The Influence of the Inside Outside Circle Cooperative Learning Model on Students' Mathematical Communication Ability

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Abstract

Students' mathematical communication is stated to be low because students learn by listening and seeing the teacher solve mathematical problems and students have difficulty in expressing everyday events in mathematical models. This study aims to determine whether there is an influence of the Inside Outside Circle (IOC) type of cooperative learning model on students' mathematical communication skills better than using scientific learning. This study uses a quantitative approach with the type of research Quasi-Experimental Design and the design of this research The Nonequivalent Postets-Only Control Group Design. The population in this study were all students of class VIII SMP Negeri 1 Nisam, while the samples were class VIIIB as the experimental class and class VIII-A as the control class with the sampling technique of purposive sampling. The data collection technique in this study used a mathematical communication ability test. The data analysis was carried out for the mathematical communication ability test using the t-test because the data were normally distributed and homogeneous, the data were processed using SPSS 18 software and the hypothesis test results were obtained with a significant value of 0.000 less than 0.05, which means reject H0 and accept Ha. The results showed that there was an effect of the Inside-Outside Circle (IOC) type of cooperative learning model on students' mathematical communication skills.

Keywords: inside-outside circle; (IOC); mathematical communication skills; cooperative learning model;

1. Introduction

The National Council of Teachers of Mathematics (NCTM, 2000:67) states that there are five abilities that students must have in learning of mathematics, namely the ability to solve of mathematical problems, mathematical reasoning, mathematical communication, mathematical connections, and mathematical representations. Mathematical communication is a way for students to express mathematical ideas either orally, in writing, pictures, diagrams, using objects, presenting in algebraic form, or using mathematical symbols (NCTM, 2000:60). The Ministry of National Education (2004:24) states that mathematical communication is the ability/skill of students to express and interpret ideas orally, in writing, or demonstrate what is in a mathematical problem. This is in line with Sumarmo (2012), mathematical communication skills including the ability to: (a) Describe pictures, diagrams, or real objects in the language of symbols, or mathematical models; (b) Explain mathematical ideas, ideas, situations, and relations orally or in writing; (c) Listening, discussing, and writing about mathematics; (d) Reading with comprehension of a written mathematical representation; (e) Restate the description or paragraph of mathematics in their language.

Several studies that have been conducted, for example, the studies of Maulidawati *et al*, (2020), Yarmasi *et al*, (2020), Irfanto *et al*, (2019), and Paroqi *et al*, (2020), found research results that some abilities increased by using cooperative learning models, such as mathematical connection skills, communication skills. Mathematical literacy skills increase according to the 2013 curriculum standards (Fitriyanto, 2020). Other studies as well, such as Faradhillah *et al*, (2020), Assiddiq (2019), Kusuma & Hamidah (2021) found that good learning will have a good impact on student achievement. Irfansyah *et al* (2020) learning outcomes can also be better by using learning media, especially in learning that uses multimedia to students. Moreover, in the study of Abda *et al*, (2020) it was also stated that students' mathematical communication skills improved by using Somatic, Auditory, Visual, and Intellectual (SAVI) Approaches. Therefore, teachers need to understand seriously that the ability of students is very dependent on what learning model will be used in

the classroom.

Based on some of the studies above, the researcher concludes that mathematical communication is the ability of students to express ideas in mathematical problems to communicate the results of their thoughts to others orally, in writing, pictures, diagrams, using objects, or using mathematical symbols. In addition, it is also important for every student to have mathematical communication with basic reasons, namely: (1) communication skills become a central strength for students in formulating concepts and strategies; (2) mathematical communication skills as a moral success for students towards approaches and solutions in mathematical exploration and investigation; and (3) mathematical communication skills as a forum for students to communicate with their friends to obtain information (Susanto, 2014: 214).

Mathematics communication skills are still low among students, this is evident from the results obtained by Indonesian students in the 2007 TIMSS event, it appears that Indonesian students are still weak in terms of mathematical communication, as happened with students' answers to one of the questions about reading data in the diagram. circle and present it in the form of a bar chart. Only 14% of Indonesian participating students were able to answer correctly, while at the international level there were 27% of students who answered correctly. The results of Osterholm's research (2006: 292) also stated that students seemed to have difficulty in articulating reasons in understanding a reading when asked to provide logical reasons for their understanding, students sometimes only focused on a small part of the text and stated that this section (a problem containing symbols) -symbol) did not understand, but did not give a reason for his statement. This is in line with Maryani (2011: 24) in her research showing that most students cannot write problem solutions systematically and have not been able to use the right mathematical language. In addition, according to the research results of Zulkarnain (2013), he stated that students have not been able to communicate ideas well, there are students' answers that are wrong to the questions given and the calculation steps taken by students are not well organized and inconsistent. So from some of the relevant research statements, the researcher concluded that the low mathematical communication of students occurs because there are still many students who are lacking in understanding reading and most students cannot write problem solutions systematically and have not been able to use the right mathematical language.

