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ANALYZING JUNIOR HIGH SCHOOL STUDENTS' MATHEMATICAL COMMUNICATION ABILITY AND SELF ESTEEM USING DISCOVERY LEARNING MODEL

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ABSTRACT

Mathematical reasoning, mathematical communication, mathematical problem solving, conceptual understanding, mathematical understanding, creative thinking and critical thinking are part of the mathematical abilities that students must have. One of the goals of learning mathematics according to NCTM is learning to communicate (mathematical communication). Mathematical communication skills in mathematics learning really need to be developed. This type of research design uses a quasi-experimental research design, namely pretest and post-test with non-equivalent control group design . The research used research subjects into two groups, namely the experimental group and the control group. The subjects of this research were students of class VII I MTs As-Sa'adah Padahanten Majalengka, numbering 64 people. Subjects were selected based on experimental class VIII A, 32 people and control class VIIIB, 32 people. Walkthroughs, questionnaires, and tests are techniques used in data collection. Data processing analysis was carried out qualitatively and quantitatively. The results of this research are that there is a difference in the effectiveness of the Discovery Learning model learning approach with the ordinary (conventional) learning model in terms of the aspects of mathematical communication skills and self-esteem of MTs in statistics material. The implications of the Discovery Learning learning model in this research are that it makes it easy for students to remember the lessons learned, integrate self concept according to their initial abilities, focus, be creative in exploratory projects, and the effect of knowledge transfer on learning outcomes can last a long time.

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INTRODUCTION

Mathematical reasoning, mathematical communication, mathematical problem solving, conceptual understanding, mathematical understanding, creative thinking and critical thinking are part of the mathematical abilities that students must have. NCTM (2000) Reveals that mathematical communication is a way for students to express mathematical ideas either verbally, in writing, in pictures, tables, diagrams, statistics, up to using objects, presenting them in algebraic form, and/or using mathematical symbols. Next some researches says that students' ability to express their mathematical ideas to others both orally and in writing is called mathematical communication (Mahmudi, 2009; Ariani, 2017; Dzarian et al., 2021).

Likewise, the affective attitude that students must have is self-esteem , with students having high self-esteem , it can prevent students from doing negative things in the process of achieving learning achievement . High self-esteem will make a person see himself as equal to other people and always want to progress and develop, feel valuable, and respect himself. Meanwhile, Buss (1983) provides an understanding of self- esteem as an individual's assessment of himself, which is implicit and not verbalized. Meanwhile, according to Wikipidia, self-esteem is an individual's overall view of himself. Self Esteem is a need that requires fulfillment and satisfaction to be continued to a higher level of need. Maslow (1942) divided two types of needs in self-esteem, namely self-esteem and appreciation from others. Coopersmith (1981) explains that self-esteem has several aspects including strength, significance, virtue, and ability.

Based on data UNESCO (2016) In the Global Education Monitoring (GEM) Report in 2016, the quality of education in Indonesia was ranked 10th out of 14 developing countries , while the quality of teachers in Indonesia was ranked 14th out of 14 developing countries in the world. Likewise with the data released https://worldtop20.org/education-database/ Indonesian education in 2024 will be in 67th place out of 203 countries in the world . Indonesia is next to Albania in 66th position and Serbia in 68th place.

Education illuminates every stage of the journey to a better life. All children need to access quality education that unlocks them for exploration and benefit from a broader education. Special efforts are needed to ensure that all children and young people can benefit equally from its transformative power. This requires sufficient resources , especially to reach those who need more support.

Mathematical communication skills in mathematics learning really need to be developed. This is because through mathematical communication students can organize their mathematical thinking both orally and in writing.

Furthermore, NCTM, in its Principles and Standards for School Mathematics , formulates communication standards to guarantee mathematics learning activities that are able to develop students' abilities, namely: 1) Organizing and integrating mathematical thinking through communication, 2) Communicating mathematical thinking logically and systematically to fellow students, teachers, as well as other people, 3) Analyze and evaluate other people's mathematical thinking and strategies, 4) Use mathematical language to express mathematical ideas accurately.

