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Analysis of the Flipped Classroom Model Using Digital Media in Improving Students' Mathematical Communication Skills

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Abstract

The flipped classroom model is a learning model in which activities usually carried out in class are changed to be carried out at home, such as material explanations by the teacher, and activities carried out at home are changed to be carried out at school, such as doing assignments. The research aims to describe the flipped classroom model using digital media to improve mathematical communication skills. This research is a qualitative descriptive study. The research subjects used were six junior high school students in Batu City. In the pretest and posttest, data collection techniques to determine students' mathematical communication abilities while observation to determine teacher activities in learning uses the flipped classroom model using digital media. The instruments used are test sheets and observation sheets. Data analysis techniques consist of data reduction, data presentation, and conclusion. The results showed that after using the flipped classroom model using digital media, there was an increase in mathematical communication skills. After learning according to the lesson plan, the results of observations were in the very good category. There was an increase of 53% in the indicator of the ability to write mathematical situations correctly and precisely. The indicator of the ability to write ideas or solve problems correctly and accurately increased by 33%, while the ability to write conclusions from problems using their language increased by 39%.

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INTRODUCTION

During the Covid-19 pandemic, learning was carried out online, where teachers in teaching used more digital media such as learning videos. According to Mansyur, (2020) the impact of the covid-19 outbreak in Indonesia on learning dynamics, one of which is learning is transferred to home through online learning and changes to technology-based learning media such as Whatsapp Group, Youtube, Zoom, Google Classroom, and others. With learning videos, students are expected to be able to understand the explanations conveyed by the teacher and feel energized and active in following the lesson. The support of digital media, such as learning videos in learning is also due to the different learning styles of students. In agreement with Mahadewi et all (2020) students who have difficulty understanding material by reading learning will be helped if they use interactive learning video media. When students can understand learning material, they can communicate it.

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Digital media can be media whose contents are stored in a digital format where accessing them requires digital devices and internet network assistance.

According to Azmi, (2021) when online learning is carried out, learning loss occurs, namely a decrease in students' abilities due to the co-19 pandemic. So it is feared that students will experience learning difficulties after the pandemic period is over. From these conditions, using the flipped classroom is expected to improve the learning abilities of students who can study at home first by using learning videos. The flipped classroom model is a learning model in which activities usually carried out in class are changed to be carried out at home, such as material explanations by the teacher, and activities carried out at home are changed to be carried out at school, such as doing assignments. By studying at home, students can have much time to study. In addition, according to Adawiah et al., (2021) research the flipped classroom model can improve students' mathematical communication skills. Learning by discussion can also help improve students' mathematical communication skills. Students can discuss this with friends and teachers. This agrees with Ariani (2017) who says that in improving mathematical communication, students can design learning to increase the interaction of educators with students and between fellow students.

According to t Handayani dkk., (2018) students often need help learning mathematical material to express and capture mathematical ideas. This is related to the mathematical communication skills possessed by students. Mathematical communication ability is the ability to receive mathematical ideas from other people and convey mathematical ideas to others, either in writing or orally, so that other people can understand the intent of the ideas conveyed. According to Saptika dkk., (2018) students must have steps to solve a problem. A way for students to be able to solve problems is in the form of mathematical communication. Having mathematical communication skills is very important for students. Then Afifah et al., (2018) by having mathematical communication skills, students can convey their mathematical ideas to others to improve their mathematical understanding. Therefore, mathematical communication skills are abilities that students must have.

Nevertheless, the fact is that several studies say that junior high school mathematical communication skills are low. Likewise, the schools where the research was conducted needed to improve their mathematical communication skills. Therefore, researchers are interested in researching the flipped classroom model using digital media to improve students' mathematical communication skills. In the research carried out, the application used was PowerPoint in making learning videos.

This research focuses on written mathematical communication skills because the research of Muzaki & Yulianti (2021) says that the problem with mathematical communication ability is that students have more difficulty solving everyday problems in the form of story questions into mathematical symbols, besides that students are not used to write down what is meant by the problem before solving it as known and answered. Therefore students often need to understand what the problem means. In previous studies, only a few studies in junior high schools examined flipped classrooms with learning videos that could improve mathematical communication skills. Amirudin dkk., (2021) researched improving high school students' disposition, and mathematical communication

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using Edmodo-assisted flipped classrooms. Ruswana (2019) examined the application of the peer instruction flipped classroom learning model to improve the mathematical solving abilities of SMK students. Nurrohma & Purnomo, (2020) researched improving mathematical communication skills using learning videos. Therefore, there is a need for research that describes learning the flipped classroom model with digital media (video) to improve the mathematical communication skills of junior high school students.

