Differences in Students' Mathematical Communication Ability Using Discovery Learning and Reception Learning Models

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Abstract: The purpose of this quantitative study is to analyze the differences in students' mathematical communication skills using discovery learning and reception learning models. The research sample was students of class MIA 1 and MIA 3 were the experimental class and class MIA 2 and MIA 4 were the control class. Mathematical communication ability test questions were the instrument of this research and were analyzed by t-test and two-way ANOVA. The results showed that (1) There are differences in the mathematical communication ability of students who learn using discovery learning and reception learning models, (2) There are differences in the mathematical communication ability of students who have high initial abilities and low initial abilities, (3) There is an interaction between the learning model and the students 'initial ability to the students' mathematical communication ability, (4) There are differences in the mathematical communication ability of students who have high initial abilities who learn using discovery learning and reception learning models, (5) There are differences in the mathematical communication ability of students with low initial abilities who learn using discovery learning and reception learning models.

Keywords: communication ability. discovery learning model, reception learning model

1. INTRODUCTION

Basic mathematical abilities can be classified into five types, namely abilities: (1) recognizing, understanding and applying mathematical concepts, procedures, principles and ideas, (2) solving mathematical problems, (3) mathematical reasoning, (4) making mathematical connections, and (5) mathematical communication [1]. The five basic mathematical abilities, without neglecting other abilities, mathematical connection skills are an important part in the activities and uses of mathematics that students learn so that these abilities must be possessed by every student.[2]

The communication skills are a very important part in learning mathematics. This is supported by the opinion of [3] which states that the role of communication in mathematics learning is: (1) Mathematical communication can be exploited in various perspectives, helping to sharpen students' thinking and sharpening students' ability to see the various relationships of mathematical material. (2) Communication is a tool to "measure" the growth of understanding and reflect students' mathematical understanding. (3) Through communication, students can organize and consolidate their mathematical thinking. (4) Communication between students in learning mathematics is very important for constructing mathematical knowledge, developing problem solving and increasing reasoning, growing self-confidence, and increasing social skills. (5) “Writing and talking” can make a very meaningful or powerfull tool to form an inclusive mathematics community.

According [4] mathematical communication is a way for students to express and interpret mathematical ideas orally or in writing, either in the form of pictures, tables, diagrams, formulas, or demonstrations. Romberg and Chair [5] put forward a broader understanding of mathematical communication, namely: connecting real objects, pictures, and diagrams into mathematical ideas; explain ideas, situations and mathematical relations orally or in writing with real objects, pictures, graphs and algebra; express everyday events in mathematical language or symbols; listening, discussing, and writing about mathematics; read with understanding a written mathematical presentation, make conjectures, construct arguments, formulate definitions and generalizations; explain and make questions about the mathematics that has been learned.

The importance of mathematical communication skills in this learning process must be emphasized at every level of education. However in reality, students still have difficulty communicating their knowledge. This is in line with the results of observations made which show that the ability of students to communicate ideas is still lacking [6]. The results of [7] research show that similar findings regarding low mathematical communication skills were also found when testing mathematical communication skills, the results obtained that the mean test of students' mathematical communication skills was 42.44% and

77.5% of students had mathematical communication skills. mathematical communication in the low category.

Therefore, mathematical communication skills need to be developed. An innovation is needed as an effort to develop students' mathematical communication skills. Innovation in mathematics learning tends to be related to three things, namely how to understand mathematics, how to teach mathematics and how to assess mathematics understanding [8]. Therefore, in responding to the low mathematical connection and communication skills of students, one of the efforts that can be done is through the application of a learning model that emphasizes the activeness of students in constructing their knowledge independently based on previous knowledge.

The principles of learning with a constructivist approach have given birth to various kinds of learning models, and from these various learning models there is the same view, that in the learning process students are active actors in learning activities by building their own knowledge based on their experiences. Some of the learning models based on constructivism are discovery learning and reception learning.

According to [9] in the discovery learning model, students are encouraged to study independently. Students are actively involved in the discovery of concepts and principles, and teachers encourage students to have experiences and relate these experiences to discover principles for themselves. The advantages of the discovery learning model are stated by Bell [10] first, it gives students the opportunity to learn actively, because they think and use their abilities to find concepts. Second, helping students form effective ways of working together, sharing information, and hearing and using other people's ideas.