Students are required to play an active role and be involved in learning to apply knowledge in real life, so that to support effective and efficient learning, an environment is needed that can increase students' curiosity and explore their own abilities. This environment is called a discovery learning environment, here students can deepen and research all new discoveries that are not yet known or similar or that already exist. With a learning environment like this, students will learn in a focused manner with better creativity (Permendikbud, 2016). Discovery learning

is problem-based learning which aims to develop project assessment instruments that are suitable for use and as an innovation in developing more operational assessments.

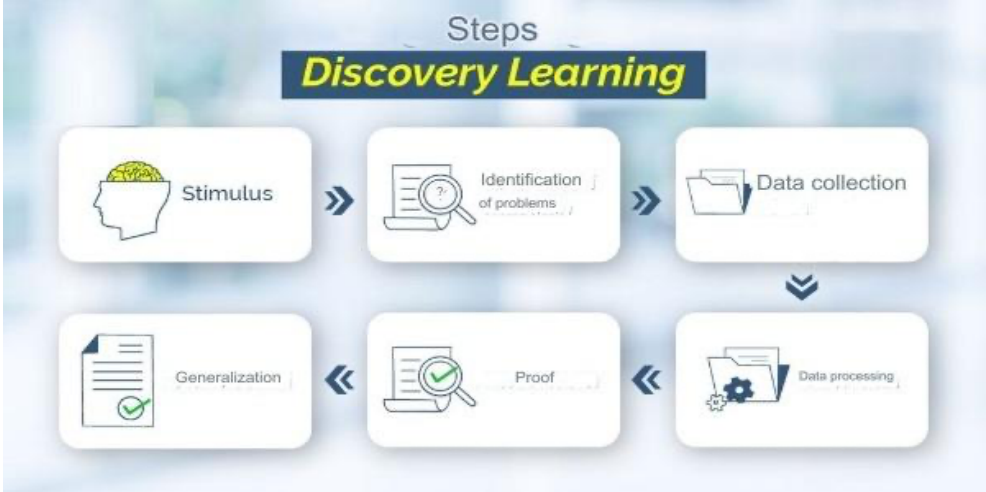
According to Bicknell-Holmes & Hoffman (2000), three things describe discovery learning, namely:

1. As exploration and solving problems by creating, integrating and generalizing knowledge.
2. Student-centered learning by carrying out various fun learning activities.
3. Integrating new knowledge that is linked to previous knowledge students have.

Discovery learning model is the same as the principles of inquiry and problem solving. The difference is that discovery learning emphasizes concepts or principles that were previously unknown and focuses on problems engineered by the teacher.

Discovery learning learning model according to Bruner (2021) include: stimulation (providing stimulation or stimulus), problem statement (identifying a problem or statement), data collection (data collection), data processing (data processing), verification (proving), and generalization (drawing conclusions about learning activities).

Picture. 1 Learning Stages Discovery Learning Model



Discovery learning learning model according to Marzano (2013) are:

1) Developing and cultivating an inquiry attitude;
2) Knowledge will be easy to remember and last a long time;
3) Better transfer effect on learning outcomes;
4) Increasing students' intellectual abilities in exploratory creative thinking
5) Getting students used to finding and solving problems without the help of others is the basis of cognitive abilities.

The Discovery Learning model activates students in learning and practicing their ability to solve independently and skillfully, accurately and skillfully and find solutions so that students' mathematical communication skills develop well. Triyani et al. (2017) in their research revealed that the impact of implementing the discovery learning model was quite good on students' mathematical communication skills at the junior high school level. The results of research conducted by Widodo et al. (2021), in the indicator of using mathematical language and symbols, there was the highest increase in mathematical communication skills. Furthermore, in contrast to Novianti (2019) who said that the indicator of interpreting pictures, graphs and tables

into mathematical language or sentences saw the greatest increase in students' mathematical communication skills. The research results show that middle school students who apply the discovery learning model have mathematical communication skills that are in the good category (Limbangan et al., 2022).

One of the objectives of mathematics learning according to the content standards for primary and secondary education units in mathematics Permendiknas (2016) states that students have the ability to communicate ideas using symbols, tables, diagrams or other media to clarify situations or problems. . The objectives of this national education regulation are in line with the general objectives of mathematics learning formulated by the National Council of Teachers of Mathematics (Principles, 2000), one of the objectives of mathematics learning according to NCTM is learning to communicate (mathematical communication). However, in fact there are still many teachers who do not pay enough attention to the National Education Ministerial Regulation and the objectives contained in the NCTM.

