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Application of Group Investigation Type Learning Model to Mathematical Communication Skills

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ABSTRACT
This research was conducted to determine the increase in the mathematical communication skills of class XI students at Tamansiswa Private Vocational School, Padang Tualang Branch, for the 2020/2021 academic year, which was taught using the group investigation learning model. In this study using the type of experimental research with data analysis techniques that are processed quantitatively. This research was conducted at the Tamansiswa Private Vocational School, Padang Tualang Branch. The samples used in this study were 2 classes among 3 classes, namely class XI TKRO-1 as the control class and XI TKRO-2 as the experimental class, each of which used SPSS Version 20. Before testing the hypothesis, the validity and reliability instruments were first tested. , it is known that the data is valid and reliable and the n-gain test is carried out then the normality and homogeneity tests are carried out. The n-gain values for students' mathematical communication skills for the experimental class and the control class are 5.5 and 2.1 and based on the calculations, the significance is 0.000 <0.05. Which means that there is an influence or significant increase in the results of students' mathematical communication abilities that have been applied between the group investigation learning model and conventional learning methods.

INTRODUCTION

Education is the main dimension to be able to create knowledgeable, knowledgeable and cultured humans. Through a good education system, a nation or country will have strong and qualified human resources (HR) in the desired field. Mathematics is one of the main subjects given to all students from elementary school to upper secondary education. The aim is to equip students with logical, analytical, systematic, critical, and creative thinking skills, as well as the ability to work together. These competencies are needed so that students can have the ability to obtain, manage, and utilize information to survive in ever-changing, uncertain, and competitive circumstances.(Kusumawati, 2023b)(Hairullah et al., 2021)

One of the objectives of learning mathematics is to improve students' ability to communicate mathematically (mathematical communication). This improvement is needed so that students can stimulate a deeper understanding of the knowledge and mathematical concepts learned and can apply them in various situations. Student communication is needed in the teaching and learning process to find student success in learning. Students are expected to communicate with each other in learning mathematics because it can have an impact on students' memories of the material that has been taught. Student involvement in carrying out teaching and learning activities can be accommodated in students' memories. Each concept will be easier to understand and remember if presented in the right method and way. So as not to make students feel bored and bored, therefore students will be more active and excited in learning mathematics.(Kusumawati, 2023a)(Hafizar, 2020)

Communication skills problems in students occur at SMK Swasta Tamansiswa Padang Tualang. Students in this school in classroom learning only wait for explanations and orders from teachers without any

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reciprocal explanation by students. Based on the objectives of learning mathematics, it can be concluded that the purpose of learning mathematics that must be mastered by students is mathematical communication skills. But in reality, the mathematical communication skills of students in class XI of SMK Swasta Tamansiswa Padang Tualang are still low. Where almost all students are only able to solve the problem in the exact same way as the teacher gave it, even then some students still have some mistakes when solving the problem. If given a question that is slightly different from the example already described, they can't solve the problem, they don't want to figure out how, they just wait for the teacher to solve the problem.(Kusumawati, 2020)(Ardiana, 2018)

The problem is because mathematics teachers do not apply methods that can make students communicate with each other. Teachers play an active role in choosing learning methods. The monotonous learning process (always using the same learning method) will make students feel bored. Students need something new, because by teaching teachers with varied learning methods, students can learn optimally and will even more easily accept explanations from a teacher.(Anggraeni &; Sundayana, 2021)

The lack of student communication skills is also caused by the fear of students asking the teacher. Students are more likely to seek answers from other sources such as textbooks about material that is not yet understood, and do not feel like asking the teacher. Because the teacher is still considered as someone scary in the classroom. Efforts to improve communication skills are certainly inseparable from the cooperation between students and teachers. The interaction that occurs will create active learning where students using communication skills try to acquire their own knowledge with the help of teachers who act as facilitators. Therefore, teachers are required to be able to develop their abilities and skills in carrying out the teaching and learning process.(Kusumawati, 2022b)(Utami, 2015)(Kusumawati, 2022a)