This is also in line with the results of interviews and observations by researchers with a class VIII mathematics teachers at SMP Negeri 1 Nisam (Junior high school), namely Mrs. Safriyati S.Pd. It shows that there are still many students who think that mathematics is a difficult subject. Students are also less able to express mathematical ideas and when students are grouped to discuss to do the assignments given by the teacher, only students with smart abilities work, and members who lack only accept it. This is because communication skills between members are still not running, so students still do not understand mathematical concepts, besides that teachers at school are still explaining the lecture method. For more details, based on the questions given by researchers at SMP Negeri 1 Nisam (Junior high school), the level of mathematical communication skills at that school is still low. The following is a matter of mathematical communication skills:

Question:
Sir Yono bought 2 gears for his motorbike for IDR. 150,000.00 for each, IDR. 40,000.00 for the rear gear and IDR. 110,000.00 for the engine. The rear wheel and engine gears of a motorcycle are circular in shape connected by a chain. If the length of the engine rear gear diameter is 12 cm, and the length of the front wheel gear diameter is 18 cm. The distance between the center of the engine gear and the rear wheel gear is 59 cm. Then specify:
a) Describe the problem above;
b) Make a mathematical model to determine the length of a motorcycle chain;
c) Solve the mathematical model of the problem above.

Description about answer:
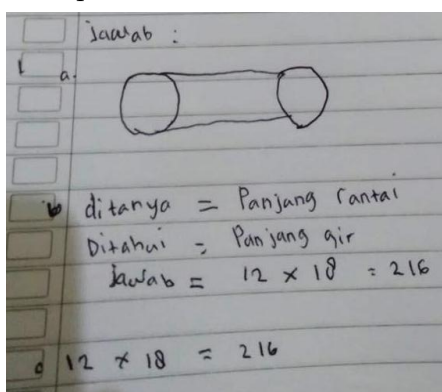
Making pictures but not complete and correct.

The answers does not use terms, notations to model mathematical problems.

Use of mathematical models and perform calculations. But the answer is incomplete.

Figure 1. Answering of the students

Figure 1 shows that students' mathematical communication skills are less than optimal because students' answers are incomplete and correct, students are also less able to use terms, notations, mathematical images to model mathematical problems and perform calculations, but the answers are still incomplete. Proven based on mathematical communication indicators, namely: (1) Ability to express mathematical ideas; (2) the ability to use mathematical terms, notations, and pictures to model mathematical problems; (3) The ability to model the problem correctly, then perform calculations completely and correctly. For further details, Ansari (2012) revealed that the results of the study showed a decline in students' mathematical understanding in class, among others because: (1) in teaching the teacher gave an example to students how to solve problems; (2) students learn by listening and watching the teacher do and solve mathematical problems; (3) when teaching mathematics, the teacher immediately explains the topic to be studied, followed by giving examples and questions for practice.

The learning conditions mentioned above also result in not developing students' mathematical communication skills. The weakness of students' mathematical communication skills can also be seen from Melly's research (2018) on mathematical communication skills that have not met expectations, where students' mathematical communication to learn mathematics is still lacking. This is in line with research conducted by PISA (Program for International Student Assessment) in 2018 which showed that the average score of Indonesian students' mathematics achievement was 379. Indonesia was ranked 72nd out of 78 participating countries. With a score of Indonesian students which is only 379, it shows that Indonesian students are at mathematical ability below level 1, which is one level from the bottom, which means that students are only able to solve problems for very simple math problems and are less able to communicate mathematical problems. However, in contrast to the results of research from Nufus (2017), it shows that students tend to have difficulty in writing the right notation and symbols and have difficulty understanding the story about the problems given. So from some relevant research statements, the researcher concludes that students' mathematical communication is low because students learn by listening and seeing teachers solve mathematical problems and students have difficulty in expressing everyday events in mathematical models. Therefore, to overcome this problem, it is necessary to develop a learning model related to students' mathematical communication skills, one of which is the cooperative learning model.