The aim of this research is to describe that there is a difference in the effectiveness of the discovery learning model learning approach with the ordinary (conventional) learning model in terms of the aspects of mathematical communication skills and self-esteem of MTs in statistics material.

METHOD

Experimental research, namely a research method that aims to investigate the influence of a variable on other variables or evaluate the causal relationship between one variable and another variable .

Experimental research is research carried out with a scientific approach using two sets of factors. The first factor acts as a constant, which is used to measure the difference from the second factor. Quantitative research methods, for example, are experimental.

Experimental research can assess concepts/ideas in a controlled environment before taking them into the field. It also provides the best method for measuring theory, with the following advantages:

- The desired outcome is having a stronger grip over the variables.
- Each subject can apply it for research purposes because it does not affect the effectiveness of experimental research.
- Specific results.
- The results of the analysis can have implications for similar concepts or conditions.
- Identify the action-reaction of a hypothesis. The results of the analysis of this relationship can be used to determine deeper ideas.
- An ideal starting point because the data collected is the basis for building more ideas, developing and conducting more research.

An experimental research design that is classified as a quasi-experimental design is when the process of appointing participants is not carried out randomly (non-randomly assignment). However, if the process of determining contestants is carried out randomly (random assignment), then this type of research design is classified as true-experiment (Christensen et al., 2015; Creswell & Creswell, 2017).

Quasi-experimental research designs do not require a true control group, but simply use a set of parameters. The set of parameters in this case can be interpreted as groups that receive

different treatment, such as: applying a conservative approach to learning (Rogers & Revesz, 2019). Moreover Campbell (1963) said that quasi-experimental research sketches were said to have shortcomings in terms of randomly selecting samples/lacks random assignment (White & Sabarwal, 2014).

This type of research design uses a quasi-experimental research design, namely pretest and post-test with non-equivalent control group design . The research used research subjects into two groups, namely the experimental group and the control group. Then the two groups carried out the same learning outcomes test. The test results were evaluated statistically to observe differences that occurred due to the treatment of the experimental class and the control class. Ruseffendi (2005) describes the research design that uses a pretest-posttest control group design as follows:

Table 1. Pretest and post-test with non equivalent control group design

Experimental Class	Pretest	Learning model	Post-Test
Symbol	O	X	O
Regular Class	Pretest	-	Post-Test
Symbol	O	-	O

According to Sumarmo (2013), indicators of communication skills, these skills are measured using the following metrics: a) Expressing a situation, image, diagram or real object in language, symbols, ideas or mathematical models; b) Explain ideas, situations and relationships orally and in writing; c) Listening, discussing and writing about mathematics; d) Read the mathematics presentation with full understanding; e) Developing hypotheses, formulating arguments, formulating definitions and generalizations; f) Rewrite the mathematics description or paragraph in your own language.

There are 5 (five) indicators to measure self-esteem mentioned Reasoner (2010), namely as follows: 1) Feeling of Security; 2) Feeling of Self-Respect (Feeling of Identity); 3) Feeling of Acceptance (Feeling of Belonging); 4) Feeling of Competence; 5) Feeling of Worth. This indicator was developed and created a question scale with 4 (four) answer points in the form of: SS (Strongly Agree); S (Agree); TS (Disagree); STS (Strongly Disagree).

Walkthroughs, questionnaires and tests are techniques used in data collection. The data analysis carried out was processing pretest and post-test data on mathematical communication skills and questionnaire data or student Self-Esteem attitude scales. Apart from that, the instruments used in this research were mathematical communication ability tests, both pretest and post-test, to measure the mathematical communication skills of class VIII MTs students and a Self-Esteem questionnaire or attitude scale to measure the Self-Esteem of class VIII MTs students.

The subjects of this research were students of class VII I MTs As-Sa'adah Padahanten Majalengka numbering 64 people. Subjects were selected based on experimental class VIII A, 32 people and control class VIII B, 32 people.

