education. So, student muct have representation mathematic ability.

Students must have representational abilities that continue to develop along with changes in information technology, Damayanti & Afriansyah (Maryati and Monica 2021). But in fact the students' representation ability is not fully good. This is consistent with the findings of Ramanisa, Khairudin, and Netti (2020) which confirms that there are still high school students who cannot solve representation problems. Suningsih and Istiani (2021) explained that student achievement on the visual representation indicator was 65.2%; expression indicators and equation representation 43.5%; and the verbal representation indicator is 41.2% which indicates that students' verbal representation abilities must be further improved.

Silviani et al,. (2021) in his research revealed that in learning statistics there are students who cannot use symbolic representation. Of the 3 subjects studied, only one subject was able to use statistical symbol representation. The results of the research by Herdiman et al. (2018) also explain that in learning mathematics at school the average representation ability is still very lacking. This is based on the results of the average score of students' mathematical representation abilities with a score of 33.75%. Mulyaningsih et al. (2020) in their research also revealed that the average student representation ability was still in the low category.

Furthermore, Silviani et al,. (2021)in his research explained that there were still students who did not understand symbol representation. Meanwhile Herdiman et al. (2018) in his research also stated that students' representation abilities were still very lacking with a percentage of 34.75%. More than that, Mulyaningsih et al. (2020) emphasized that students in using mathematical representations still don't understand how to use them.

Putra et al. (2018) in his research emphasized that students' representational abilities were not optimal due to the teacher's knowledge of using learning models. Students are often taught with conventional learning models. From this explanation, teachers in learning mathematics need to make efforts and efforts to change students' mathematic representation ability. One solution that can be used by teachers is by using various learning models. In this study, two learning models have been tested by several researchers to bind students' mathematical representations, namely inquiry and discovery learning models.

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According to Maryati and Monica (2021) inquiry is one of the learning designs that is widely used by teachers to develop students' thinking skills, especially in terms of analyzing and formulating solutions to a problem so that students are able to solve the given problem. Dwirahayu et al,.(2020) explains that teachers can improve students' representation abilities by using inquiry learning models instead of using conventional models.

Mahardika, Rofiqoh, and Supeno (2019) in his research also revealed that the inquiry model can improve verbal abilities, mathematical representations and student learning outcomes. Furthermore AM. Nuriman et al,. (2021) emphasized that students' representation abilities were much higher by learning using the inquiry model than using conventional learning models. Moreover, Gani et al,. (2016) also emphasized that the inquiri greatly influences the high level of student representation abilities.

According to Caswati et al,. (2019), he discovery is a desain in learning which in practice requires students to use all knowledge to find and investigate a concept from a given problem themselves. Here the teacher is only in control of student activities, while students must be active in finding answers to a problem themselves (Maharani, Gunowibowo, and Wijaya, Agung 1972). Moreover, (Hapsari and Muandar 2019) emphasized that by using the discovery learning model students will be self-trained in using various representations, so that students build mathematical representations in various problems.

Furthermore, several studies have shown that the discovery learning model has a very positive impact on improving students' mathematical representation abilities. This is evidenced by Diba, Bharata, and Widyastuti (2018) which explains that after applying the discovery learning model to matrices, functions, trigonometry, students are clearly able to use mathematical representations to solve various problems. More than that, Kusumaningsih and Marta (2017) in his article also emphasized that the discovery learning model is more effective than conventional learning models. In applying the discovery learning model, it provides space for students to find their own mathematical representations in solving problems, so that students can improve their thinking skills in using mathematical representations.

In addition, various studies have shown that this learning model has a positive function in learning representation in schools. This is shown by Diba, Bharata, and Widyastuti (2018) which shows that after applying the discovery learning model to matrices, functions, and trigonometry functions, students are clearly able to use mathematical representations to solve various problems. In addition, Kusumaningsih and Marta (2017) also emphasized in their article that discovery mode has a more significant influence than traditional models during learning. Because this model provides opportunities for students to continue to create and experiment when solving problems.

As can be seen from the above descriptions, the inquiry and discovery learning model can improve students' mathematical skills, and more specifically, can improve students' expressive ability. Here is a reference for the authors to apply these two learning models. These two learning modes are used in different classes. In previous studies, there is no research comparing inquiry learning mode and discovery learning mode to improve students' representation ability, so the authors are interested in comparing the two learning modes.