Therefore, it is a big task for mathematics teachers to improve the learning system so that there is an increase in students' mathematical communication skills. The new paradigm of education demands student-centered learning . One way that can be done is to use a learning model that is able to build creativity, independence and communication between students to build knowledge with group learning activities. Such a learning model is called a cooperative learning model.(Syarifuddin, 2018)

According to the theory that in a cohesive group each group member consists of 4-5 heterogeneous students (ability, gendre and character) there is control and facilities, and asks for responsibility for group results in the form of reports or presentations. This learning model requires students to have good communication skills and group process skills, so that it will grow students' mathematical communication skills. This model can also train students to cultivate independent thinking skills. Active student involvement can be seen from the first stage to the end of learning.(Rahmawati, 2018)

The Group Investigation learning model is a form of cooperative learning model that emphasizes student participation and activity to find their own lesson material (information) to be learned through available materials. According to the word, "Group Ivestigation is a model that involves students from planning, both in determining topics and ways to learn them through investigation". Then said, "the GI type is the type that requires students to have good communication skills and group process skills." According to "The syntax of the GI model includes selecting topics, planning cooperation, implementing, analyzing and synthetic, presenting final results and evaluating.(Hasibuan, 2019)(Mandopa, 2023)(Siregar et al., 2022)

Based on observations made by researchers at SMK Swasta Tamansiswa Padang Tualang Branch regarding student learning outcomes have not been obtimal. This can be seen from the average score of mathematics lessons in the odd semester final assessment in Semester 1 in the 2021/2022 academic year, currently there are still many students who have not reached the minimum completeness creteria score (KKM) limit, which is a score of 73. The factors that cause students to get scores below KKM are the lack of motivation and interest in learning students in mathematics lessons.

In this case, there are several relevant studies in my opinion, which I make the basis of research, namely the research of Elza Zaini Putri, et al (2019) entitled The Effect of the Investigative Group Learning Model on the Mathematical Communication Skills of Class VIII Students in the Even Semester of the 2018/2019 Academic Year. The conclusion of this journal "there is an influence of the Group Investigation learning model on mathematical communication skills in grade VIII students in the even semester of SMP Negeri 5 Bandar Lampung for the 2018/2019 academic year.

The next research related to the influence of investigasion groups is the research of Jonter Situngkir and Izwita Dewi (2019) entitled Efforts to Improve Students' Mathematical Communication Skills by Using the Investigative Group Type Cooperative Learning Model in Class IX of Gajah Mada Private Junior High School Medan. Because it has met the criteria for students' mathematical communication skills (indicators of success in research have been achieved) and have improved from cycle I to cycle II, it can be concluded that the Group Investigation type cooperative learning model can improve students' mathematical communication skills in the material Build Curved Side Space.

METHODS

This type of research is quasi-experimental research with data analysis techniques that are processed quantitatively. Experimental research according to Sugiono (2016) is defined as a research method used to look for the influence of certain treatments on others under controlled conditions. This type of experimental research aims to determine the effect of treatment on students' mathematical communication skills through conventional learning models on Arithmetic Line and Series material in class XI SMK Tamansiswa Padang Tualang

According to Arikunto (2016) the population is the entire subject of research. Based on this statement, the population in this study is all grade XI students of SMK Swasta Tamansiswa Padang Tualang for the 2021/2022 academic year, consisting of three classes with a total of 112 students.

While the sample according to Arikunto (2016) is part of the number and characteristics possessed by the population. We can say that the sample is part of the population. Thus, the sample in this study will be selected 2 classes as a control class and an experimental class. Class XI TKRO 2 as an experimental class and class XI TKRO 1 as a control class of many students in one class of 37 students. The sampling technique used is purposive sample. According to Arikunto (2016), purposive sample is taken by taking subjects not based on strata, random or regional but based on certain goals.

