The Effects of Online Mathematics Learning in the Covid-19 Pandemic Period: A Case study of Senior High School Students at Madiun City, Indonesia

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Abstract: *This study aims to determine the differences in students' mathematics learning outcomes before and after online learning and their positive responses to this method's use. Data were quantitatively and non-randomly collected from Senior High School students in Madiun city, Indonesia, in May 2020, by using the documentation and questionnaire methods. There are two sources of data, namely mathematics learning outcome and student's response using an online questionnaire. Data were used to determine the effect of learning during the COVID-19 pandemic. Meanwhile, the questionnaire was used to determine their responses. The results showed that the average of mathematics learning outcomes before online learning is greater than the average after online learning and students' average positive response towards mathematics before online learning is greater than the average after online learning.*

Keywords: Student mathematics learning outcomes, Online learning, COVID-19 pandemic

1. INTRODUCTION

Mathematics is one of the subjects learned in High Schools and Universities. It is one of the basic educational components that require students to be skilled and understand for the various methods used to structure lives. For instance at the end of 2019, the world was shocked by the inception of the coronavirus in Wuhan, one of the cities in China, which subsequently spread to several countries worldwide. Therefore on January 30, 2020, the World Health Organization (WHO) declared this outbreak as a Public Health Emergency. In a letter written by WHO's Director-General, Tedros Adhanom, to President Jokowi on March 10, 2020, the organization advised Indonesia to undertake several steps to prevent the spread of the virus declaring a national coronavirus emergency. The letter was also forwarded to the Ministries of Health and Foreign Affairs (Sari, 2020). Currently, COVID-19 has infected more than 4.7 million people, with 1.8 million recoveries, and more than 300 thousand deaths, based on updated across the world on May 17, 2020.

Therefore, President Joko Widodo has declared the virus a public health disaster, and it is recommended to work, study, and worship from home. The government's appeal to the community was also conveyed through the Minister of Education and Culture, Nadiem Makarim. Due to these new rules, learning activities that are usually carried out at school eventually take place online (Sari, 2020). Therefore, learning activities that are usually routinely carried out in schools finally take place online. Regarding learning from home, the Minister of Education and Culture emphasizes that online or distance learning is carried out to provide meaningful learning experiences for students, without being burdened with the demands of completing all curriculum achievements for grade promotion or graduation. The Minister of Education and Culture also recommends regions that have learned from home to ensure that teachers also teach from home to maintain teacher safety (Sari, 2020).

Online learning is education that takes place over the Internet. Online learning is just one type of distance learning for any learning that takes place across distance and not in a traditional classroom. One of the main reasons for this is it gives students' greater access to education in comparison to traditional methods of teaching as students can undertake their study from anywhere and at any time as well as being given the option to study part-time or full-time (El-Seoud et.al., 2014). Through online learning, interactive activities such as teacher-student interaction, student-student interaction, student–content interaction, and student–technology interaction are considered. Students participated in the blended learning course in which formative assessment was used to evaluate student learning outcomes by the combination of different learning activities through a learning management system (Nguyen, 2017). According to Salamat et.al. (2018) "Online learning can refer to the situation where the interaction between the students and the teacher is done through online system. Students are received training and taught through online system and teacher may also in the same building with them".

Various school efforts have been made to continue learning even though the school is on vacation. Based on the description above, the following problem formulation is obtained:

a. Are there differences in students' mathematics learning outcomes before and after online learning?

b. Are there differences in students' positive responses to mathematics before and after online learning?

2 RESEARCH METHOD

The quantitative research method was used to determine the effect of the online learning outcome of mathematics in Senior High School students at Madiun. Furthermore, this is a quantitative research due to its ability to use samples to solve problems related to online learning. This research

used the one-group pretest-posttest design to compare the conditions before and after online learning (Wijayanto et.al, 2017).

The research population consists of two Senior High School students in Madiun City with the Non-Random Sampling method. It is used to obtain data from teachers that are alumni of the Mathematics Education Study Program at Widya Mandala Catholic University Surabaya, Indonesia. Furthermore, this technique was chosen several cities implemented the Large-Scale Social Restrictions (LSSR) to stop the spread of COVID-19, with questionnaire research samples collected through telephone interviews.

The data collection techniques in this study are the documentation and questionnaire methods. The documentation is in the form of learning outcomes before and after online learning. Meanwhile, questionnaires need to be answered or responded to by students.

In addition, the Paired Sample Test was used because the secondary data are processed in intervals. "Paired samples have the same subject with different treatments" (Rea and Parker, 2014). The population normality test is also conducted as a prefix to statistical tests that were carried out using the SPSS program.

The population normality test uses the *Kolmogorov Smirnov Goodness of Fit Test* statistic and SPSS program with menu procedures of *Analyze, Descriptive Statistics, and Explore*. In *Display*, select *Plot* and check the *Normality Plot to* determine the two conditions. When both data are normally distributed, then *the paired sample t-tests* are used. Furthermore, data processing is carried out by using the SPSS program with the menu procedure of *Analyze, Compare Means, and Paired Sample t-Test*. The *t*-value is recorded as *t*-count (t_{-count}) and *df* value as degrees of freedom to determine *t* table (t_{-table}) based on the output results in the Paired Samples Test table. Assuming one or both of the data are not normally distributed, the non-parametric statistical testing, which is the Wilcoxon Signed Ranking Test, is used to test the two paired samples. Subsequently, data processing is carried out using the SPSS program with the menu procedure of *Analyze, Compare Means, and 2 Related Sample*, with the *Test Type* selected by *Wilcoxon*. Based on the output results in the *Test Statistics* table, the *Asymp Sig. (2-tailed)* is recorded as the *Asymp* count ($Asymp_{count}$)

3 DISCUSSION OF RESEARCH RESULTS

3.1 Discussion of Student Mathematics Learning Outcomes

Data analysis was conducted after obtaining data on student mathematics learning outcomes. The samples in this study are 96 students from two Senior High Schools. This is based on data processing on learning mathematics using the SPSS program, as shown in Table 1.