RESEARCH METHOD

This qualitative descriptive research aims to describe the flipped classroom model that uses digital media to improve students' mathematical communication skills. This research was conducted at the junior high school level in Batu City. The sample used in this study was six students with four days of research time. The research procedures carried out were research preparation, research implementation, and research reporting.

The technique of collecting data on the pretest and posttest used a written test, and to see the implementation of the flipped classroom model was done by observation. The research instruments used in this study were observation sheets and written test sheets. In analyzing the data obtained using data analysis techniques, according to Miles & Huberman (Sugiono, 2014) there are three stages of analysis, namely 1) Data reduction, namely by correcting students' written test results to determine students' mathematical communication abilities, 2) Data Presentation and 3) Drawing conclusions or verification stages. Knowing students' mathematical communication abilities can be seen from the achievement of mathematical communication abilities indicators used are adaptations of the instruments used in Rachmawati et all (2021).

The data obtained is given a score for each pretest & posttest question, and the average value of mathematical communication ability is found with the following formula.

$$Result = \frac{the\ total\ score\ obtained}{36} \times 100\%$$

While the data obtained is divided by the score for each practice question, and then the average value of mathematical communication ability is found with the following formula:

$$Result = \frac{the\ total\ score\ obtained}{45} \times 100\%$$

The score results obtained are grouped into 3 categories as follows:

Table 1. Grouping of Mathematical Communication Ability Categories

Mathematical Communication Ability Results	Categories
67% < Result ≤ 100%	High
33% < Result ≤ 67%	Medium
0% ≤ Result ≤ 33%	Low

(Aritonang, 2020)

Observation sheet data is used to determine the implementation of the flipped classroom model in learning. For the observation sheet, it can be seen from the total obtained by the following formula:

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$$Result = \frac{Total\ Score}{51} \times 100\%$$

After that the results are grouped into three categories as follows:

Table 2. Classification of Flipped Classroom Model Implementation Categories

Mathematical Communication Ability Results	Categories
67% < Result ≤ 100%	High
33% < Result ≤ 67%	Medium
0% ≤ Result ≤ 33%	Low

(Aritonang, 2020)

RESULTS AND DISCUSSION

The results showed that in the first study, the results of observations were 72.5% in the very good category, and the second study received 74.5% observations in the very good category. The observation sheet shows that all the flipped classroom model steps have been carried out with mostly good and some very good scores. The results of the tests carried out. Namely, the pretest and posttest, which consisted of 4 questions, showed an increase in students' mathematical communication skills as seen from the achievement of the indicators.

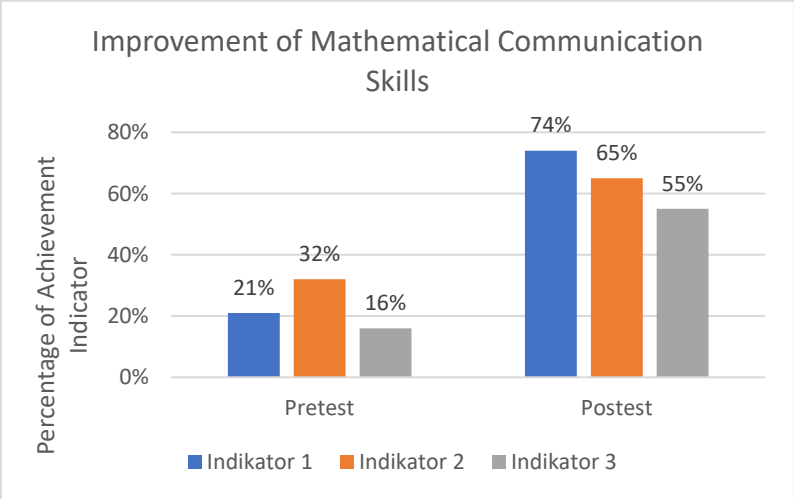

Figure 1. Achievement of Students' Mathematical Communication Ability Indicators

From the results of the pretest and posttest observations presented in Figure 1, an increase in each indicator of students' communication skills was obtained. On the indicators of mathematical communication ability, namely indicator 1) the ability to write mathematical situations correctly and precisely, which has increased by 53%, in 2) the ability to write down ideas or solve problems correctly and correctly obtained an increase of 33% while in 3) the ability to write conclusions from problems with using their language obtained an increase of 39%.