The cooperative learning is a learning model that is currently widely used to realize student-centered learning activities, especially to overcome teacher problems in activating students who do not cooperate with others (Isjoni, 2007:16). According to Slavin (2010: 4), Cooperative learning is learning that refers to various teaching methods where students work in small groups to help each other in learning materials. This is in line with Nurulhayati (2002:25) cooperative learning is a learning strategy that involves the participation of students in a small group to interact with each other. In a cooperative learning system, students learn to work together with other members. Because in this model students have two responsibilities, namely students learn for themselves and help fellow group members to learn and students learn together in small groups and students can also do it alone. So the cooperative learning model in addition to helping students understand concepts that are difficult to learn is also useful in helping students grow collaboration skills in their groups and train students in understanding the subject matter presented. This is evident from the results of research McMaster and Fuchs (2002) stated that "research conducted in 1990-2000 showed that cooperative learning is very influential on the academic achievement of students who have learning difficulties".

There are several types in the cooperative learning model. One of them is the type of model that can provide students' mathematical communication skills, namely the Inside-Outside Circle (IOC) type of cooperative learning model. The Inside-Outside Circle (IOC) type of cooperative learning model requires students to work in groups to strengthen the relationship between individuals. In addition, this learning model requires good communication skills and group processes. In this case, the Inside-Outside Circle type of cooperative learning model is very appropriate for learning. The Inside-Outside Circle learning model is a learning model with a small circle system and a large circle system that begins with the formation of a large group in the class consisting of an inner circle group and an outer circle group (Rusman, 2013:21). Likewise, the Inside-Outside Circle type of cooperative learning model according to Shoimin (2014: 87) is a small circle and large circle learning model that begins with the formation of large groups in the classroom consisting of inner circle groups and outer circle groups. In contrast to Lie (2008:65) "The Small Circle-Big Circle teaching technique (Inside Outside Circle) was developed by Spencer Kagan to provide opportunities for students to share information at the same time because mathematics is deductive, logical, the group in sharing information and can improve communication skills. This is also in line with Suyatno (2009: 69) which states that the IOC learning model is a learning model with a small and large circle system where students share information at the same time with different pairs shortly and regularly.

Based on some of the definition above, the Inside-Outside Circle learning model is a learning concept consisting of groups of inner and outer circles who share information from the content of the material that

has been conveyed, all students will provide each other and receive learning information simultaneously, which aims to make students simultaneously independent can practice to convey information to others and can develop knowledge and skills in solving a problem. According to Huda (2011: 144), the advantages of this model are "there is a clear structure and allows students to share with clearly different pairs shortly and regularly". In addition, this model allows students to practice students' communication skills. Students will understand better when communicating with other friends. This is because when students communicate with other students, the language used is easier to capture and understand, this is evidenced by Wati's research, (2014:4) that students' mathematics learning outcomes who apply the Inside-Outside Circle type of cooperative learning model is better than learning outcomes mathematics students who apply ordinary learning in class VIII SMP Negeri 9 Pariaman. And also the results of Arfiananti's research (2010) show that the implementation of the Inside Outside Circle Method can help achieve complete learning for students of class VIII E SMP Negeri Muntilan.

Based on the description above, researchers are interested in applying the Inside-Outside Circle (IOC) Cooperative learning model to determine students' mathematical communication skills. Therefore, the researcher took the title "The Influence of the Inside Outside Circle Cooperative Learning Model on Students' Mathematical Communication Abilities in Class VIII SMP Negeri 1 Nisam".

2. Methods

The approach used in this study is quantitative. The quantitative approach is a study whose calculations use a lot of numbers starting from data collection, interpretation of the data, and the appearance of the results (Arikunto, 2014:27). While the type of research used in this study is a quasi-experimental design. According to Sugiyono (2017: 77), Quasi-Experimental Design is a design that has a control class but does not fully function to control the variables that affect the experiment. This study is a quasi-experimental design research that uses two groups, namely the experimental group and the control group. The experimental class uses the Inside-Outside Circle type of cooperative learning model, while the control class is given behavior with scientific learning. In this study the class was not chosen randomly, so the design of this study was The Nonequivalent Postets-Only Control Group Design (Lestari and Yudhanegara, 2015:136) as the Table 1.

Table 1. Research Design

X	O_1
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	O_2

Source: Lestari and Yudhanegara (2015:136).