RESULTS

A. Research Results

This research was carried out on grade XI students of SMK Swasta Tamansiswa Padang Tualang Branch with 2 sample groups of TKRO class 1 as a control class totaling 34 students by applying conventional learning. and TKRO class 2 as an experimental class totaling 37 students were treated with *a group investigation* learning model.

To obtain data from this study, researchers conducted tests in the form of descriptions. This test is given to students to determine the improvement of students' mathematical communication skills on Arithmetic Line and Series material. This test is given after applying the learning.

Based on data analysis and observations in this study, research results were obtained in the form of improving students' mathematical communication skills in conducting experimental activities which include cognitive aspects in the *Group Investigation* learning model. Data analysis and data processing were carried out in the study using the help of *SPSS Version 20.*

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B. Test Results Try Instruments

1. Validity

Based on the results of the calculation of the question validity test conducted at SMK Swasta Tamansiswa (TAMSIS) Padang Tualang, the results of the question validity test in accordance with the data obtained show that:

a. Validity of Mathematical Communication Skills Test

Table 1. Validity of Mathematical Communication Skills Test

Question No.	Correlation Coefficient	Interpretation
1	0,34	Low Validity
2	0,74	High Validity
3	0,43	Sufficient Validity
4	0,397	Low Validity
5	0,80	High Validity
6	0,59	Sufficient Validity
7	0,76	High Validity
8	0,29	Low Validity

Based on the results of the table above from 8 questions of mathematical communication skills test is said to be valid.

2. Reliability

Based on the results of the Reliability calculation carried out, the reliability of students' mathematical communication ability test questions can be seen in the table below:

Table 2. Reliability of Students' Mathematical Communication Skills Test

Student Mathematical Communication	
Coleration Coefficient	Interpretation

0,59	Medium Reliability

3. Difficulty Level

Based on the table above that the mathematical communication skills test questions were carried out, the data obtained showed that:

Table 3. Difficulty Level of Mathematical Communication Skills

Question No.	Index	Interpretation
1	0,57	Keep
2	0,58	Keep
3	0,37	Difficult
4	0,107	Difficult
5	0,71	Easy
6	0,79	Easy
7	0,91	Easy
8	0,64	Keep

Based on the table above, the mathematical communication skills test questions have high, medium, and low levels of difficulty. The questions that have a high level of difficulty are questions number 3 and 4, those with a medium level of difficulty are questions no. 1, 2 and 8, then those with a low difficulty are questions no. 5, 6, 7.

4. Differentiating Power

Based on the results of calculating the distinguishing power of the test on communication skills, the results are obtained in accordance with the existing data as follows:

Table 4. The Discriminating Power of Mathematical Communication Skills

Question No.	Index	Interpretation
1	0,5	Accepted
2	0,43	Accepted
3	0,38	Accepted
4	-0,38	Discarded
5	0,5	Accepted
6	0,25	Accepted
7	0,31	Accepted

From the table above, it can be seen that of the 8 communication skills test questions that are eligible to be accepted as a question test as 6 questions and 2 questions are discarded. Based on the results of the validity, reliability, discriminating power and difficulty tests, 8 questions of the mathematical communication skills test are said to be valid, have moderate reliability and have a level of difficulty of 3 questions, easy 3 questions and difficult 2 questions. There were 6 questions received and 2 questions were discarded. Therefore, researchers chose questions no. 2, 3, 5 and 6 that are suitable to be used as *pretest* and *post test* questions for students' mathematical communication skills.

b. Descriptive Statistical Analysis of Students' Mathematical Communication Skills

The results of the study were obtained based on data analysis conducted on quantitative data obtained through tests of students' mathematical communication skills given to 71 students consisting of 37 students in the experimental class and 34 students in the control class. The test is carried out 2 times, namely before and after learning.