Students' mathematical communication skills are categorized into three categories: high, medium, and low. In the research that has been done, the results are as follows

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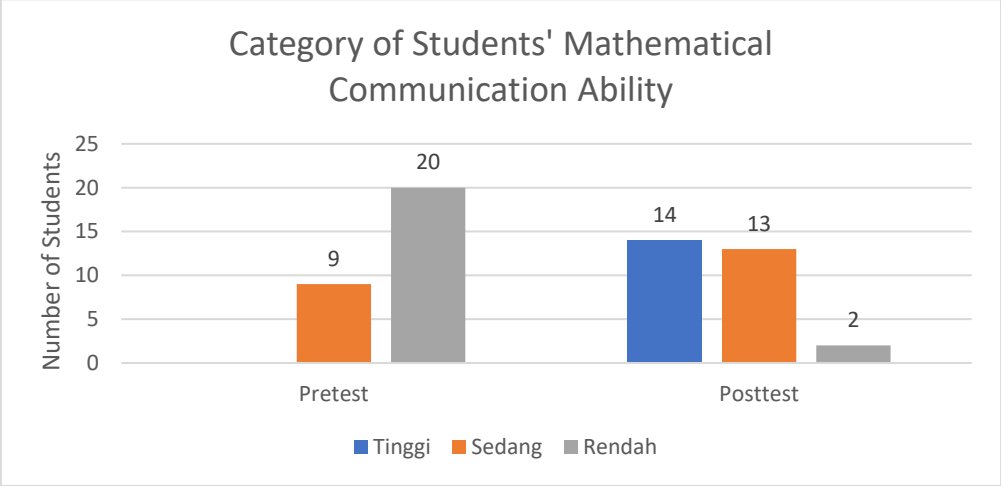

Figure 2. Categories of Students' Mathematical Communication Ability

Figure 2 displays a graph of the results of students' mathematical communication abilities. In the pretest written test, nine students had moderate students' mathematical communication skills, and 20 students had low mathematical communication skills. Posttest results can be seen that there is an increase in students' mathematical communication skills. Fourteen students had high mathematical communication skills, 13 had moderate mathematical communication skills, and two had low mathematical communication skills.

Based on the results of grouping mathematical communication abilities, the results of the subject selection are presented in Table 3.

Table 3. Results of the Selection of Research Subjects

No	Name	Ability	Subject Code
1	FA	High	T1
2	NSZ	High	T2
3	KRAP	Medium	S1
4	ATU	Medium	S2
5	NHN	Medium	S3
6	FWR	Low	R1

Researchers used the written test results to determine students' mathematical communication skills. The following is an analysis of the results of the test answers.