Information:
X = Cooperative learning model type Inside-Outside Circle
O_1 = Post-test Experiment class
O_2 = Post-test control class

This study was conducted in class VIII SMP Negeri 1 Nisam (junior high school) is one of the junior high schools located on Jalan Pendidikan No. 29 Keude Amplah, Nisam District, North Aceh Regency. The implementation time of this study is in the Even Semester, namely April-May 2020/2021. The population in this study were all students of class VIII SMP Negeri 1 Nisam and the samples taken were class VIII-B as the experimental class and class VIII-A as the control class. The study sample was taken using a purposive sampling technique, namely taking the same sample as the object of research. This study is a type of test instrument, namely the post-test of students' mathematical communication skills in the form of description questions consisting of 7 questions but only 5 questions that are used that have validity, reliability, discriminatory power and level of difficulty.

As for obtaining accurate data, the test used is. Tests that meet good criteria are tests of validity, reliability, discriminatory power, and those that have a minimum moderate difficulty index. Data collection is the method that will be used by researchers to collect data. The data collected by the researcher is the test result data. The test used is a final test (post-test), before being used the test is first tested using validity, reliability, discriminatory power, and difficulty index tests. The following is a summary of the results of the validity, reliability, discriminatory power, and difficulty index of students' mathematical communication skills tests presented in the following table 3.

Table 2. Guidelines for Scoring Mathematical Communication Skills

Indicators of Mathematical Communication Ability	Student Responses to Questions	Score
Ability to express mathematical ideas	No answer	0
	There is an answer, but it's wrong	1
	Can express some mathematical ideas	2
	Can state all mathematical ideas, but only partially correct.	3
	Can state all mathematical ideas correctly and precisely.	4
Ability to use mathematical terms, notations and pictures to model	No answer	0
	There is an answer, but it's wrong	1
	Can use some mathematical terms, notations and pictures to model mathematical problems	2
	Can use mathematical terms, notations and pictures and can only partially model mathematical problems	3
	Can use mathematical terms, notations and pictures to model mathematical problems	4
Ability to model problems correctly, then perform calculations completely and correctly.	No answer	0
	There is an answer, but it's wrong	1
	Unable to model the problem correctly, perform calculations completely but incorrectly	2
	Can model the problem correctly, then cannot perform calculations completely and correctly	3
	Can model the problem correctly, then perform calculations completely and correctly	4

Source: Modification of Muin Ulfah (2010:39)

Table 3. Summary of Students' Mathematical Communication Ability Test Results

Question No.	Validity	Reliability	Distinguishing power	Difficulty Index	Description
1	Valid		Enough	Midle	Used
2	Not valid		Not enough	Easy	Not Used
3	Not valid	Enough	Not enough	Midle	Not Used
4	Valid		Good	Midle	Used
5	Valid		Enough	Midle	Used
6	Valid		Enough	Difficulty	Used
7	Valid		Good	Midle	Used

Based on the results of the analysis of validity, reliability, discriminatory power and difficulty index of the students' mathematical communication ability tests that have been tested, they are feasible to be used as test instruments. Then the questions that will be taken are 5 questions that are used as post-tests, namely questions number 1, 4, 5, 6, and 7. Data analysis is a process of processing and interpreting data with the aim of placing various information according to its function so that it has a clear meaning and meaning in accordance with the study objectives. The data processing stage is the most important stage in a research, because at this stage the researcher can formulate the results of his study, the formula used is the t-test formula and also uses the SPSS 18 software program. The data analysis technique for this study used the Normality Test, Homogeneity, and T-Test using SPSS software.

3. Results and Discussions

3.1 Results

Normality Test

This study is quantitative in which the data is obtained in the form of numbers which are then analyzed using SPSS 18 software. The data from this study are analyzed to determine whether there is an effect of the Inside Outside-Circle (IOC) Cooperative learning model on students' mathematical communication skills. Study has conducted at SMP Negeri 1 Nisam (Junior High School) on April 19 – May 01, 2021, even semester of the 2020/2021 Academic Year. This study involves two classes, namely class VIII-B is an experimental class in which the class is given treatment using the Inside Outside-Circle (IOC) Cooperative learning model

with a total of 20 students, while class VIII-A is a control class, namely the class that is not given treatment with 20 students as well. The results of the data that have been collected and obtained by the researchers are test data for students' mathematical communication skills and obtained from the test instrument, namely the post-test. The post-test data of the two classes, namely the experimental class and the control class, will be tested for normality, homogeneity and hypothesis testing (t-test) using SPSS 18 Software. The normality test of this study used the Shapiro-Wilk technique because the sample in this study was less than 30. The following are the results of the normality test calculation using SPSS 18 Software.

