

Experimentation of cooperative learning model with group investigation type on communication ability and mathematical disposition

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KEYWORDS

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ABSTRACT This study tries to see: 1) Are there differences in mathematical communication between students who use the direct learning model and students who use the cooperative learning model? 2). Is there a difference in disposition between students who use the direct learning model and students who use the cooperative learning model? A quantitative approach to the type of experimental quiz used in this study, Nonrandomized Control Group design, and Pre-Posttest Design. The population is class VIII students of SMP N 2 Pekalongan. Sixty-four students were included in the sample; 32 were in the experimental group, and 32 were in the control group. Sampling was tried by simple random sampling. The research instrument was a test of communication skills and a questionnaire on students' mathematical dispositions. Data were analyzed using MANOVA, one-way ANOVA, and paired sample t-test. After fulfilling the prerequisite tests, namely the multivariate normality test and the homogeneity of variance and covariance. According to the results of the t-test calculations for two paired samples, the value of Sig. Equal to $0.000 < 0.05$. This means that H_0 is rejected, and H_1 is accepted. It can be concluded that there is a difference between the pre and post-test results for the experimental and control classes, as well as showing if the type of GI cooperative learning model on students' communication abilities and mathematical dispositions can increase. The Manova and Anova tests show if the Wilks' Lambda value is in the model line with Sig. 0.000 is smaller than the alpha value of 0.05, so H_0 is rejected, and the two educational models do not have the same impact on students' communication abilities and dispositions. The conclusions of this research are: 1). There is a difference in communication between students using the cooperative and direct learning models. 2) There is a difference in mathematical disposition between students who use cooperative and direct learning models.

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1. INTRODUCTION

Education is an essential role in creating generations that have high quality (Benly, 2020), intelligence (Tang, 2020), creativity (Picard, 2020), Skills (Samaher, 2021), productivity (Nugroho et al, 2018), as well as being responsible and virtuous for development in advancing the nation and state (Abildgaard et al, 2021) so that it can become a guide in society and can compete with other countries in all fields (Graven, 2016; Suneki, 2020). In this case, all parties, especially the state, must provide quality learning (Abildgaard et al, 2021). The quality that is meant here is the result and two interrelated parts: the learning process and the education results.

In the learning process where the teacher dominates using the direct learning model is high (Abildgaard et al, 2021). The tendency of students to be passive in learning (Otero, 2021), sleepy student (Abildgaard et al, 2021; Chan, 2018), and not concentrate (Fu, 2022; Graven, 2016), it is difficult to understand the material, students are lazy to pay

attention and learning is not conducive and effective (Aliste, 2022; Phukan, 2022), not by the indicators that have been made (Hamaya, 2018; Jeon, 2018).

Based on the research that the authors conducted at SMP Negeri 2 Pekalongan, it was found that some students had different levels (of expertise) in cognitive processes. Given the importance of students' communication skills in education, teachers must improve educational models that can provide facilities for students to communicate thoughtfully and provide more time to build their understanding.

The GI-type cooperative learning model is an educational strategy supporting communication and disposition. Learning is an attempt by teachers to educate students so that students can become better (Chan, 2018). With the group investigation educational model, it is hoped that it can increase activity in communication and disposition so that students feel safe and happy when understanding mathematics education and can more quickly master the basic concepts of comparison and be able to explain them in everyday language and understand the steps for solving

them. (Kashyap, 2018; Kumar, 2018). In cooperative learning, group investigation involves "choosing topics, cooperative planning, implementation, analysis, presentation, and evaluation" (Binkhathlan, 2018; Ruscio, 2020).

Researchers are interested in conducting experimental research by trying the group investigation type's cooperative learning model, as seen from the explanation above. What underlies the selection of this learning model is that it is more effective and efficient because students do not feel tense in learning, they do not feel awkward communicating with the teaching here, and they are more active in learning. For this reason, a teacher needs to pay attention to students' communication skills and mathematical dispositions. In educational activities, it is significant to use strategies to help students build on the knowledge they already have to participate in mathematical dialogue and communicate efficiently what they are learning. Accordingly, if students (Abildgaard et al, 2021) can speak efficiently, they have excess knowledge to unravel all math problems. Communication is a discussion or interrelated event in the classroom where there is a transfer of messages, and the transferred messages contain mathematics modules that students are studying. Another opinion is (Otero, 2021) that communication is an opportunity for everyone to interact with others by exchanging information online. Cooperative (Abildgaard et al, 2021) claims that "disposition consists of a high desire, awareness, and dedication that exists within students to learn and carry out learning mathematics" (Abildgaard et al, 2021). Another understanding is that disposition is the tendency of students' interest and self-confidence in learning mathematics and the desire to reflect on their thoughts (Jeon, 2018); to improve communication and disposition of students, teachers need to prepare appropriate modules so that students are accustomed to discussions and students have a high curiosity.