a. T1

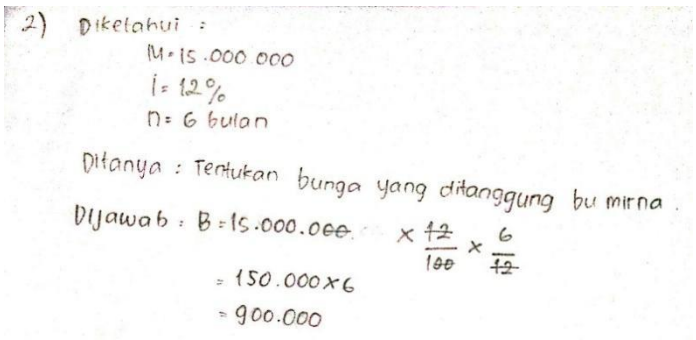

Figure 3. Results of the T1 Pretest Answers Number 2

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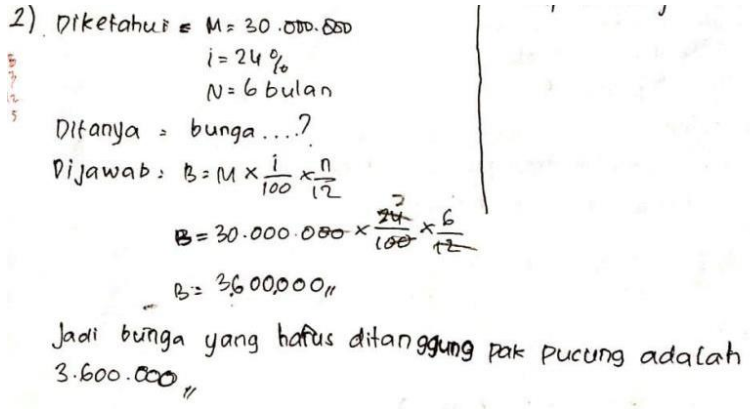

Figure 4. Results of Posttest T1 Answers Number 2

T1 in Figure 4 shows that the subject experienced an increase in mathematical communication skills which initially only reached one indicator: correctly and precisely, namely, writing down mathematical situations. It can be seen in Figure 3 that the second indicator was not fulfilled because it needed to write down the completion steps correctly, and the third indicator was not achieved because T1 needed to write a conclusion. At the same time, the post-test results have reached three indicators of mathematical communication. In figure 4, T1 has written down what is known and asked correctly. T1 has also written the solution sequentially, correctly, and precisely. Conclusions have also been written using their language correctly.