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2. Method

This research was conducted using a quantitative experimental model with a quasi-experimental research design model (see figure 1). The population in this study, namely class X at one of the high schools in Bima Regency in the 2021/2022 school year. The research sample was class X IPA 1 who received the Inquiry learning model as many with as 30 students, and class X IPA 2 which received the Discovery learning model with as many as 30 students. So, the number of samples that participated in this study were 60 students. Each sample will receive different treatment. To collect data on research, researchers used observation and interview techniques. Meanwhile, to measure the representational abilities of researchers using tests. To test the research data, the researcher used the Prerequisite test (Normality and Homogeneity) and Hypothesis Test (N-Gain, t-test). The research design in this study we can be seen in Figure 1.

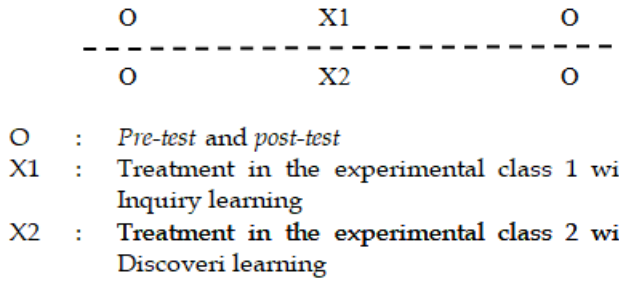

Figure 1. Research Design

3. Results and Discussion

3.1. Results

In this study, the data obtained were analyzed using the standards of the individual experimental classes. Here there are two experimental classes, namely the Inquiry class and the Discovery class. The following presents an analysis of the data from each class.

3.1.1 Results Research Experimental Inquiry Class

During the inquiry session, collect pre-test and post-test data. Collect pre-test data before the course begins using a query-based learning model. While posttest data obtained after applying the inquiry learning model. In the first study, the distribution of pretest and posttest data will be sought, so that the differences between the two data will be seen. The description of the inquiry class pretest and posttest data can be observed in Table 1.

Table 1. Descriptive Statistics of Experiment 1

Statistic Deskriptif	Pre_Test	Post_Test	N-Gain Persen
Mean	46.2	83.4	71.66
Median	46.50	86.00	72.26
Std. Deviasi	16.252	9.967	10.56
Varianci	264.133	99.344	111.46
Minimum	15	60	52.94
Maximum	76	97	87.88

In Table 1 above it can be observed that in the N-Gain Percent column the average value is 71.6610 or 71.7%, the median value is 72.2611 or 72.3%, the Std Deviation value is 10.56 or 10 .6%, the variance value is 111.46 or 111.5%, the

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minimum value is 52.94 or 53% and the maximum value is 87.88 or 88%. Table 1 also shows that the mean value of the pre-test is 46.50 and the mean value of the post-test is 86.00, with a score difference of 37.3 points, which means that the student representation has increased by 37.3% after applying the inquiry-based learning model.

Also in this study, researchers conducted a study of the effectiveness of using the inquiry learning model by looking at the average value of N-Gain. To see the N-Gain effectiveness category can be seen in Table 2.

Table 2. Category of N-Gain Effectiveness Value

N0	Persentase N-Gain	Category
1	<40	Ineffective
2	40-55	Less effective
3	56-75	Effective enough
4	>76	Effective

Table 1 it can be observed that Mean N-Gain value using the Inquiry model is 71.7 or 71.7% which, based on Table 2, the use of the inquiry model is included in category 3, that is quite effective. So that it can be understood that in this study it was included in the category of quite effective for increasing students' representation abilities.

The achievement of the aspect of representational ability with the inquiry learning model can be seen from Table 3 as follows:

Table 3. Achievement of Ability Aspect Representation with Inquiry Model

Type	Aspect (%)					Mean
	1a	1b	2	3	4	
Pretest	45	47	50	51	38	46,2
Postest	81	83	85	83	85	83,4
Difference	36	36	35	32	47	

Based on the Table of Aspects of representation ability, it can be observed that students' achievement in making representations has changed before and after using the inquiry model. This can be seen in the aspect of visual representation ability which has increased by 36 points, in other aspects of visual representation ability it has increased by 36, in the aspect of expressive representation ability it has increased by 35 points and in the aspect of verbal representation it has increased by 32 points.

The mean value of the aspect of representational in the pretest was 46.2, indicating that prior to the treatment, the achievement of students' mathematic representation abilities had not been completed, both in visual, symbol and verbal representations. While the mean value of the aspect representational ability in the posttest is 83.4, indicating that the achievement of the aspect of representational ability has been achieved, the achievement of the aspect of mathematical representational ability has included visual, symbolic and verbal representations.

3.1.2 Results Research Experimental Discovery Class

Just like the previous Inquiry class, the Discovery class also obtained pretest and posttest data. The data that has been obtained will look for the distribution of the data, so you will see the difference between the two data. To see the description of the Discovery class, it can be seen in Table 4.

