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Comparison of Students' Mathematics Critical Thinking Skills Through the Use of Learning Management Systems and WhatsApp Groups in Online Learning

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Abstract. This research aims to investigate the comparison of students' critical thinking skills through the use of Learning Management Systems (LMS) and WhatsApp Groups (WAG) in online learning. Cluster random sampling technique was used to select a research sample of 72 Junior High School students. The research sample was grouped into experimental class and control class. The description test instrument is used to measure students' critical thinking skills. The research data were analyzed using the t-test and the N-Gain test, and students' learning mastery was presented in a quantitative descriptive manner. The results showed that the use of LMS was more effectively applied in online learning. This is in line with the critical thinking ability of students who received learning using LMS better than the critical thinking skills of students who received learning using WAG. Most of the students finished studying and improving their critical thinking skills in the medium category.

INTRODUCTION

The Covid-19 is hitting the world right now, and Indonesia is no exception. In order for education to continue, the learning process is carried out through online learning [1][2]. This is done to minimize the spread of the COVID-19 virus. The distance learning policy has changed the paradigm of the face-to-face learning system in the classroom into virtual learning. In the traditional view, the concept of learning is always described through face-to-face meetings in the classroom between teachers and students [3][4]. The new paradigm arises because of the presence of technology that makes it easier for people to interact without being bound by space and time anymore. This paradigm is described through virtual meetings while maintaining the concept of teacher and student interaction [5]. A teacher can build virtual classes and use technology that is suitable for students, for example using e-learning pages (LMS), WhatsApp, Google Class, Zoom applications and You Tube.

Several research results using LMS in online learning were carried out by several researchers who showed that LMS is effectively used for online learning [6][7][8][9]. While research using WhatsApp Group (WAG) in online learning was carried out by several researchers who showed that WAG is effectively used for online learning [10][11][12][13][14]. Different results who concluded that online learning using WAG is better than using LMS by paying attention to the system applied during learning [15][16]. Online learning using WAG provides advantages for math teachers such as: 1) every student has a WhatsApp, 2) students have the opportunity to correct mistakes as quickly as possible, 3) WhatsApp provides learning that saves internet quota [17].

However, some researchers point out the advantages of LMS over other online learning media. By using LMS, students are facilitated to exchange information with students quickly and flexibly [15][18][19]. Students get learning materials, practice questions, assignments, interact with teachers, or with other students, and get other sources or teaching materials related to the learning materials being discussed during the learning process using LMS [7][8][20]. The advantage of using LMS is that there is a discussion forum menu and chat. Through this menu, there is interaction between students and students, students and teachers, so that student activity in learning is higher [6][8][9][21].

Problems arise from online learning, namely the large number of assignments. In such circumstances, it is very possible that students' critical thinking skills are very low [22][23]. This is evident from several indicators, including: students have difficulty in providing basic explanations, analyzing problems, setting problem solving strategies and concluding that problem solving is still low. Critical thinking is a process in which a person tries to rationally answer questions that cannot be answered easily and where all relevant information is not available [24][25]. Knowing students' critical thinking processes in solving math problems is very important for teachers. Teachers must understand students' critical thinking and how students process incoming information while directing students to change their way of thinking if it turns out to be necessary [26].

Based on the description of the importance of students' critical thinking skills and considering the implementation of online learning during the Covid-19 pandemic, the purpose of this study was to determine the effectiveness of using LMS and WhatsApp Group in learning and to determine the improvement of students' critical thinking skills in online mathematics learning.

METHOD

Research Sampel

This research includes quantitative research. The cluster random sampling technique was used in the selection of the research sample, so that every student in the class group could be the sample of this study. The sample of this study consisted of 72 students of SMP N 2 Gubug, Central Java Indonesia. Each class consisted of 36 students who as the experimental class received learning using LMS, while the control class received learning using WAG. Prerequisite tests were carried out before the implementation of the study, namely: normality test using the Lilliefors method, homogeneity test using Bartlett's test, and t-test. The results show that the sample from the learning class using LMS and the learning class using WAG comes from a population that is normally distributed, the variances of the two groups are homogeneous, and both samples have the same initial ability.

Instrument and Procedures

Learning material experts were asked for their willingness to validate mathematics learning tools. Two validators validated and the results showed that the tool developed for online learning was feasible to use, with an expert rating of 82.2% (good), and 91.1% (very good) to use.