The selection of this learning model is based on the results of previous researchers. Namely, the research results of (Ruscio, 2020) found that there were differences in mathematical communication ability between the TSTS cooperative learning model and the conventional learning model, and the results of educational evaluations using the TSTS cooperative learning model showed a higher average ratio (Graven, 2016). Meanwhile, from (Abildgaard et al, 2021), the results showed that the GI-type cooperative learning model affected/ students' mathematical communication abilities and positive attitudes (Chan, 2018). Another study, namely from researcher (Fu, 2022), found that applying the GI model can increase student activity and learning outcomes (Güner & Gökçe, 2021).

The researcher was interested in examining whether the GI type of cooperative learning model could affect students' communication abilities and mathematical dispositions. Moreover, look at the average ratio of communication skills and student dispositions.

2. METHOD

The quantitative research approach was used in this study. Using a quasi-experimental type experiment (quasi-experiment), the research design is a Nonrandomized Control Group, Pre-Posttest Design. A design where work has not been done but instead uses existing groups has just completed the process of balancing between experimental and control classes.

The population in this research were all students of class VIII SMP Negeri 2 Pekalongan. The sample consisted of 64 students divided into 2 classes: class VIII.2 was given the treatment, and class VIII.1 became the control group and did not receive treatment with the direct method. "Probability Sampling is a technique in which students are given equal treatment of members of the population in the process of selecting sample members" (Sugiyono) (Muhammad et al., 2023). This type of research uses simple random sampling. To avoid class noise, the researcher used an existing class using a quasi-experimental design.

In this research, there is 1 independent variable, namely the learning model; for the dependent variable, there are 2, namely communication skills and dispositions. They collect data for this research analysis through observation, tests, questionnaires, and documentation. Before continuing the study, the researcher conducted a balancing test between the two population groups. Moreover, the test is carried out after fulfilling the conditions for Multivariate Normality and the Homogeneity of the Variance and Covariance Matrix. Hypothesis testing uses one-way Multivariate Analysis of Variance and Analysis of Variance. Item Analysis, Cognitive test instruments, use difficulty levels, discriminating power, and the Polytomy instrument test because this study uses essay tests and attitude scales with scores of more than two possible answers obtained; before that, the researcher conducts test trials in classes other than those used in the research.

2.1 Data Analysis Technique

a. Descriptive Statistical Analysis.

Ways to collect and analyze data to provide helpful information. At this time, the pre-test and post-test data were analyzed descriptively to assess students after the experiment.

b. Inferential Statistical Analysis.

This includes all data analysis methods on samples, which are then generalized to the population, which is where Inferential Statistics uses a type of Parametric Statistics. Multivariate Normality Tests and Homogeneity of Variance and Covariance Matrixes were performed. Furthermore, the Hypothesis Test was used to see the impact of the treatment given on communication skills and mathematical disposition. This study uses the formula *Manova*, *Anova*, and *T Two Sample Pairs*.

3. RESULTS & DISCUSSION

Observations in the field are used for observation, then tests in written and mathematical disposition scales. This research is in the form of a description test on the research instrument. Pre-test where students have not been given treatment, and post-test where students have received treatment. This study used the Pythagorean theorem material (Kashyap, 2018). This test is in the form of a description because it is known that there are differences in students' answers in completing mathematics lessons, and the results of this assignment can draw several conclusions from students. The questionnaire is in the form of an adapted disposition scale, which refers to the Likert scale. Moreover, finally, namely, documentation to obtain data on students' abilities before and after conducting experiments in research.

All data used for research needs to be tested first to determine the validity and reliability of the data used. The results of the calculation of validity and reliability test data are as follows:

It can be seen from the laken validity index that the entry value is at intervals of > 0.80 , so overall, the instrument is valid to use and is classified as high. From the calculation results obtained a value of $0.75 > 0.70$, it was concluded that the test instrument was reliable. After testing the research data, tests were conducted on both research classes.

3.1 Communication Ability and Disposition of Students in the Experimental Group

An initial test was carried out to measure students' communication skills and position before being given treatment, from the test results obtained the following Table 1.

Based on the pre-test data, the average value of communication skills is 53.28, which is categorized as low with a range (range of values) of 50, and in mathematical disposition, an average value of 22.84 is obtained, categorized as medium with a range of 13. After knowing students' communication skills and initial disposition, students are treated. After being given cooperative learning, the final test is to see communication skills and dispositions after the GI cooperative learning treatment. Obtained an average value of 80.9, the student's communication skills can be categorized as high with a range (range of values) 30, and in the ability of dispositions, an average value of 30.6 is obtained, so it is categorized as high with a vulnerable value of 13.

