Analysis of Students's Mathematical Communication Ability in Learning Mathematics Using the Jigsaw Cooperative Method

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Abstract
This research aims to determine students' mathematical communication skills in mathematics which was carried out using the Jigsaw cooperative method. The research method uses experimental research. The design in this research leads to a true experimental design with a posttest-only control design. The sampling technique was simple random sampling taken from odd semester student report cards. The research sample consisted of 2 classes, namely class VIIA and VIIB. The research instrument consists of a test sheet consisting of five descriptive questions with material about plane figures and an observation sheet containing two indicators of mathematical communication, written and oral. The data analysis technique uses an independent T-Test, so it can be concluded that (1) the Jigsaw type cooperative learning method has an effect on students' mathematical communication skills. (2) Independent sample T-Test with a significance value of < 0.05 showing a significant difference between class VII A as the experimental class and class VIIB as the control class.
Keywords: Mathematical Communication, Mathematics Learning, Cooperative Jigsaw.

Introduction

Mathematical communication ability is the basic ability of students to convey an idea or idea orally or in writing. Mathematical communication can strengthen and formulate concepts in solving mathematical problems, making students capital in approaching, exploring, and investigating mathematics and providing a forum for communicating with friends to obtain opinions and assess and sharpen ideas in mathematics (Ahmad & Nasution, 2018; Fatkhiyyah et al., 2019). The cause of the lack of communication among students during class is the lack of motivation to learn and a teacher's concern for the importance of communication during learning because communication can train students to be more active (Fatubun et al., 2022; Ribut, 2021; Wijayanto et al., 2018). Communication can be interpreted as conveying information or a message to recipients orally, in writing, or digitally (Ningtyas & Ekawati, 2021; Syafina & Pujiastuti, 2020).

To improve students' mathematical communication, teachers should pay more attention to students being given methods that can later affect students' mathematical communication skills; one that can be used is the Cooperative Jigsaw method. This type of Jigsaw cooperative method is a learning method that groups students in small groups, which contain 4-5 students in one group and are given material to discuss together (Pujingsih & Sri, 2021).

In the Jigsaw type suitable method, students can give opinions on the material that has been given, after that the groups will be rotated, with each group containing students who study different material, then take turns presenting the results of each group to friends other group friends and continues until the last group (Siregar, 2020; Yunus, 2020). Related to several previous studies that have been carried out, one way to improve mathematical communication is the Jigsaw cooperative method (Rasyid, 2020; Rifdah & Priatna, 2020). This method can have a good impact on students because besides being able to understand the material more easily, it can also improve mathematical communication while learning, which gives students more confidence in the future(Rianti Rahmalia et al., 2020; Widodo et al., 2021).

The research conducted by La Wui (2021) showed that the mathematical communication skills applied with Jigsaw-type cooperative learning reached the first cycle of 66.67% and for the second cycle reached 86.67%, with an increase of 20.00%. Meanwhile, in the research conducted by Dadang Apandi et al. (2018), learning mathematics using the Jigsaw cooperative method can activate students to reduce teacher-centred learning and communication skills are applied very well overall and get a positive response.

The present study differs from earlier research in that it used a Jigsaw-type cooperative learning paradigm and function derivative materials, while the previous study used flat shape materials to analyze students' mathematical communication skills. Therefore, the purpose of this study is to determine how well students use the Jigsaw cooperative style of mathematics instruction to communicate mathematical ideas.

Method

This research aims to assess student's mathematical communication skills in mathematics learning using the cooperative jigsaw method. This type of experimental research is a type of research that involves two variables, namely an experimental class that is treated using quantitative methods, and a control class that is not treated, as well as a posttest only control design. The choice of a posttest only control design is appropriate in this study because it involves two separate variables in two sessions.

Table 1. Research design.

Group	Test	Post-Test
Experiment	X_1	O_1
Control		O_2

Source : (Kusumah et al., 2020)

Specification:

X_1 : Research is conducted on the experimental group using the Jigsaw method.

O_1 : Result of the sal communication ability test from the first experiment class

O_2 : Result of the matematical communication ability test from the control class

Data and Data Collection

The data to be collected in this study is data on students' mathematical communication abilities in learning mathematics and learning mathematics using the Cooperative Jigsaw method, which can be seen from the results of observations and students' post-test scores. The results of odd semester report cards are initial data to see homogeneous student classes. Before carrying out a homogeneity test, a normality test is needed first. The normality test is a test carried out to see whether the two classes have a normal distribution in the results of the data that has been collected. Before carrying out a homogeneity test, a normality test is needed first. The normality test is a test carried out to see whether the two classes have a normal distribution in the results of the data that has been collected(Amelia et al., 2019). Data was collected in the experimental and control classes, where two classes were taken: class VII A as the experimental class and class VII B as the control class.