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Table 4. Descriptive Statistics of Experiment 2

Statistik Deskriptif	Pre_Test	Post_Test	N-Gain Persen
Mean	48.2	87,80	79.31
Median	48.20	91.00	72.26
Std. Deviasi	16.252	9.345	11.42
Varianci	264.133	87.338	130.446
Minimum	17	65	57.83
Maximum	78	99	97,50

In Table 1 above it can be observed that in the N-Gain Percent column the means value is 79.31 or 79.31%, the median value is 72.26 or 72.3%, the Std Deviation value is 11.42 or 11.4%, the variance value is 130.45 or 130.5%, the minimum value is 57.83 or 57.9% and the maximum value is 97.50 or 97.6%. In Table 1 it can also be observed that the mean value of the pretest is 46.50 and the posttest is 86.00 with a difference in value of 39,7, meaning that the students' representation abilities increased by 39.7% after applying the model.

In Table 4 it can be observed that the mean N-Gain value using the Inquiry model is 79.31 or 79.31% which, based on Table 2, the use of the discovery model is included in category 3, which is effective. So, it can be concluded that the discovery learning model is very effective in change students' representation abilities.

Student achievement in making mathematical representations before and after using the discovery model can be observed in Table 5.

Table 5. Achievement of Ability Aspect Representation with Model Discovery

Type	Aspect (%)					Mean
	1a	1b	2	3	4	
Pretest	45	47	50	51	38	48.2
Postest	81	83	85	83	85	87.8
Difference	36	36	35	32	47	

Based on the Table 5 is of Aspects of representation ability, it can be observed that students' achievement in making representations has changed before and after using the inquiry model. This can be seen in the aspect of visual representation ability which has increased by 49 points, in other aspects of visual representation ability it has increased by 45, in the aspect of expressive representation ability it has increased by 48 points and in the aspect of verbal representation it has increased by 55 points.

The average value of the aspect of representational ability in the pretest was 48.2, indicating that before being given treatment, the achievement of the aspects of students' mathematical representation abilities had not been completed either in visual, symbol and verbal representations. While the average value of the aspect of representational ability in the posttest is 87.8, indicating that the achievement of the aspect of representational ability has been achieved, the achievement of the aspect of mathematical representational ability has included visual, symbolic and verbal representations.

3.1.3 Differences Experiment Inquiry and Discovery Class

As previously explained, aim of this research is to see the differences in the use of

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the inquiry model and the discovery model in learning mathematical representation. To answer this, the data that has been obtained will be tested using parametric statistics, namely the Paired Sample t-test. Meanwhile, to see the difference in the use of the two models, a comparison of the average N-Gain value is used.

To use the parametric statistical test, the data that has been obtained must first be tested for the normaly and homogen of the data. Based on the results of the data normaly test in the inquiry and discovery classes, the inquiry class had a sig value of 0.09 and the discovery class had a sig value of 0.14. Meanwhile, for the results of the homogeneity test for both inquiry and discovery class data, a sig value of 1.00 for the inquiry class and 0.6 for the discovery class respectively was obtained. Based on the results of the calculation of the normaly and homogen tests of the data, that the data in the inquiry and the discovery are normally and homogeny because the data grather than 0.05, so it can be continued for parametric statistical tests.

Because the data in the inquiry and discovery classes already meet the requirements for the parametric statistical test, these data will be analyzed using the Paired Sample t-test. Results of Analysis Paired we can see in Table 6.

Table 6. Results of t-Test

	Paired Differences				
	Mean	Lower	Upper	t	Sig. (2-tailed)
Model Inkuiri - Model Discoveri	-4.433	-5.019	-3.848	-15.479	.000

Based on Table 6 on top of it can be real experiential to the t-count value is -15.479, while the Sig.(2-tailed) rate is 0.00. Standards can be a position to control the speculation that has been planned. Towards build it simpler now, the analyst employments the Sig.(2-tailed) rate. Since the rate of Sig.(2-tailed) is fewer than 0.05, the speculation that was already proposed was H_0 Unwanted and H_1 Accepted. It can be concluded that there is a critical difference in students' mathematical representation capacities in the use of inquiry learning models by the use of discovery learning model.