Table 4. Normality Test Results

Groups	Shapiro-Wilk		
	Statistic	Df	Sig.
Experiment	0,919	20	0,096
Control	0,921	20	0,102

Based on the results of the normality test from the table above, the significant value of the experimental class is 0.096 while the control class is 0.102. Following the criteria for the normality test hypothesis, accept H0 if it is significant > 0.05 so it can be concluded that the post-test value of students' mathematical communication skills is normally distributed. The following is a graph of the normality of the experimental class and the control class.
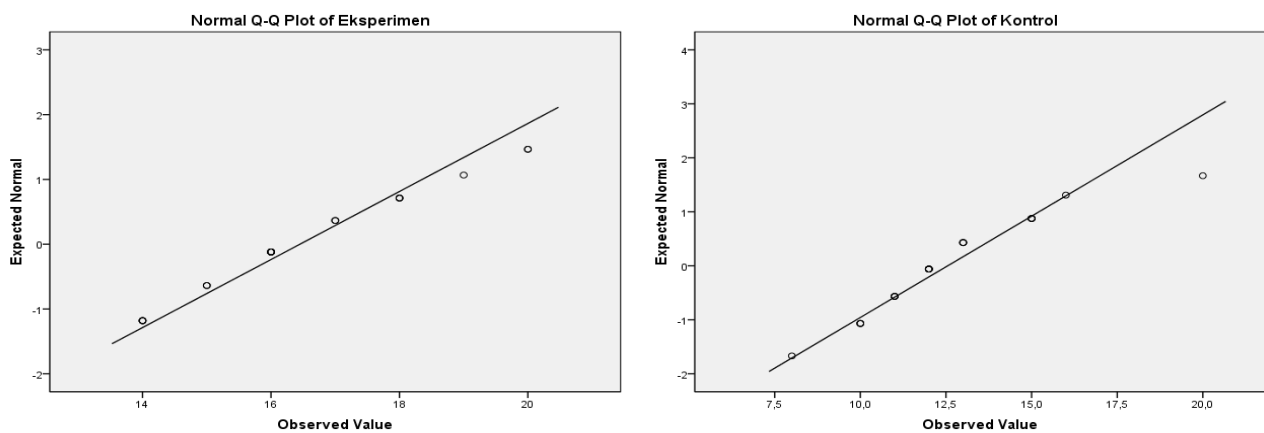

Figure 2. Graph of Normality Test Data Results of Mathematical Communication Ability

Based on the graph above, it can be concluded that the data is normally distributed because the points on the graph are very close to the line or attached to the line, these points are data that has been tested for normality.

Homogeneity Test

The homogeneity test aims to determine whether the data from the post-test results of the experimental class and the control class are homogeneously or not homogeneously distributed. Homogeneous data if sig. 0.05. Testing this research using SPSS 18 software and the following are the results of the homogeneity test as table 5.

Table 5. Homogeneity Test Results

Levene Statistic	df1	df2	Sig
0,842	1	38	0,365

Based on the table above, it can be seen that the significant value of the homogeneity test is 0.365. In accordance with the criteria for the homogeneity test hypothesis, accept H0 if the significant value is 0.05, then the data from the students' mathematical communication ability test results are homogeneous. Hypothesis testing was carried out after conducting the normality test and homogeneity test. Hypothesis testing is carried out to determine the truth of the statements that have been made to be accepted or rejected. The following is a hypothesis test table for students' mathematical communication skills as table 6.

Table 6. Hypothesis Test Results

Statistic	T	Df	Sig.
Equal variances assumed	5,324	38	0,000

Based on the table above, it can be seen that the statistically significant value obtained is 0.000, so the value of sig. < 0.05, and according to the criteria for hypothesis testing if the value of sig. < 0.05, then H0 is rejected and Ha is accepted, it can be interpreted that there is an influence of the Inside Outside Circle (IOC) Cooperative learning model on the mathematical communication skills of students in class VIII SMP Negeri 1 Nisam.