In this research, the data collection method used is as follows: a) student data was collected using observation techniques; Students were observed to determine students' mathematical communication skills when using the Jigsaw cooperative method in mathematics class. b) The technique known which is a posttest method consisting of multiple-choice questions used to assess students' mathematical communication skills in mathematics class using the cooperative Jigsaw method. Based on the explanations provided above regarding research methodology and data collection techniques, the homogeneous approach is a suitable method for doing this kind of research. The goal of homogeneous uji is to ensure that both of the classes that will be used for research are homogeneous(Aminah et al., 2018; Usmadi, 2020). This is very important since both classes need to be equal or homogeneous. If the population is homogeneous, this research sample can be used. The first semester report on mathematics instruction in experimental

and control classes using Bangun Datar materials will be used to ensure the homogeneity of this research sample. Through a close examination of student observations, this study can determine the average student communication threshold. In this study, the following data analysis methods will be used: Data Analysis of Observation Sheet Results: Student and teacher data will be examined to see whether or not the Jigsaw cooperative approach improves students' mathematical communication abilities. The goal of the analysis is to determine how well the method teaches mathematics. assessed from oral and written aspects, which will later be seen in student observations.

$$persentase(\%) = \frac{number\ of\ point}{quantity\ of\ the\ sample} \times 100\%$$

The observation sheet contains scores from the assessment which need to be accompanied by questions that will be filled in by the observer. The following are guidelines for applying a descriptive scale to this assessment: This scale establishes whether and to what extent Jigsaw cooperative learning techniques are appropriate for mathematical communication.

Table 2. Descriptive Scale.

Assessment Score	Category
5	Very Good
4	Good
3	Enough
2	Not Good
1	Not Good

Analysis of Student Test Data: The purpose of analyzing student test results in this research is to compare how well students who receive mathematics learning using the cooperative Jigsaw method or called the experimental class with students who do not receive treatment or the so-called control class, learn mathematics concepts in writing to deepen their understanding topics discussed further. The following is an example of how to assess exam results for students.

Table 3. Test Scoring Guidelines.

Information	Skor
Students do not answers at all in the answer sheet	0
Students write answers without knowing (wrong)	5
Students write answers without knowing (correct)	15
Students just write known (wrong)	15
Students only write known (correct)	20
Student answered completely (wrong)	20
Students answer completely (correctly)	25

Research Instruments

Data on students' mathematical communication skills in mathematics learning will be collected for this research based on observation findings and post-test results. Observations in this study used observation sheets to assess students' mathematical communication when learning mathematics using the Jigsaw cooperative method. This observation sheet was adapted from (Aprilianti & Astuti, 2020).

The aspects that will be used in this observation sheet are oral and written, oral contains indicators, namely 1) being able to discuss, 2) being able to give suggestions or opinions, 3) being able to convey results, while the written aspect contains indicators, namely being able to answer test results, and being able to summarize discussion results.

The research instrument used to determine students' mathematical communication skills was the results of student test sheets. This test will be carried out at the end of the session (posttest) which aims to determine students' mathematical communication skills when learning using the Jigsaw cooperative method and to see students' understanding of the flat shape material. This test is structured in the form of essay questions with a total of 5 questions. The test questions that will be given to students contain indicators of students' mathematical communication, namely 1) students can understand the meaning of lines, line segments, rays, angles, perpendiculars, parallels, and include methods. 2) students understand the meaning and how to express arcs, chords, curves, central angles, straight lines, perpendiculars and central points. This test instrument was adopted from junior high school mathematics books (Ii et al., 1995).

Results and Discussion

Result

Description of Data Analysis Results on Report card Values, Observations, and Post-test

Table 4. Descriptive Statistics of Report Value Results

	Class VII A	**Class VII B**
Valid	20	20
missing	0	0
Means	68,550	68,450
std. Deviation	7,937	5,978
Shapiro-Wilk	0879	0.874
P-value of Shapiro-Wilk	0.017	0.014
Minimum	58,000	58,000
Maximum	86,000	75,000

Based on Table 4, the average obtained from 20 students is 67,550 in class VII A, while the average in class VII B is obtained from 20 students. The maximum score for class VII A is 86,000, the maximum score for class VIIB is 75,000, and the minimum score for each class is 58,000, in the descriptive results on the report card values in Table 4. It can be seen that the results of Shapiro-Wilk class VII A and VII B > 0.05, it can be concluded that class VII A and VII B report card values are normal. Because the report card scores in odd semesters are normal, they can be tested for homogeneity to see whether the tested classes are balanced (homogeneous).

Table 5. Test the homogeneity of report card results.

F	**df1**	**df2**	**P.S**
1,328	1,000	38,000	0.256

Based on the results of table 5, which carried out a homogeneity test based on report cards, it was obtained that P > 0.05 means that classes VII A and VII B are homogeneous. The conclusion is that because the report cards for class VII A and class VII B are homogeneous, we can continue to look at the test scores and observation results.

