Students’ Mathematical Communication Abilities: A Comparison of Distance Learning Methods and Direct Learning Methods

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**Abstract.** Since the Covid-19 pandemic, the education system has been faced with a new situation that required both teachers and students to master distance learning media. However, when it comes to mathematical communication abilities, distance learning is considered to be less than optimal because the mathematical communication abilities consist of oral communication and written communication. The purpose of this research is to find out which methods are better between classes using the distance learning methods during the Covid-19 pandemic and classes using conventional direct methods. This type of research is a quasi-experimental research with the design used is a post-test only control design. The sample in this study was class VIII A of the 2016/2017 and class VIII B of the 2020/2021 school year in one of the Madrasah Tsanawiyah (junior high school) in Kuningan. Data on mathematical communication abilities in mathematics learning are obtained from the results of tests of mathematical communication abilities, the data is then processed using the Mann-Whitney nonparametric difference test. The results showed that students who used distance learning methods have better results than students who used conventional direct learning methods in terms of mathematical communication abilities.

1. Introduction  
   Mathematics is one of the subjects given to students from elementary schools to tertiary institutions which is useful for equipping students with the ability to think logically, analytically, systematically, critically, and creatively as well as the ability to work together [6]. However, many students consider mathematics to be a difficult, monotonous, and boring subject so that sometimes students avoid it. Even though without realizing it, mathematics is often used in everyday life. Also, mathematics is one of the prerequisite fields for continuing school to a higher level.

In the process of learning mathematics in the classroom, sometimes students have difficulty conveying ideas by using spoken language, written or pictorial objects related to mathematics. When the teacher asks, the students are still not able to formulate an argument well. Learning is still dominated or teacher-centered. And students also have not been able to express a situation or problem in the form of symbols, diagrams, or mathematical models [1].

According to Baroody (1993), there are two important reasons why communication in mathematics learning needs to be developed among students. First, mathematics as a language, meaning that mathematics is not just a tool to aid thinking, a tool to find patterns, solve problems or draw conclusions, but mathematics is also an invaluable tool for communicating a variety of ideas clearly, precisely, and succinctly. Second, mathematics learning as a social activity, meaning as a vehicle for interaction between students, as well as a means of communication between teachers and students [3].

In mathematics learning, communication is indispensable because the standard process in mathematics learning includes problem-solving, reasoning and proof, communication, connections, and representations [5]. Thus, mathematical communication abilities in learning mathematics need to be developed. This is because through mathematical communication students can organize their mathematical thinking both orally and in writing [9]. Communication in mathematics can help teachers understand students' ability to interpret and express their understanding of the mathematical concepts and processes they are learning [10].

Also, there are several indicators to measure students' mathematical communication abilities in mathematics learning, that is (1) Connecting real objects, pictures, and diagrams into mathematical ideas; (2) Explaining mathematical ideas, situations, and relations orally and in writing with real objects, pictures, graphics, and algebra; (3) Declare everyday events in language or mathematical symbols; (4) Listening, discussing and writing about mathematics; (5) Read the mathematics evaluation presentation and compose relevant questions; (6) Develop arguments, formulate definitions and generalizations [8].

Therefore, a learning model is needed that can improve students' mathematical communication abilities which in the process not only makes the teacher the center of learning but students can also play an active role in it. One learning model that can be used is the TTW (Think Talk Write) Model. The TTW learning model was first developed by Huinker da Laughin who stated that the application of TTW allows all students to issue the ideas behind their thinking, build appropriately for thinking and reflection, organize ideas, and test these ideas before students are asked to write [2].

But the problem that is happening right now is the Covid-19 outbreak that has hit the world, including Indonesia. Since the Covid-19 pandemic, various efforts have been made by the government to prevent its spread. The Minister of Education and Culture of the Republic of Indonesia, Nadiem Anwar Makarim issued circular letter Number 4 of 2020 on March 24, 2020, containing the Implementation of Education Policy in the Covid-19 Emergency Period. In the circular, it is explained that the learning process is carried out at home via online or remotely without directly meeting students. Changes in the learning process were carried out to prevent the rapid spread of the Covid-19 virus [11].

With these problems, the education system is faced with a new situation that required both teachers and students to master distance learning media. However, when it comes to mathematical communication abilities, distance learning is considered less optimal in improving mathematical communication abilities because mathematical communication abilities consist of oral communication and written communication. Oral communication such as discussion and explaining. Written communication such as expressing mathematical ideas through pictures/graphs, tables, equations, or in the students' language [4].

Based on the above problems, the research was conducted to find out whether there were differences in mathematical communication skills in mathematics between students who used distance learning methods during the Covid-19 pandemic period with direct (face-to-face) learning methods. If there are differences, which method is better between the distance learning method during the Covid-19 pandemic and the conventional direct learning method.