This study aims to determine whether there is an effect of the Inside Outside Circle (IOC) Cooperative learning model on students' mathematical communication skills better than scientific learning. Based on the results of the study, it shows that there is an influence of the Inside Outside Circle (IOC) type of cooperative learning model in the experimental class with a hypothetical value of 0.000 because in this learning model the teacher distributes groups to students in which there is an outer circle group and an inner circle group to each other. share information simultaneously, so that students can generate ideas from communicating or connecting thoughts with one another. So it can be concluded that there is an effect of the Inside Outside Circle (IOC) type of cooperative learning model on students' mathematical communication skills. This is supported by the results of wati's research (2014: 4) where the results of her research reveal that the mathematics learning outcomes of students who apply the Inside Outside Circle (IOC) type cooperative learning model are better than the mathematics learning outcomes of students who apply ordinary learning in class VIII SMP Negeri 9 Pariaman.

3.2 Discussion

Discussion of Students Answer

The following are student answers based on indicators of mathematical communication skills:
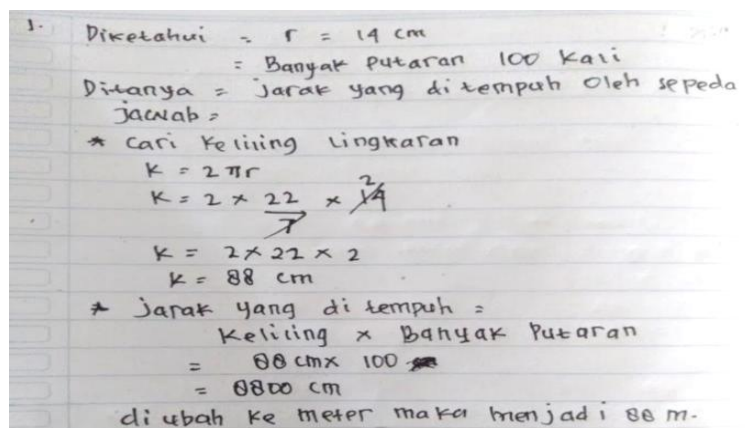

Figure 3. Experimental class post-test answers

Based on the results of the post-test answers above, in which the students stated what they knew and what was asked, after that the students answered the questions. Where in the problem it is known how many radii and how many rounds, and the question is how much distance the bicycle has traveled. First students have to find the circumference of the circle after that the students find the distance traveled. Therefore, based on the results of students' answers, they have shown indicators of students' mathematical communication skills, namely students can express mathematical ideas correctly and precisely.
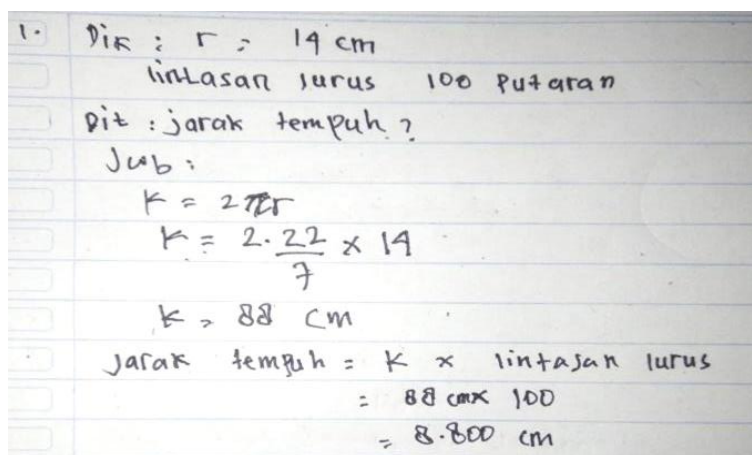

Figure 4. Control class post-test answers

Based on the results of the post-test answers above, it can be seen that students already know what is known and are asked about the question. From the questions above, students can show indicators of mathematical communication skills, namely that students can express mathematical ideas but only partially correct them. So it can be concluded that the experimental class using the Inside-Outside Circle (IOC) type of cooperative learning model is better than the control class with scientific learning.

4. Conclusion

Based on the results of study and discussion on the effect of the Inside Outside-Circle (IOC) type of cooperative learning model on the mathematical communication skills of students in class VIII of SMP Negeri 1 Nisam, it can be concluded that there is an influence of the Inside Outside-Circle (IOC) type of cooperative learning model on mathematical communication skills. students in class VIII SMP Negeri 1 Nisam.

Acknowledgement

The authors would like to thanks to the people who have been instrumental in their assistance and the successful completion of this study.

Author's Contribution

All authors discussed the result and contributed to from the start to final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

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