Although this learning model has been criticized, the mathematical communication skills of students who are taught with discovery learning are better than students who follow conventional learning. [11]. As well as the opinion[12] showed that the discovery learning model with a scientific approach resulted in better learning achievement than the classical learning model with a scientific approach.[13]**. T**he application of discovery learning is a hope to overcome the low mathematical communication of students

2. METHOD

This quasi-experimental research involved two class groups, namely the experimental class and the control class, selected by purposive sampling from 353 eleventh grade students of MAN 2 Palu in the 2019/2020 school year. The selected sample was 123 people with details of 62 people in the experimental class and 61 students in the control class.

Table 1. Research Design

Initial Ability	Learning Model (A)	
	Discovery learning A_1	*Reception learning* A_2
High (B_1)	A_1B_1Y	A_2B_1Y
Low (B_2)	A_1B_2Y	A_2B_2Y
	A_1Y	A_2Y

Information:
A_1 = Discovery learning model
A_2 = Reception learning model
B_1 = High starting ability
B_2 = Low starting ability
Y = Student's mathematical communication ability.

Students' initial ability is obtained from students' daily test scores on the material of a three-variable system of linear equations. The students' daily test scores were categorized into two categories, namely, the initial ability in mathematics in the high category and the initial ability in mathematics in the low category. This categorization is done by finding the mean value of the daily test scores obtained by all students. The initial ability in mathematics is categorized as high if the value obtained is more or equal to the mean value and the initial ability in mathematics is categorized as low if the value obtained is less than the mean value.

The research data were obtained from the results of the mathematical communication ability test on the subject of linear programming as many as 3 essay questions. The test was given after all samples were treated, namely the learning experiment class using the discovery learning model and the learning control class using the reception learning model. Before the test instrument was given to students, a trial was first conducted, and then an analysis of test validity, reliability analysis, discriminatory analysis and analysis of the level of difficulty were carried out.

Analysis of the validity of the test of mathematical communication ability instruments on questions number 1 and 2 is 0.96 and question number 3 is 0.94 with very high validity criteria. the analysis of the differentiating power of the mathematical communication ability test instrument on question number 1 is 0.52, question number 2 is 0.62, and question number 3 is 0.42 with good interpretation criteria, and analysis of the difficulty level of testing the mathematical communication ability instrument on question number 1 which is 0.69, question number 2 is 0.65 and question number 3 is 0.35 with moderate interpretation criteria.

3. RESULTS

3.1 Results of Requirements Analysis Summary

Similarity test was carried out before the two classes were given treatment. Prior to the similarity test, the normality and homogeneity of the data were first tested.

Table 2. Data Normality Test

Class	Kolmogorov-Smirnov[a]		
	Statistic	Df	Sig.
Experiment	0,093	62	0,200*
Control	0,111	61	0,061

In table 2, the significance values are 0.200 and 0.061, which shows that the significance value is greater than the value of = 0.05. This shows that the sample comes from a population that is normally distributed.

Table 3. Data Homogeneity Test

Lavene Statistic	df_1	df_2	Sig.
0,255	1	121	0,615

In table 2, The researcher obtained a significance value of 0.615, which shows that the significance value is greater than the value of = 0.05. This indicates that the research data obtained are homogeneous.

Table 4. Results of the Similarity Test of Early Mathematics Ability (EMA)

	Levene's Test for Equality of Variances	t-test for Equality of Means		
	Sig.	t	df	Sig. (2-tailed)
Score KAM Equal variances assumed	0,615	1,893	121	0,061

From the calculation results obtained in table 4, the value of sig. 0.061 which shows that the significance value is greater than the value of = 0.05. The empirical data shows that the results of the treatment have no effect on the initial mathematical ability in each class.

3.2 Analysis of Normality Test and Data Homogeneity of Students' Mathematical Communication Ability

Before testing the hypothesis, the normality and homogeneity of the data were first tested.

Table 5. The results of the data normality test of students' mathematical communication skills

Class	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Experiment	0,102	62	0,170
Control	0,084	61	0,200*

Table 5 shows a significant value of 0.170 in the experimental class and 0.200 in the control class which shows that the significance value is greater than the value of = 0.05. This shows that the test data of students' mathematical communication skills are normally distributed.