The data above shows that communication skills and dispositions taught by cooperative learning increased from the pre-test to the post-test, with the difference in the average score on communication skills of 27.62 and disposition of 7.76.

3.2 Communication Skills and Disposition of Students in the Control Class

Before learning, students were given a pre-test to see their communication skills and position in the control group before being given treatment using direct learning. Obtain the initial grades of students as Table 2.

Based on the pre-test data, the average value of communication skills is 56.09, so it can be categorized as low with a range (vulnerable value) of 60 and in mathematical disposition, an average value of 23.53 is obtained, so the pre-test results of students are categorized as moderate with a range (vulnerable). value) 13. After knowing the communication skills and disposition. Students learn by

direct learning. After completing the delivery of the material, students are given a post-test to determine communication skills and dispositions after using direct learning. Obtained an average value of 76.09, which can be categorized as moderate with a range of 25 on communication skills, and on disposition, an average value of 28.28 is obtained, so it is categorized as high on the post-test students with a vulnerable value of 9. The data shows that communication skills and dispositions taught using direct learning increased from the pre- to post-test, with an average difference in communication skills of 20 and a disposition of 4.75.

3.3 Prerequisite Test

3.3.1 Multivariate Normality Test

The requirements of the first analysis must fulfill the normality test to carry out the following test stage, namely the hypothesis test, where the data must be normally distributed. This study, using a correlation test between the value of Mahalanobis Distance and Chi-Square, aims to determine whether the distribution of data communication skills and dispositions is normally distributed. Obtained data as follows:

From the results of the data analysis tested using SPSS and shown in the table above, it can be concluded that the correlation coefficient between the Mahalanobis Distance and Chi-Square values is Sig. 0.000 < 0.05 , the correlation is significant, and H_0 is accepted. In summary, the test results on communication skills and dispositions show if the population samples have the same variance and are normally distributed.

3.3.2 Homogeneity Test of Variance and Covariance

Homogeneity test of variance and covariance to see if the sample used has a homogeneous population. In this research, the Box Test's M statistic is used with a significance level 0.05. The data shows the value of Sig. 0.390 > 0.05 , then H_0 is accepted. Moreover, it can be concluded that the covariance matrix of the dependent variable in all population groups is the same.

3.4 Hypothesis Test

3.4.1 Manova Test

After the two prerequisite tests show if the samples are normally distributed and homogeneous or the same, a hypothesis test is carried out to identify the impact of the educa-

TABLE 1. Pre and Post-test scores for Students' Initial Abilities (N=32)

No	Statistics	Pre-Test		Post-Test	
		Communication	Disposition	Communication	Disposition
2	Total Value	1705	731	2590	979
3	Average	53,28	22.84	80.9	30, 6
4	Standard Deviation	13.95	3,361	7,34	3,181
5	Variance	194,531	11,3	53,931	10,12
6	Maximum	85	28	95	36
7	Minimum	35	15	65	23
The Difference in Average Values		27,62		7,72	

TABLE 2. Results of Control Class Pre and Post-test Values (N=32)

No	Statistics	Pre-Test		Post-Test	
		Communication	Disposition	Communication	Disposition
2	Amount	1795	753	2435	905
3	Average	56.09	23.53	76.09	28,28
4	Standard Deviation	14.01	2,862	7.59	2,203
5	Variance	196.35	8.193	57,636	4,854
6	Maximum	80	28	90	32
7	Minimum	20	15	65	23
The Difference in Average Values		20		4,72	

tional model used the same or not. The Multivariate Analysis of the Variance Test using Wilk's Lambda Test Statistics with a significance level 0.05.

Based on the Wilks' Lambda value analysis in the model line, Sig. $0.000 < 0.05$, then H_0 is rejected, and the two learning models do not have the same effect on students' communication abilities and dispositions. After knowing the results of the Manova test, namely not giving the same effect, an ANOVA test was carried out to see whether there were differences in the impact between the learning models.

3.4.2 Anova Test

By determining the population means with a significance level of 0.05 using the Scheffe method as follows:

TABLE 3. Descriptive Statistics (n=64)

	Min	Max	Means	SD
Pre Communication	20	85	54,69	13,941
Communication Post	60	95	78,28	8,272
Pre-Disposition	15	28	23,19	3,116
Post Disposition	23	36	29,44	2,954

From calculations using SPSS to obtain the sig value in the model line:

- Sig. value for the communication pre-test of $0.424 > 0.05$, then H_0 is accepted. There is no difference in the effect of the learning models on the results of the pre-test of communication skills.
- The sig value for the communication post-test is $0.009 < 0.05$, so H_0 is rejected. There are differences in the effect of the learning models on the post-test results of communication skills.
- Sig. value for the disposition pre-test of $0.382 > 0.05$, then H_0 is accepted. There is no difference in the effect of the learning models on the results of the pre-test of dispositional abilities.
- The sig value for the dispositional post-test is $0.001 < 0.05$, so H_0 is rejected. There are differences in the effect of the learning models on the post-test results of dispositional abilities.