b. T2

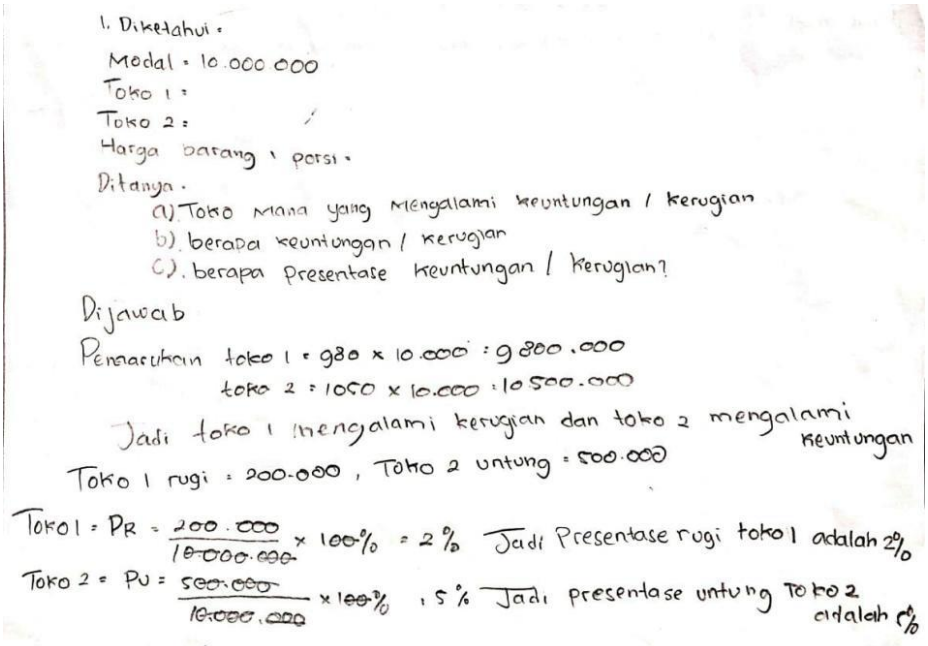

Figure 5. Results of the T2 Pretest Answers Number 1

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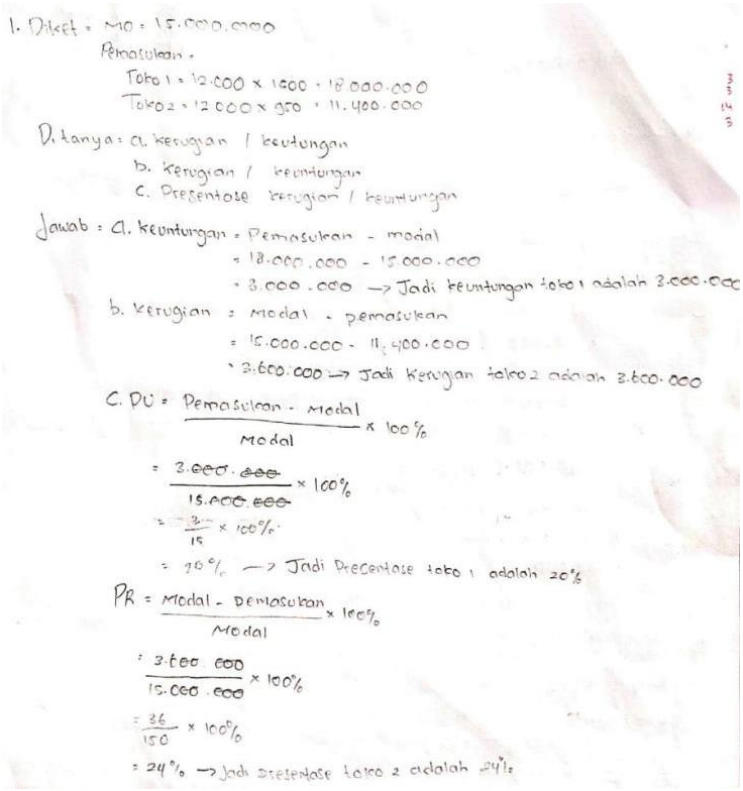

Figure 6. Results of Posttest T2 Answers Number 1

Figures 5 and 6 are the results of the subject T2's pretest. These results are good but have yet to reach the indicators of mathematical communication ability. In Figure 5, T2 has written known but incomplete things, while for the things asked, T2 still needs to write a question mark. As a result, the first indicator was not achieved. T2 also did not reach the second indicator because T2, in writing, the solution needed to be more coherent even though the final answer was correct. Most of the conclusions written are correct and follow the questions asked, but they need to be corrected. The results of the posttest T2 were almost the same as those of the pretest, which can be seen in Figure 6. T2 in writing things that were known to be complete, but in writing, things asked needed to be completed and accurate because T2 did not reach the first indicator. In writing the idea of solving the T2 problem, I have written it well, but there is one problem that still needs to be written down on how to solve it. The conclusions are also correct by writing using their language but need to be corrected.

c. S1

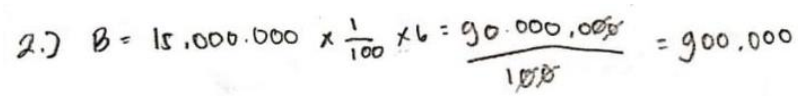

Figure 7. Results of S1 Pretest Answers Number 2

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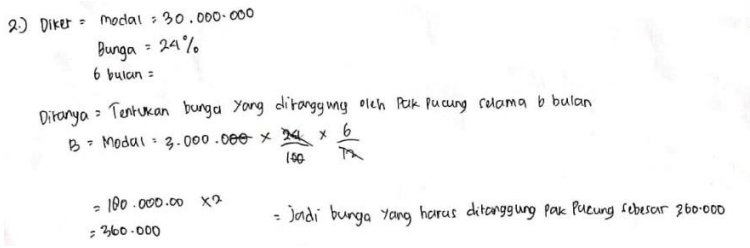

Figure 8. Results of Posttest S1 Answers Number 2

In Figure 8 for pretest activities, S1 has yet to reach the mathematical communication indicator. S1 does not write down what is known, asked, and conclusions. I only wrote down the solution, but it needed to be corrected, and I needed to write down the steps for solving it. The posttest results on number 2, S1, achieved one indicator of mathematical communication: writing conclusions from problems using their language. The way to solve it needs to be completed and corrected, but the result is correct. The conclusions written follow what was asked and are correct.

d. S2

Figure 9. Results of Pretest S2 Answers Number 4

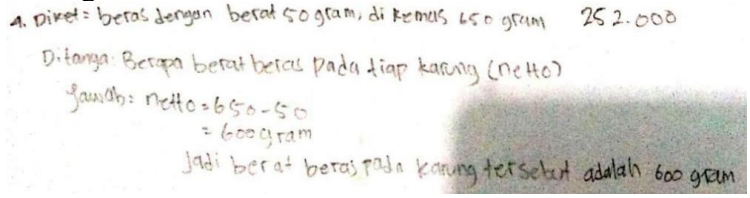

Figure 10. Posttest S2 Answer Results Number 4

Figures 9 and 10, in number 4 S2, have yet to reach the mathematical communication indicator. S2 does not write down what is known, asked, and conclusions. In solving the S2 problem, write an incomplete and inaccurate solution, but the final result is correct. S2 in this posttest, there is an increase in mathematical communication skills. S2 achieves one indicator, namely being able to write conclusions from problems using their language. This can be seen in the picture. S2 has written down what is known but not correct, and what is written in the questioned section is correct but still needs to be entirely right. The way to answer it is good enough and get the final result correct, but completing it needs to be corrected. The conclusions written are correct, following what was asked.