Table 1 - Statistics Description of Mathematics Learning Outcomes

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Mathematics Learning Outcomes Before Online Learning	96	60	100	83.60	9.153	83.779
Mathematics Learning Outcomes Before Online Learning	96	53	98	76.82	9.072	82.295
Valid N (listwise)	96					

A normality test is carried out to determine whether the data from the population is normally distributed. The result showed that outcomes before and after online learning do not come from normally distributed populations.

Table 2- Calculation Results for Normality Test with Kolmogorov-Smirnov Test before and after the online learning

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mathematics Learning Outcomes Before Online Learning	.172	96	.000	.919	96	.00
Mathematics Learning Outcomes Before Online Learning	.170	96	.000	.954	96	.002

        a. Lilliefors Significance Correction

In Table 2, output in the *Tests of Normality* table obtained a significance value (Sig.) Of 0.00 for mathematics learning outcomes before and after online learning. This value is less than the significant level (α) of 0.05. This means that data before and after online learning does not come from the normally distributed populations.

These two paired samples test uses the non-parametric statistical testing method, namely the Wilcoxon Signed Ranking Test.Furthermore, the data processing is carried out using SPSS with

the menu procedure of *Analyze*□□*Compare Means*□□*and 2 Related Sample*, with the *Test Type* selected by *Wilcoxon*.

Table 3 - The Results of Wilcoxon Signed Ranks Test

		N	Mean Rank	Sum of Ranks
Mathematics Learning Outcomes Before Online Learning	Negative Ranks	63[a]	48.02	3025.00
	Positive Ranks	21[b]	25.95	545.00
Mathematics Learning Outcomes Before Online Learning	Ties	12[c]		
	Total	96		

      a. Mathematics Learning Outcomes After Online Learning <Mathematics Learning Outcomes Before Online Learning

      b. Mathematics Learning Outcomes After Online Learning >Mathematics Learning Outcomes Before Online Learning

      c. Mathematics Learning Outcomes After Online Learning = Mathematics Learning Outcomes Before Online Learning

Table 4 - Wilcoxon Test Statistics Table

	Mathematics Learning Outcomes After Online Learning - Mathematics Learning Outcomes Before Online Learning
Z	-5.538[a]
Asymp. Sig. (2-tailed)	.000

      a. Based on positive ranks

      b. Wilcoxon Signed Ranks Test

In the *Test Statistics* table, the A*symp Sig. (2-tailed)*values obtained an *Asymp$_{count}$*of 0,000, which is less than the significant level (α) of 0.05. Therefore, there are differences in the average of

student mathematics learning outcomes before and after online learning. The average of the mathematics learning outcomes, before online learning is greater than after online learning.

3.2 Discussion of Student Responses towards Mathematics

The response questionnaire data were obtained from 75 Senior High Schools students in Madiun City. The responses using the SPSS program with normality test analysis showed that before and after online learning outcomes do not come from the normally distributed populations. The processing data obtained using the SPSS program with the Wilcoxon Signed Ranking Test is shown in Table 5.

Table 5 - The Results of Wilcoxon Signed Ranks Test

		N	Mean Rank	Sum of Ranks
Student Responses After Online Learning-Student Responses Before Online Learning	Negative Ranks	29ᵃ	17.81	516.50
	Positive Ranks	6ᵇ	18.92	113.50
	Ties	40ᶜ		
	Total	75		

    a. Student Responses After Online Learning < Student Responses Before Online Learning

    b. Student Responses After Online Learning > Student Responses Before Online Learning

    c. Student Responses After Online Learning = Student Responses Before Online Learning

Table 6 - Wilcoxon Test Statistics Table

	Student Responses After Online Learning – Student Responses Before Online Learning
Z	-3.615ᵇ
Asymp. Sig. (2-tailed)	.000

    a. Based on positive ranks

    b. Wilcoxon Signed Ranks Test

In the Test Statistics table, the *Asymp Sig. (2-tailed)* values of $Asymp_{count}$= 0,000 are obtained and less than the significant level (α) of 0.05. Therefore, there are differences in the average results of student questionnaire responses before and after online learning. Table 5 shows that the average positive response of students' towards mathematics before online learning is greater than after online learning.

4. CONCLUSIONS

The following conclusions were made based on the research:

a. The average of student mathematics learning outcomes before online learning is greater than after online learning.

b. The average student's positive response towards mathematics before online learning is greater than after online learning.

Positive responses to mathematics after students take online learning were obtained from questionnaires. The following are the results obtained from filling out the questionnaire as many as 75 students, namely:

a. Obstacles faced by students when participating in online learning, namely non-smooth signals, limited quota, the teacher directly gives questions without any material explaining how to solve problems so that students do not understand the material, and feel disturbed by noise in the home environment;

b. The efforts that have been made by students in overcoming these obstacles, namely: look for a smooth internet/wifi network to neighbors or other places outside the home; search for material on the internet (browsing) and access YouTube; asking friends and doing it together; studying in the room to avoid noise;

c. Media used in online mathematics learning, namely Whatsapp (WA), Google Classroom (GC), Zoom, E-learning schools, and e-mail;

d. Suggestion from students for online mathematics learning, that is, teachers should make videos or explain material through videos so that students can better understand completion steps and formulas that can be used.

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