Data processing analysis was carried out quantitatively and qualitatively. Statistical analysis measurements are given to compare 2 independent samples (which are not paired) on the data that has been collected by testing the normality of data distribution in the initial stage, then the hypothesis test in the second and final stage is the z test (paired sample z test).

RESULTS AND DISCUSSION

Results

Table 2. Normality test of mathematical communication ability data

		Kolmogorov-Smirnov [a]		
	Class	Statistics	df	Sig.
Mathematical_Communication	Discovery Learning	.109	32	,200 *
	Conventional/Ordinary	.123	32	,200 *

Due to the large amount of data exceeding 30 values, based on Table. 2 above, the data processing results used are in the Kolmogorov-Smirnov table, and the Sig value is obtained. experimental class is 0.200 and the Sig value. control class is 0.200. Because the Sig value. both classes are greater than 0.05, so it can be concluded that the two data are normally distributed and the conditions have been met, so that next time the independent z test can be carried out. Next, the independent z test steps are carried out .

$$H_0 : \mu_1 = \mu_2$$

no difference in students' mathematical communication abilities between those whose learning uses the Discovery Learning learning model and those whose learning uses ordinary (conventional) learning .

$$H_\alpha : \mu_1 \neq \mu_2$$

There are differences in students' mathematical communication abilities between those whose learning uses the Discovery Learning learning model and those whose learning uses ordinary (conventional) learning .

Table 3. Statistical groups

	Class	N	Mean	Std. Deviation	Std. Error Mean
Mathematical_Communication	Discovery Learning	32	79.97	3,277	,579
	Conventional/Ordinary	32	60.44	3,331	,589

Based on Table. 3. The experimental class average score was 79.97 and the control class average was 60.44. Descriptively it can be concluded that there is a difference in the average value of students' mathematical communication between the experimental class and the control class.

Table 4. Homogeneity test of mathematical communication ability data

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mathematical_Communication	Equal variances assumed	0.024	0.877	23,645	62	0,000	19,531	0.826	17,880	21,182
	Equal variances not assumed			23,645	61,984	0,000	19,531	0.826	17,880	21,182

Based on the output results in Table. 4, then the Sig Levene's test for equality of variance is 0.877 > 0.05. This means that the data variance between the experimental class and the control class is homogeneous, the independent sample test output table is guided by equal variances

assumed for the Sig (2-tailed) value, namely 0.000 < 0.05. Based on this, H_0 is rejected and H_α is accepted, meaning that there is a significant difference between the average statistical value of the experimental class (Discovery Learning) and the control class (conventional/usual).

Based on the results of all the processing of the students' mathematical communication data, it was found that the second sample of data was in a population with a normal and homogeneous distribution with a Sig value. > 0.005 in the experimental class and control class, namely 0.200 each, and Sig. Homogeneity variance 0.877 > 0.05. Sig value. 2 tailed in the t test, namely 0.000 < 0.05. Based on this, to test the hypothesis *H*0 is rejected and *H*α is accepted, meaning that it can be concluded that there is a difference in students' mathematical communication abilities between those whose learning uses the Discovery Learning learning model and those whose learning uses ordinary (conventional) learning.

Table 5. Normality test of self-esteem data

		Kolmogorov-Smirnov [a]		
	Class	Statistics	df	Sig.
Self_Esteem	Discovery Learning	,098	32	,200 *
	Conventional/Ordinary	,098	32	,200 *

Due to the large amount of data exceeding 30 values, based on Table. 5 above, the data processing results used are in the Kolmogorov-Smirnov table, and the Sig value is obtained. experimental class is 0.200 and the Sig value. control class is 0.200. Because the Sig value. both classes are greater than 0.05, so it can be concluded that the two data are normally distributed and the conditions have been met, so that next time the independent z test can be carried out. Next, the independent z test steps are carried out.

$$H_0 : \mu_1 = \mu_2$$

There are no difference in students' Self-Esteem abilities between those learning using the Discovery Learning learning model and those learning using ordinary (conventional) learning.

$$H_\alpha : \mu_1 \neq \mu_2$$

There are differences in students' Self-Esteem abilities between those studying using the Discovery Learning learning model with its learning using ordinary (conventional) learning .