e. S3

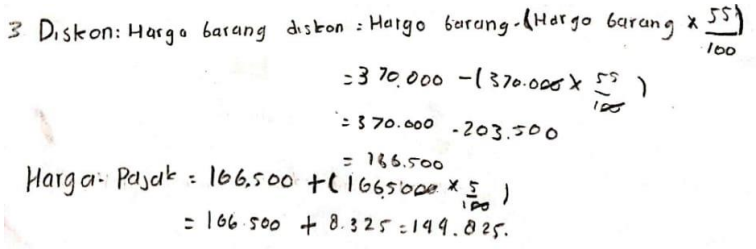

Figure 11. Results of Pretest S3 Answers Number 3

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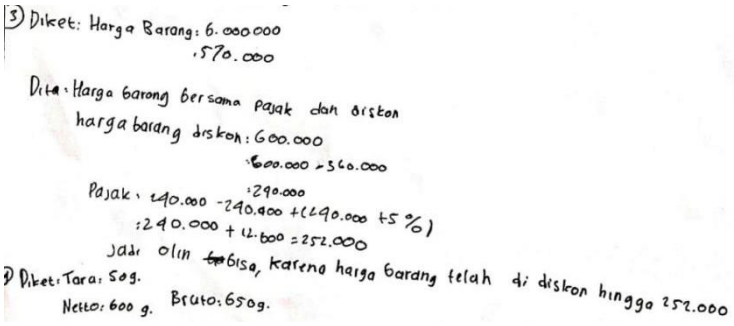

Figure 12. Posttest S3 Answer Results Number 3

Figures 11 and 12 show the work results for the S3 subject were obtained, namely that, at first, the S3 did not reach the mathematical communication ability indicator. S3 does not write down what is known, asked, and conclusions. In solving the S3 problem, writing the solution coherently and most solutions are correct, but writing the numbers needs to be corrected. The calculations still need to be corrected, so the final result is also wrong. At the posttest, S3 has not yet reached the indicator of mathematical communication ability but has an increase in mathematical communication ability. At the same time, S3 has written down what is known and asked about the questions, but it needs to be corrected and completed. Most of it needs to be more precise and complete in solving the problem. Writing problem-solving is also inaccurate and incomplete. The conclusions written follow the questions asked, and the results are correct but need to be corrected.

f. R1

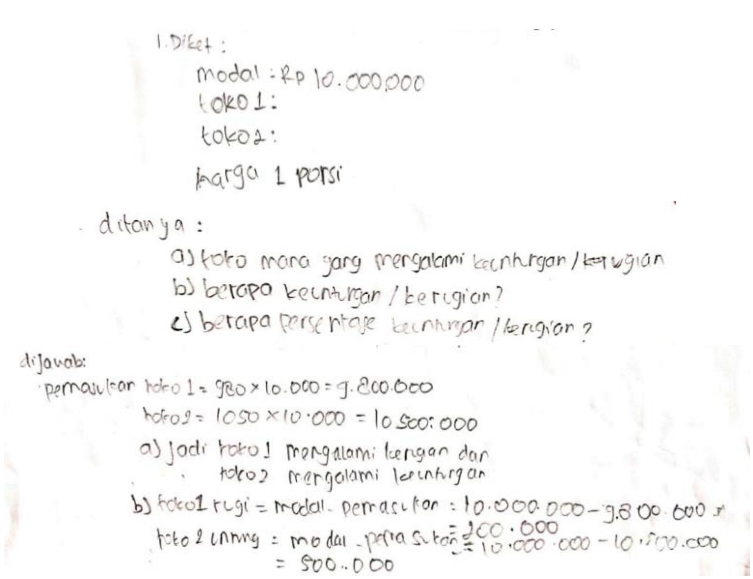

Figure 13. Results of Pretest R1 Answers Number 1

From Figure 13, at first, R1 did not reach the mathematical communication ability indicator—R1 in writing things that are known to be incomplete. In writing, the things asked are not quite right. In writing, how to solve most of it is not correct. Some problems have not been written down on how to solve them. R1 Do not write conclusions. R1 in the posttest did not reach the indicators of mathematical communication ability.