Based on top of the paired sample t-test calculation chart, it can exist watched to the mean rate of the paired sample t-test is 4.433, which based at the criteria here the learn appears to the dissimilarity in the use up of the two learning models in students' mathematical representation capacities is 4.43%. For the meantime, here Table 3 and Table 5 it can to be watched to the mean rate of N-Gain in the Inquiry Class is 71.6 and in the discovery class is 79.31. Based on these results at what time compared, the mean value in the discovery class is better than to in the inquiry class. Additional than that, the results of the calculation of the completeness Expression of representation ability were condensed that the average posttest score in the inquiry class was smaller than the covered class with a ratio of 83.4 to 87.3. Since a few clarifications of the results of these calculations, it can exist concluded to the employ of the discovery model is superior to expanding students' representation abilities than the use of inquiry models.

3.2. Discussion

Mathematics is one of the subjects that is often considered a difficult subject, almost all countries think that mathematics is a difficult subject to learn, so that

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not a few students really dislike mathematics. Towards overwhelm this, it is essential to enhance in learning mathematics, solitary of which is by with the inquiry learning model and the discovery learning model.

Within this learn, analysts utilized inquiry and discovery learning models to expand students' mathematical representation abilities. In general, these two learning models are often used by other researchers, not only in the context of mathematics, there are also those who do it in the context of chemistry, physics, biology, etc.

Based at the comes about of the statistics analysis carried absent, it can exist so as to these two learning models can get better students' mathematical representation aptitudes. This can exist seen as of the comparison of the mean N-Gain Percent comes about of students' abilities before and after applying the inquiry learning model and the discovery learning model. The results of this discovery are within agreement by what was supposed by (Dwirahayu et al. 2020) which revealed so as to the inquiry learning model can get better students' mathematical representation abilities in learning mathematics. Additional than so as to, (Hapsari and Muandar 2019) too expressed to the use of Discovery learning model can get better students' representation abilities.

The spirit of this study is towards scrutinize the contrasts among the two learning models in getting better students' mathematical representation abilities. As of the comes about of the chemical analysis of the Paired sample t-test data, it was establish so as to hand were differences in the two learning models utilized by means of a change level of 4.43%. This is in accordance with the theory from Putra et al., (2021) which states that the use of the two learning models will not show the same results, they will always be different.

More than that, the comparison of the two learning models does not only come to curiosity about the differences, but researchers want to simultaneously examine which of the two learning models is better. Towards inspect this can exist seen during the comes about of the taking after statistics analysis: First: based on top of the N-Gain Rate Effectiveness Table, the employ of inquiry learning models is categorized since enough. In the interim, the employ of discovery learning models is inside the effective category.

Second, based on the achievement table for the aspect of mathematical representation ability, the average value of using the inquiry model is smaller than the average value of using the discovery model. As a result, looking next to the comes about of the two statistics analysis carried absent, it can exist concluded so as to the make use of the discovery learning model is greater in getting better the ability of mathematical representation than the make use of the inquiry learning model.

On or after a few explanations and comes about of statistics analysis so as to has been carried absent in this learn, it can take place supposed so as to the representation abilities of students who get classes by means of the discovery learning model are better-quality to the mathematical representation capacities of understudies who get classes by way of the inquiry learning model. Into this learn around were some belongings that were not deliberate by analysts, as a result that during the request of the learning model to hand were a few components so as to might hearten students' motivation in learning, thus to understudies might build up mathematical representation abilities outside of actions exclusive of going to classes through both learning models. This is in accordance with what is said by

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(Fiantika and Zhoga 2021);(Putra 2020) which states that in conducting research related to the use of learning models there are several factors that cannot be examined such as student motivation factors and unclear teacher delivery, all of which can determine the results end of research.

4. Conclusions

Based at the comes about of the statistics analysis and discussion more than, it can exist concluded to convenient are contrasts between the make use of the inquiry learning model and the discovery learning model in students' mathematical representation abilities. Also, inside this learn the analysts establish so as to in the feature of mathematical representation aptitudes, students' interpretation abilities utilizing inquiry and discovery models had been completed. In addition, within this learn the make use of inquiry learning models in moving forward students' figurative capacities was built-in in the quite effective category, while the use of discovery learning models in improving students' figurative capacities was built-in in the effective category. The mathematical representation ability of students who obtain classes utilizing the discovery model is better-quality to students who obtain classes utilizing the inquiry learning model. Inside scholarship mathematics on discipline, improved instructors attempt to relate a variety of learning models towards get better students' mathematical representation skills. The learning model second-hand have to appearance on the conditions and capacities of understudies inside learning.

Author Contributions

In this study, the authors carried out activities related to data collection, data analysis, and reporting of research results. While those who carry out the activities of giving treatment are mathematics teachers who are in the school environment where the research takes place.

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Declaration of Competing Interest

The author declares that it has no conflicts of interest.

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