Here is a table used to illustrate the descriptive data *of pretest*, *posttest* and *n-gain* for tests of students' mathematical communication skills. The results of *pretest*, *posttest* and *n-gain* scores can be seen in the following table:

Table 5. Student Mathematical Communication Skills Score Data

Score	Experiment				Control			
	N	$\bar{X}$	S	%	N	$\bar{X}$	S	%
Pretest	37	6,11	9,25	0,30	34	4,53	4,35	0,25

posttest	37	11,27	2,40	0,75	34	6,50	4,05	0,55
n– gain	37	5,5			34	2,1		
Maximum score = 16								

The table above is the results of *pretest*, *posttest* and *n-gain* scores from tests of students' mathematical communication skills for the control class and experimental class. At the time of the *pretest*, the average was 6.11 and 4.53, and *the post test* was obtained with an average of 11.27 and 6.50.
It can also be seen in the following:

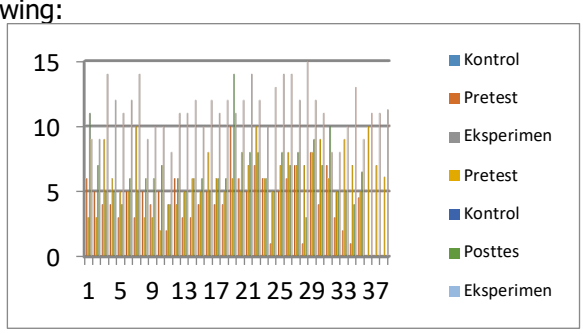

Figure 1 *Pretest* and *posttest* averages on mathematical communication skills

Based on the picture above, it can be seen that the *average pretest* scores of students' mathematical communication skills for the control class and experimental class are slightly different. This shows that the initial ability for both classes before treatment has a relatively similar average. When there is no treatment pretest so that no improvement can be seen, improvement can be seen after the posttest. Students' mathematical communication skills in the experimental class after being treated with the application of the *Group Investigation* learning model. The average value of *n - gain* can be seen in the following figure:

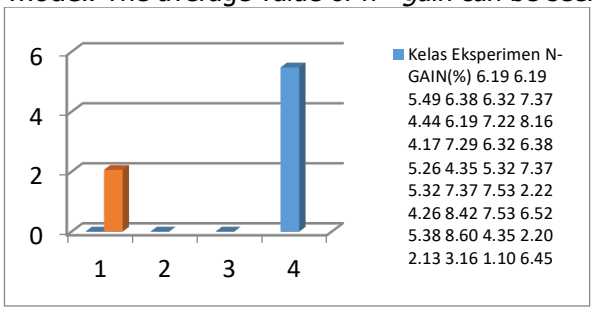

Figure 2 Average N-Gain

From the picture above, it shows that the average value of *n - gain* for the experimental class is superior to the control class with average values of 5.5 and 2.1 respectively, it can be said that with the application of the *group investigation* learning model to students' mathematical communication skills is said to increase.

Table 6. Average N – gain on mathematical communication skills

Class	Average value n – gain	Category
Experiment	5,5	Keep
Control	2,1	Keep

Based on the table above, the calculation of the average value of n-gain for the experimental class and the control class is that *the n-gain* for the experimental class.

C. Pretest Testing

Before the hypothesis test is carried out, prerequisite tests are carried out on both data, including normality tests and homogeneity tests. The following is described the results of testing normality and homogeneity against mathematical communication ability score data.

1. Student Mathematical Communication Normality Test Results

The data normality test aims to determine whether the data obtained in this study is normally distributed or not to determine the type of statistical test used in subsequent data analysis. The normality test in this study used the *Shapiro-Wilk* technique. Where a significant value of > 0.05 control over students' mathematical communication skills is presented in the table as follows:

Table 7. Data Normality Test Results Mathematical Communication Skills Test of Normality

Group	Kolmogrov-Smirnov			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
experiment gain control	114	37	200*	967	37	433
	081	34	200*	985	34	923

Based on the table above, we see the results of the normality test of students' mathematical communication ability data in the control class obtained 0.923 and the experimental class obtained 0.33, then the results of the two classes > 0.05, then Ho received which means the data is normally distributed.