3.4.3 Paired-sample T Test

On the results of the Hypothesis Test using Manova and Anova. After carrying out the Paired-Sample T-Test (Test

of 2 Paired Samples) to see whether there is a significant difference between students' communication abilities and mathematical dispositions before and after learning using the GI cooperative learning model can be seen in the following table:

According to the calculation results above, the value of Sig. $0.000 < 0.05$. This means that H_0 is rejected, and H_1 is accepted. It can be concluded that there is a significant difference between the pre-test and post-test results for the experimental and control classes, as well as showing if the type of GI cooperative learning model on students' communication abilities and mathematical dispositions can increase.

Based on the data analysis above, there is a difference between students who study with the educational model and students who learn directly. This study's cooperative learning model and direct learning prove the existing hypothesis. After carrying out learning research and taking values (data), it is more effective to use Group Investigation learning compared to using direct learning. It is then based on the hypothesis testing from Manova, the value of Sig. 0.000 for the Wilks' Lambda Test < 0.05 , so it was decided that H_0 was rejected, and the two learning models did not have the same impact. This shows if there are differences in communication and disposition between learning models. The cooperative learning model is better than the direct learning model.

Before conducting the research, the researcher designed a group investigative study by making lesson plans. In carrying out the learning contained in the lesson plan, the researcher carried out the research in 4 meetings. At the first meeting, the students were given a pre-test to find out their initial abilities; after that, in the second and third meetings, the researcher introduced the group investigative learning model to determine students' communication abilities and mathematical dispositions. At the last meeting, the researchers gave a post-test to find out the learning outcomes of students after the treatment was given to students, whether there were differences in mathematical communication between students who used the direct learning model and students who used the cooperative learning model, and also to find out the dispositions between students who used direct learning and students who use cooperative learning models.

Applying the group investigative learning model makes students active and enthusiastic because they learn and process the material with their group through exchanging ideas. This lesson gives a meaningful impression because students can be free with their groups to discuss

TABLE 4. Descriptive Statistics

Source	Dependent	Type III Sum of		Mean		
	Variables	Squares	df	Square	F	Sig.
Model	Pre Communication	126,563	1	126,563	0.648	0.424
	Communication post	451,563	1	451,563	7,254	0.009
	Pre-Disposition	7,563	1	7,563	0.776	0.382
	Post Disposition	85,563	1	85,563	11.428	0.001

with each other and understand the material well. In the Pythagorean theorem material, the teacher has never interacted with the learning model with this material. This cooperative learning model emphasizes teamwork in solving a problem. In this approach, students learn as a team while completing group assignments to achieve a common goal. Where students find it easier to find and understand topics in learning, and they can debate these issues with their friends (Samaher, 2021).

Better communication skills because in GI cooperative learning, students try to solve problems independently, and each group consists of students with different abilities. This is where each student can complement each other to obtain information from the sub-material provided by the teacher. Take turns each group presents the information they get, and the other groups ask questions. In this way, students become more active, creative, and complementary.

In the attitude scale questionnaire data after being given the GI cooperative learning treatment, the students experienced significant changes because, in this model, students were required to be more active in learning.

In the learning process carried out with the learning model, its application has advantages and disadvantages. The advantages include training students to improve cooperation in groups, training students to be responsible for solving them in groups, and being able to combine students with different abilities through heterogeneous groups. The drawbacks include that the learning process cannot be carried out according to plan because it is constrained by time. The solution is that the researcher continues discussing material not completed at the next meeting to maximize learning.

4. CONCLUSION

Based on research results and data analysis from previous reviews, the Manova test obtained a value of $0.000 < 0.05$ on the Wilk' Lambda test. H_0 was rejected, and on the ANOVA test, obtained a pre-test communication value of $0.242 > 0.05$, post-test communication $0.009 < 0.05$, disposition pre-test $0.382 > 0.05$, and disposition post-test $0.001 > 0.05$, it can be concluded that: There are differences in communication between students who use the group investigation cooperative learning model and the direct learning

model. There is a difference in disposition between students who use the direct learning model and the cooperative learning model, and the cooperative model influences communication skills and mathematical dispositions.

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TABLE 5. Paired Samples Test

		Paired Differences			95% CI		t	df	Sig.
		Means	SD	SD Means	Lower	Upper			
Pair 1	Pre Communication - Communication Post	-23,594	8,041	1.005	-25,602	-21,585	-23,473	63	0.000
Pair 2	Pre-Disposition - Post Disposition	-6,25	3,809	0.476	-7,201	-5,299	-13,127	63	0.000

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