1. Experimental Method

This research is quasi-experimental research because the researcher cannot control all variables that may affect the variables studied. The design used was a post-test only control design, where two groups were randomly selected [7]. This study was to see differences in mathematical communication abilities by comparing the results of solving math problems by the indicators of mathematical communication abilities of two class groups, namely the control group (students who get learning in class, namely class VIII A in the 2016/2017 school year) and the experimental group (students who get distance learning because in the Covid-19, namely class VIII B in the 2020/2021 school year).

The sample in this study took 2 classes, namely class VIII A for the 2016/2017 school year, totaling 30 students as the control class and class VIII B for the 2020/2021 school year, totaling 30 students as the experimental class. The application of the conventional direct learning method was used in the control class while the application of the distance learning method during the Covid-19 pandemic was used in the experimental class.

The data on the results of the mathematical communication abilities test is obtained from the results of working on mathematical problems by the indicators of mathematical communication abilities, then the data is processed using SPSS 21 software with the following steps:

1. Calculating the mean and standard deviation (descriptive analysis of sample data)
2. Sample data normality test
3. Average Difference Test
4. Results and Discussion

The following are the results of a descriptive analysis of mathematical communication abilities in mathematics students at class VIII A in the 2016/2017 school year and class VIII B of the 2020/2021 school year as presented in Table 1 below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 1. Students’ Mathematical Communication Abilities** | | | | | |
| Group | N | Minimum | Maximum | Mean | Std. Deviation |
| Control Class | 30 | 72 | 86 | 78.15 | 4.237 |
| Experiment Class | 30 | 75 | 89 | 81.02 | 4.731 |

Table 1 above shows the average score of students' mathematical communication abilities test for the experimental class using the distance learning method, which has a higher average score of 81.02 compared to the control class average score of 78.15. The maximum score achieved by the experimental class students was higher, that is 89 compared to the control class who got a maximum score of 86. The minimum score achieved by the experimental class students was also higher, that is 75 compared to the control class that is 72. So it can be concluded from the table above that the experimental class got better test results than the control class. To answer the research questions, statistical tests were carried out using the mean difference test.

Previously, the data distribution normality test of students' mathematical communication abilities was carried out, normality testing was carried out on the results of the students' mathematical communication abilities test results in the 2016/2017 and 2020/2021 school years carried out in experimental and control classes using the Kolmogorov - Smirnov test.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tabel 2. Test of normality** | | | | | |
|  | Kolmogorov-Smirnov | | |
| Statistic | df | Sig. |
| Experiment | .187 | 30 | .009 |
| Control | .171 | 30 | .025 |

Based on table 2 above, the previously determined significance level is α = 0.05. Based on the results of processing with SPSS, in the control group, the results obtained were 0.025 (sig = 0.025), thus it can be concluded that the data on the results of mathematical communication abilities for the control group were not normally distributed because of Sig. smaller than α or 0.025 <0.05. In the experimental group, the result was 0.009 (sig = 0.009), and it can be concluded that the results of the mathematical communication ability test results for the experimental group are not normally distributed because of Sig. smaller than α or 0.009 <0.05. Based on the normality test that has been done, nonparametric statistics will be used to test the Mean Difference, namely using the Mann-Whitney test.

|  |  |
| --- | --- |
| **Tabel 3. Mann-Whitney Test Result** | |
| Kemampuan Komunikasi Matematis | Hasil |
| Mann-Whitney U | 298.000 |
| Wilcoxon W | 763.000 |
| Z | -2.281 |
| Asymp. Sig. (2-tailed) | .023 |

Based on table 3 above, the results of the Mann-Whitney test on the results of the mathematical communication abilities test result in a probability value (sig) <0.05 (0.023 <0.05), which means that in general there is a very significant difference in the ability of mathematical communication between classes. using distance learning methods during the Covid-19 pandemic with classes using conventional direct learning methods. So the conclusion is that comparing the many samples above, students who do distance learning are better students who use conventional learning methods in terms of mathematical communication abilities.

Based on interviews with several students who use distance learning (online) methods, it is known that there are several advantages when learning with this method:

1. Online distance learning can foster student learning independence
2. Distance learning either through WhatsApp, Telegram, Google Classroom, Zoom, and so on makes students more comfortable to express opinions or ask questions to the teacher.
3. With group chat, it can make it easier for students to discuss with other students and can be done anytime and anywhere
4. Students are given teaching materials that can be stored on laptops or smartphones so that later they can re-access the teaching materials.
5. The material presented by the teacher becomes more varied so that students are more interested in participating in learning
6. Conclusion

Based on the results of the research and the results of the data analysis that has been done, it can be stated that there is a significant difference in the communication abilities of students between students who use distance learning methods during the Covid-19 pandemic period and students who use direct conventional learning, especially in mathematics class VIII at Madrasah Tsanawiyah (junior high school) in Kuningan in the 2016/2017 school year and 2020/2021 school year. By comparing the two samples above, students who undertook distance learning were significantly better than students who used conventional direct learning methods in terms of their mathematical communication abilitiess.

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