Table 6. The results of the data homogeneity test of students' mathematical communication skills

Levene Statistic	df1	df2	Sig.
0,017	1	121	0,897

Table 6 shows a significant value of 0.897 which shows that the significance value is greater than the value of = 0.05. This shows that the test data of students' mathematical communication skills is homogeneous. After the research data meets the entire series of normality and homogeneity tests, then a hypothesis test will be carried out. The results of the analysis show: (1) The high difference in students' mathematical communication skills using discovery learning and reception learning models. (2) There are differences in the mathematical communication skills of students who have high initial abilities and low initial abilities. (3) There is an interaction between the learning model and the students' initial ability to the students' mathematical communication skills. (4) There are differences in the mathematical communication skills of students who have high initial abilities who learn by using discovery learning and reception learning models. (5) There are differences in the mathematical communication skills of students who have low initial abilities who learn by using discovery learning and reception learning models. Descriptive statistical data analysis.

Table 7. Descriptive statistics of mathematical communication ability data

Model	Early Mathematics Ability	Mean	Standard Deviation	N
Discovery Learning	High	79,85	5,46	37
	Low	62,13	9,44	25
	Total	72,71	11,37	62
Reception Learning	High	67,88	8,95	21
	Low	56,77	9,14	40
	Total	60,60	10,45	61
Total	High	75,52	8,98	58
	Low	58,84	9,55	65
	Total	66,70	12,47	123

The following are the results of the research hypothesis testing using the t-test and two-way ANOVA.

Table 8. The results of the first hypothesis test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Communication Ability	Equal variances assumed	0,121	0,728	6,150	121	0,000
	Equal variances not assumed			6,154	120,450	0,000

The results of the t-test calculation in table 8 show that the value of Sig.(2-tailed) is 0.000. This shows that the value of Sig.(2-tailed) <0.05, it means that there are differences in the mathematical communication skills of students who study using discovery learning and reception learning models. The results of student communication descriptively that the mathematical communication ability of students who are taught by discovery is higher than the average value of students in the reception learning group. This is in line with research conducted by which concluded that the application of discovery learning models can improve students' mathematical communication skills. In addition, research conducted by [14] information was obtained that students' mathematical communication skills increased through the discovery learning model

Table 9. Results of the second hypothesis test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Communication Ability	Equal variances assumed	1,048	0,308	9,942	121	0,000
	Equal variances not assumed			9,977	120,660	0,000

The results of the t-test calculation in table 9 show that the value of Sig.(2-tailed) is 0.000. This shows that the value of Sig.(2-tailed) <0.05, it means that there are differences in the mathematical communication skills of students who have high initial abilities and low initial abilities.

This situation can be interpreted that there are differences in students' mathematical Communication abilities based on students' initial abilities. In line with the results of research conducted by [15] stated that there was an increase in mathematical communication skills in students with high early mathematical abilities and there was no increase in mathematical communication skills in students who had early mathematical abilities. medium and low. This is in accordance with what was stated by [16] that students who have high initial abilities will tend to easily receive information and associate it with the information that is within them so that the learning process occurs, while students who have low initial abilities will have more difficulty in learning, acquire new knowledge that comes to him.

Table 10. The results of the third hypothesis test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10889,642[a]	3	3629,881	53,528	0,000
Intercept	509177,672	1	509177,672	7508,608	0,000
Model	2155,617	1	2155,617	31,788	0,000
EMA	5943,661	1	5943,661	87,648	0,000
Model * EMA	311,585	1	311,585	4,595	0,034
Error	8069,691	119	67,813		
Total	566248,844	123			
Corrected Total	18959,333	122			

The results of the two-way ANOVA calculation in Table 10 show that the value of Sig.(2-tailed) is 0.034. This indicates that the value of Sig.(2-tailed) < 0.05. This means that there is an interaction between the model and the students' initial ability to students' mathematical communication skills.

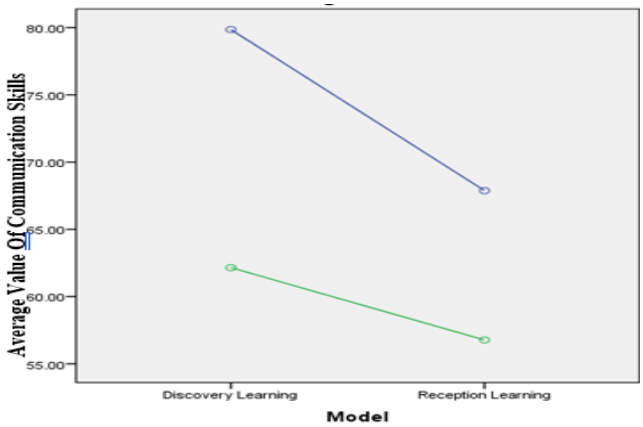

Figure 2. Graph of Interaction Between Models and Students' Initial Ability to Students' Mathematical Communication Ability

Table 11. Results of the fourth hypothesis test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Communication Ability	Equal variances assumed	10,340	0,002	6,340	56	0,000
	Equal variances not assumed			5,570	28,633	0,000

The results of the t-test calculation in table 11 with the help of the SPPS application show that the value of Sig.(2-tailed) is 0.000. This indicates that the value of Sig.(2-tailed) < 0.05. This means that there are differences in the mathematical communication skills of students who have high initial abilities who learn by using discovery learning and reception learning models.