Table 6. Descriptive Statistics of Observation Results.

	Oral 1	**Oral 2**	**Oral 3**	**Oral 4**	**Oral 5**	**Oral 6**	**Writing**
Valid	20	20	20	20	20	20	20
missing	0	0	0	0	0	0	0
Means	3,550	3,700	2,100	3,450	3,100	3,050	3,500

	Oral 1	**Oral 2**	**Oral 3**	**Oral 4**	**Oral 5**	**Oral 6**	**Writing**
std. Deviation	0.605	0.733	0912	0.945	0912	0.686	0.607
Minimum	3,000	3,000	1,000	1,000	1,000	1,000	3,000
Maximum	5,000	5,000	4,000	5,000	5,000	4,000	5,000

Based on Table 6,above shows that for the Oral indicator, the maximum value is 5,000 in speeches 1,2,4 and 5, while for speeches 3 and 6, it has a maximum value of 4,000. In the writing indicator, the maximum value is 5,000. Based on the data in Table 4 above, the total number of students is 20, so the average for each indicator is, verbal indicator 1 is 3,550, verbal indicator 2 is 3,700, verbal indicator 3 is 2,100, verbal indicator 4 is 3,450, oral indicator 5 is 3,100, the spoken indicator 6 is 3,050, and the written indicator is 3,500.

Table 7. Descriptive Statistics of Post-Test Value Results

	Class VII A	**Class VII B**
Valid	20	20
missing	0	0
Median	85.000	75.000
Mean	84.250	74.000
std. Deviation	7.482	5.982
Minimum	70.000	60,000
Maximum	95.000	85,000

Based on the data presented in Table 7 above, it can be seen that in class VII A the number of students is 20 each with an average of 84,250 and has a median score of 85,000, while in class VII B the number of students is 20 each with an average of 74,000. has a median value of 75,000. Apart from that, it can be seen that the minimum score for class VII A is 70,000 and class VII B is 60,000, the maximum score for class VII A is 95,000 while class VII B is 85,000. These results can provide the conclusion that the average experimental class students who receive mathematics learning using the Jigsaw cooperative method have written mathematical communication ability scores were higher compared to the control class.

Results of the T-Test Test Analysis on the Communication Ability Test

The T-test is a statistical technique used to determine whether there are significant differences between two groups or populations. The T test assumes that the data being

tested has the same variance and is normally or almost normally distributed. The results of the normality test for students' mathematical communication skills were obtained from the results of the post-test carried out by two classes with homogeneous classes.

Table 8. Test of Normality (Shapiro-Wilk).

		W	p.s
Mathematical Communication	Class VII A	0.917	0.086
	Class VII B	0.933	0.175

Note. Significant results suggest a deviation from normality.

The results of the normality test with Shapiro Wilk are shown in Table 6, the value of the normality test on the results of the students' mathematical communication ability test for class VII A is 0.917, and for class VII B is 0.933, because the normality test requirement is $P > 0.05$, the conclusion is that the normality test results in the test of students' mathematical communication skills is normal and meets the requirements to analyze test results using the Independent Samples T-Test method.

Table 9. Independent Samples T-Test.

	Q	df	p.s
Mathematical Communication	4.785	38	< .001

*Note.*Student's t-test.

Based on the information in Table 8. It is known that the results of the post-test sheet normality test are P > 0.05, so the data is normally distributed, so in Table 9 an Independent sample T-Test was carried out with the results of the significance value being <0.05 indicating a significant difference between class VII A as the experimental class and class VIIB as the control class.

Discussion

based on this research that the class A learning model, which is carried out using the Jigsaw cooperative method, shows that it has a greater average than class B, which does not get treated using the Jigsaw cooperative method (Nurlailatul Qiram et al., 2022).

The mathematical communication skills carried out using the Jigsaw cooperative method with the help of PowerPoint presentation media get an average of 75.08. In contrast, the mathematical communication taught using the conventional model only got an average of 70.00; it can be concluded that students' mathematical communication abilities with using a higher Jigsaw-type suitable method, this is in line with research Loka Son & Nur

Ahzan (2017). This is because the Jigsaw model is always used in the teaching process. students must master specific concepts and be able to articulate them to other group members. Jigsaw is a tool that allows students from many groups to come together and discuss a common issue until they are all subject matter experts on it. then go back to the original group and instruct their buddies in the subjects they have mastered.

Conclusion and Suggestion

Descriptive analysis shows that students' mathematical communication scores in learning that uses the Jigsaw cooperative method are higher compared to classes that do not use the Jigsaw cooperative method, this can be seen in the average results. The Jigsaw type cooperative learning method influences students' mathematical communication skills. An independent T-test was carried out with a significance value of <0.05 showing that there was a significant difference between class VII A as the experimental class and class VII B as the control class.

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