2. Homogeneity Test of Variance

The homogeneity test is performed to determine the variance of homogeneously distributed data or not. The homogeneous test is carried out with the Levene test, a guideline to find out whether both data are homogeneous or not if p > 0.05, then it can be homogeneous and if p > 0.05 then the data is not homogeneous. The results of the homogeneity test of experimental class data and control class on students' mathematical communication skills are presented in the following table:

Table 8. Results of Data Homogeneity of Students' Mathematical Communication Skills Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.508	1	72	224

The results of the homogeneity test of data on students' mathematical communication skills in the experimental class and control class were obtained 0.224, explaining that *p valube* (sig) > 0.05 so that it can be concluded that the variance in the data is homogeneous.

3. Hypothesis Test Results

Based on the normality test and variance homogeneity test, it was obtained that the data on students' mathematical communication skills for the control class and experimental class were normally and homogeneously distributed. Based on this, the next stage will be hypothesis testing with a t-test. The hypotheses of this study are as follows:

Ho : = : The Average Improvement of Student Mathematical Communication with the $\mu_1\mu_2$ *Group Investigation* Type *Cooperative* Learning Model is Significantly Similar to the Conventional Learning Model on Arithmetic Line and Series Material in Class XI of SMK Swasta Tamansiswa Padang Tualang Branch.

Ha : > : The Average Improvement of Student Mathematical Communication with the $\mu_1\mu_2$ *Group Investigation* Type *Cooperative* Learning Model is significantly better than the increase in students' Mathematical Communication Skills with the Conventional Learning Model on Arithmetic Line and Series Material in class XI of SMK Private Tamansiswa Padang Tualang Branch.

D. Discussion

Based on the results of the statistical analysis test for hypothesis 1 above, it shows that students' mathematical communication skills with the application of the group investigation learning model are better than conventional applications, this is shown by the average value of n-gain for the experimental class with the application of the *group investigation* learning model 5.5 (categorized moderate) and the control class with the application of conventional learning 2.1 (categorized medium).

The results of statistical analysis for experimental and control classes both distributed normal and homogeneous. Then in testing the hypothesis tested using a *t-test* with *2-Tailed* significance, the value of 0.0000 < 0.05 Ha was accepted and Ho was rejected so that this study was said to be successful and it can be concluded that students' mathematical communication skills applied with the *group investigation* learning model are better than conventional learning models.

Learning with *the group investigation* model begins with the division of groups. Furthermore, teachers and students choose certain topics in accordance with problems that can be developed. Each group works systematic scientific activities ranging from collecting data, data analysis, systematic, so as to draw conclusions. With this, the *group investigation* learning model is able to improve students' mathematical

communication skills, students are free to convey their investigations and opinions on problem topics. Thus, it can be concluded that the use of *the group investigation* learning model in mathematics learning can improve students' mathematical communication skills in grade XI students of SMK Swasta Tamansiswa Padang Tualang Branch.

CONCLUSION

Conclusion making in this study is important because it describes what we have researched and describes the results of a study and its studies. Based on the theoretical basis supported by the results of statistical analysis that has been stated in Chapter VI and refers to the formulation of the problem that has been described in front, it can be concluded that:

1. Before the application of the learning model, students obtained an average pretest score that was not much different, so it can be said that the level of cognitive ability of students is said to be relatively the same.

2. With the application of the group investigation learning model, it can improve students' mathematical communication skills in mathematics lessons, especially in rows and arithmetic series.
3. Based on the results obtained that students' mathematical communication skills are better with the application of the group investigation learning model compared to conventional learning models on row and arithmetic series material in class XI of SMK Swasta Tamansiswa Padang Tualang

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