The results of the analysis as table 7 show that students who are taught by discovery learning have higher mathematical communication than students who are taught by reception learning. This is in accordance with the results of [11] which concluded that the improvement of students' mathematical communication skills who took part in learning through the discovery learning model was better than those who participated in direct learning.

Table 12. The results of the fifth hypothesis test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
Communication ability	Equal variances assumed	0,050	0,823	2,279	63	0,026
	Equal variances not assumed			2,262	49,825	0,028

The results of the t-test calculation in table 12 show that the value of Sig.(2-tailed) is 0.026. This indicates that the value of Sig.(2-tailed) < 0.05. This means that there are differences in the mathematical communication skills of students who have low initial abilities who learn by using discovery learning and reception learning models.

The results of the study such as table 7 show that students who have early learning abilities with the discovery learning model are higher than the average value of students who study with the reception learning model. The results of the study [17] concluded that the discovery learning model had a positive effect on communication and learning. concluded that the discovery learning model had a positive impact on communication and learning.

4. DISCUSSION

a. Students' mathematical communication skills have differences between students who learn to use the discovery learning model and the reception learning model. Overall, it can be seen from the average score of students who are taught by the discovery learning model, which is higher than the average value of the students who are taught by the reception learning model. This is in line with the research conducted by [18] which concluded that the application of the discovery learning learning model can improve students' mathematical communication skills. In addition, research conducted by [14] obtained information that students' mathematical communication skills increased through discovery learning models.
b. Mathematical communication skills of students with initial abilities have high learning outcomes compared to students with low initial abilities. that is, there are differences in students' mathematical communication skills based on students' initial abilities. The results of this study indicate that the mathematical communication skills of students who have early abilities are better than students who have low initial abilities. In line with the results of research conducted by [15] stated that there is an increase in mathematical communication skills in students with early abilities high mathematics and there is no increase in mathematical communication skills in students who have moderate and low initial mathematical abilities. This is in accordance with what is stated by [16] that students who have high initial abilities will tend to easily accept information and relate it to the information contained in the text. themselves so that the learning process occurs, while students who have low initial abilities will have more difficulty acquiring new knowledge that comes to them.
c. Based on the two-way ANOVA calculations carried out, the results showed that there was an interaction between the model and students' initial abilities on students' mathematical communication skills. This shows that there is an effect of the learning model and students' initial abilities together on students' mathematical communication skills.
d. There are differences in students' mathematical communication skills, between student study groups with discovery learning models and reception learning models which have high initial abilities. So the mathematical communication skills of students who are taught with the reception learning model in the group of students who have the initial ability of students with the discovery learning model are better than the reception learning model. This is in accordance with the results of [11] research which concludes that the increase in mathematical communication skills of students who take part in learning through the discovery learning model is better than those who take part in direct learning.
e. There are differences in the mathematical communication skills of students who are taught with the discovery learning model and the reception learning model in groups of students with low initial abilities. Therefore, the mathematical communication skills of students with low initial abilities have different results between students who study with the discovery learning model and the reception learning model. it can be said that the mathematical communication skills of students who are taught by the reception learning model. students who have low initial learning abilities with discovery learning learning models are better than reception learning models. The results of the research by [17] concluded that the discovery learning model had a positive impact on communication and learning.

5. CONCLUSION

Based on the results of research and discussion, it is concluded that: (1) There are differences in the mathematical communication ability of students who learn using discovery learning and reception learning models. (2) There are differences in the mathematical communication ability of students who have high initial abilities and low initial abilities. (3) There is an interaction between the learning model and the students 'initial ability to the students' mathematical communication ability. (4) There are differences in the mathematical communication ability of students who have high initial abilities who learn using discovery learning and reception learning models. (5) There are differences in the mathematical communication ability of students with low initial abilities who learn using discovery learning and reception learning models.

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