Table 6. Group statistics

	Class	N	Mean	Std. Deviation	Std. Error Mean
Self_Esteem	Discovery Learning	32	104.91	3,216	,569
	Conventional/Ordinary	32	75.13	3,180	,562

Based on Table. 6. The experimental class mean score was 104.91 and the control class mean was 75.13. Descriptively it can be concluded that there is a difference in the mean value of students' mathematical communication between the experimental class and the control class.

Table 7. Homogeneity test of self-esteem data

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Self - Esteem	Equal variances assumed	0.005	0.943	37,246	62	0,000	29,781	0.800	28,183	31,380
	Equal variances not assumed			37,246	61,992	0,000	29,781	0.800	28,183	31,380

Based on the output results in Table. 7, then the Sig Levene's test for equality of variance is 0.943 > 0.05. This means that the data variance between the experimental class and the control class is homogeneous, the independent sample test output table is guided by equal variances assumed for the Sig (2-tailed) value, namely 0.000 < 0.05. Based on this, H_0 is rejected and H_α is accepted, meaning that there is a significant difference between the average statistical value of the experimental class (Discovery Learning) and the control class (conventional/usual).

Based on the results of all the processing of the students' mathematical communication data, it was found that the second data sample was in a population with a normal and homogeneous distribution with a Sig value. > 0.005 in the experimental class and control class, namely 0.200 each, and Sig. Homogeneity variance 0.943 > 0.05. Sig value. 2 tailed in the t test, namely 0.000 < 0.05. Based on this, to test the hypothesis $H0$ is rejected and $H\alpha$ is accepted, meaning that it can be concluded that there is a difference in students' Self-Esteem abilities between those learning using the Discovery Learning learning model and those learning using ordinary (conventional) learning.

Discussions

The development of mathematics learning in achieving its goals still really needs to be developed, in the 21st century various kinds of modern learning models have been developed through research, one of which is the Discovery Learning learning model as an exploratory learning model and is able to improve students' cognitive and affective aspects, in line with with research Asih et al. (2019) which states that based on the research that has been conducted it can be concluded as follows: (1) 21st century learning is innovative, collaborative and student-centered learning where the model Discovery Learning is a learning model that encourages students to be active, (2) the discovery learning model has a positive impact on communication and learning.

Fazriansyah (2023) Based on empirical evidence and scientific discussions described in the research, it can be concluded that the Discovery Learning model is an established teaching strategy that has shown efficacy in cultivating and improving mathematical communication skills. That there is an influence of using the discovery learning model in developing students' mathematical communication skills, as well as being able to increase students' active learning in mathematics learning at the junior high school level (Maulida et al., 2018) .

Research finds that the mathematical communication skills of students who receive discovery learning are better than students who receive conventional learning (Qodariyah & Hendriana, 2015). Students who receive Discovery Learning experience increased mathematical communication skills in the high and medium categories (Kanah & Mardiani, 2022).

The application of modern learning is applied to be able to stimulate high-level thinking that focuses on real problem situations, so that it can arouse students' interest in accordance with their intellectual development (Nurdin et al., 2023).

Discovery Learning model in this research creates a learning environment that can develop students' self-potential, be active in teaching and learning activities, focus on solving real problems, meaning that the conclusion of the hypothesis results as a solution obtained because of self-esteem for one's own abilities without asking for help. others.

CONCLUSION

From the overall research activities, it can be described that there is a difference in the effectiveness of the Discovery Learning model learning approach with the regular learning model in terms of the aspects of mathematical communication skills and MTs Self Esteem in statistics material.

The results of data processing show that there are differences in the mathematical communication abilities of students whose learning uses the Discovery Learning learning model which is better compared to the mathematical communication abilities of students whose learning uses ordinary (conventional) learning.

The results of data processing also show that there are differences in the Self-Esteem abilities of students whose learning uses the Discovery Learning learning model which is better compared to the Self-Esteem abilities of students whose learning uses ordinary (conventional) learning.

Discovery Learning learning model in this research are that it makes it easy for students to remember the lessons learned, integrate self-concept according to their initial abilities, focus, be creative in exploratory projects, and the effect of knowledge transfer on learning outcomes can last a long time.

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