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Nevertheless, R1 experienced a decrease in mathematical communication ability. In this solution, R1 writes down known but incomplete things and needs to write down the problems asked. In writing how to answer incomplete, there are writing errors. Most of the solutions still need to be entirely right. It can be seen in Figure 14 R1 does not write a conclusion. At number 1, there is a decrease in mathematical communication ability. This can be seen in Figure 13 and Figure 14.

The following is an analysis based on indicators of students' mathematical communication abilities:

1. Write down mathematical situations correctly and precisely
   In the category of high communication skills, most students can write down what is known and ask correctly and precisely. In the medium category, students wrote down what was asked and answered correctly, but they needed to be more precise and write more about what was known. The low category writes down known and asked but not yet specific things. Some write down only what is known or what is asked.
2. Write down ideas or problem-solving correctly and precisely
   The high category in writing ideas in solving problems is correct primarily and written sequentially. Most of what is written are correct. In the moderate category, there are those where most of the solutions are correct, and some are not. In the low category, the way to solve the problem needs to be corrected, and the presentation of the idea cannot be understood.
3. Write the conclusion of the problem using their language
   In the high category, in conclusion, they have written conclusions using their language appropriately, but there are still those who still need to write conclusions. In the medium category, conclusions have been written, but some need to be corrected. Whereas in the low category, they only write conclusions in one number, and even then, it is still not right

Learning with the flipped classroom model using digital media in research was done twice to get very good results. At the first meeting, the results were 72.5%, and at the second meeting, the results were 74.5% in a very good category. In Aryati, (2020) it was also found that the implementation of learning using the flipped classroom model in learning mathematics was in a very good category. Namely, in the first meeting, it reached 96%, and in the second meeting, it reached 100%. Students' mathematical communication abilities after learning the flipped classroom model using digital media have increased students mathematical communication abilities. In line with the research of Jazuli dkk., (2022) he results showed that learning activities using the Blended learning model of the Flipped Classroom Type increased mathematical communication skills.

In this study, the indicator of writing mathematical situations correctly and precisely increased by 53%. Some students have written down what is known and asked, and some only write down what is known or asked. This is in line with Anderha & Maskar, (2020) who get 50% for indicators of explaining ideas and situations orally or in writing in their language where students are good enough but still need to understand the meaning of the problem. Students in writing problem-solving need to write ideas coherently. This is in line with the research of Bachriani

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dkk., (2021) which states that students write less structured answers. In addition, some students needed to be more careful in working on it and made mistakes in counting. In their research, Ramadhan & Minarti, (2018) also said that students needed help understanding the basic concepts of calculating mathematics. They tend to need to be more careful in working on questions because they want to finish quickly. In this study, some students have written conclusions correctly and correctly, some have also written conclusions even though they are incorrect, and some do not write conclusions. In line with Meiliyah & Setianingsih, (2019) research, which obtained students' results in the high and medium categories, they had written conclusions, while those in the low category did not write conclusions. In addition, many students found the final answer correctly in this study, but the conclusions needed to be corrected. This is in line with Ismayanti & Sofyan, (2021) research that students with high, medium, and low mathematical communication skills are not used to writing conclusions from the solutions that have been obtained.

CONCLUSION

Learning with the flipped classroom model with digital media, carried out according to the lesson plans, obtained an observation result of 72.5% at the first meeting and 74.5 at the second meeting, both of which were in the very good category. After conducting learning using the flipped classroom model with digital media, there was an increase in students' mathematical communication skills. This ability can be seen from the achievement of indicators of mathematical communication ability, where the indicator of the ability to write mathematical situations correctly and precisely increases by 53%, the ability to write down ideas or solve problems correctly and accurately increases by 33%, the ability to write conclusions from problems using their language increased by 39%.

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