TABLE 1. Analysis of test instrument

Number question	Reliability		Difficulty level		Differentiation of item		Remark
	r	Criteria	Score		r	Criteria	
1	0,866	Reliable	0.669	Medium	0.51	Good	Used
2			0.708	Easy	0.44	Good	Unused
3			0.611	Medium	0.37	Bad	Unused
4			0.689	Medium	0.49	Good	Used
5			0.678	Medium	0.51	Good	Used
6			0.631	Medium	0.32	Bad	Unused
7			0.683	Medium	0.31	Bad	Unused
8			0.564	Medium	0.16	Bad	Unused
9			0.619	Medium	0.52	Good	Used
10			0.370	Difficult	0.45	Good	Used

For the evaluation of the research, a test instrument was used. The test instrument has been tested to determine the reliability, level of difficulty and discriminating power of items. Test questions are used to measure students' critical thinking skills in the experimental class and control class. The results of the analysis of the test instrument trials are presented in Table 1, which clearly shows that there are five items used as pre-test and post-test questions in this research.

Data Analysis

To test the effectiveness of using LMS, the Posttest Only Control Design was used, namely the experimental class received learning using LMS and the control group received learning using WAG. The data tested is the post-test result, in the following way:

$H_0 : \mu_1 \leq \mu_2$ (The average critical thinking ability of students who receive learning using LMS is not better than those who receive learning using WAG)

$H_a : \mu_1 > \mu_2$ (The average critical thinking ability of students who received learning using LMS was better than those who received learning using WAG)

Furthermore, students' learning completeness is determined. Students complete learning if their critical thinking skills show a score of 75 after completing the questions. Meanwhile, classical learning completeness is fulfilled if at least 85% of students in the class have achieved learning mastery. To calculate the improvement of student's critical thinking ability in mathematics before and after learning, it is calculated by the normalized gain formula [27], namely:

$$N - \text{Gain } (g) = \frac{\text{post test score} - \text{pre test score}}{\text{maksimum idealscore} - \text{pre test score}}$$

The result of N-Gain calculation then interpreted on Table 2.

TABLE 2. Interpretasi N-Gain (g)

Amount of N-Gain (g)	Interpretation
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Medium
$g < 0,3$	Low

RESULT AND DISCUSSION

Test Prerequisite

It is clear that Table 3 illustrates that $L_{obs} < L_{table}$, dengan $\alpha = 5\%$ and $n = 36$, obtained $L_{0.05; 36} = 0.1477$ where $DK = \{L_0 | L_0 < 0.1477\}$ dan $L_0 = 0.1223 \notin DK$ and obtained $L_{0.05; 36} = 0.1477$ where $DK = \{L_0 | L_0 > 0.1477\}$ dan $L_0 = 0.1222 \notin DK$. Thus, it can be concluded that the samples from the experimental class and control class came from a normally distributed population.

TABLE 3. Normality test result

Learning strategy	n	L_{obs}	L_{table}	Hypothesis	Remark
Experiment	36	0.1223	0.1477	H_0	accept
Control	36	0.1222	0.1477	H_0	accept

After the two samples were proven to come from a normally distributed population, the homogeneity test was then carried out. This homogeneity test aims to determine whether the variances of the two groups are the same or not. is presented in Table 4 that $F_{obs} = 1.357$, $F_{table} = 1.757$, $\alpha = 5\%$, dan H_0 is accepted. It is concluded that the variance of the two groups is homogeneous.

TABLE 4. Homogeneity result

Learning strategy	n	F_{obs}	F_{table}	Hypothesis	Remark
Experiment	36	1.357	1.757	H_0	accept
Control	36				

Test Research Data

Based on the results of the prerequisite test, further tests were conducted to determine the differences in students' critical thinking skills from the application of LMS and WAG in learning mathematics. Table 5 shows that $s_p = 2.1776$, $t_{obs} = 3.031$, with a value of $v = 36 + 36 - 2 = 70$ and $\alpha = 5\%$, we get $t_{(0.05,70)} = 1.62$. Thus H_0 is rejected. It can be concluded that the critical thinking ability of students in the class using LMS is better than the class using WAG.

TABLE 5. The results from the t-test of the post-test scores

Learning strategy	n	mean	t_{obs}	t_{table}	Hypothesis	Remark
Experiment	36	12.694	3.031	1.62	H_0	reject
Control	36	12.139				

Pre-test value data was obtained at the beginning of learning before using LMS for online mathematics learning, while post-test scores were obtained after giving learning treatment using LMS. Table 6 clearly shows the achievement of learning completeness. Students who use the LMS, the percentage of complete learning is 86.635% (32 students), students who use the WAG are only 72.222% (26 students) which means that there are still many students who have not completed reaching the KKM.

TABLE 6. Mean of pre-test, post-test, and mastery learning percentage

Learning strategy	Mean		Mastery learning Percentage
	Pre-test	Post-test	
Experiment	7.638	13.694	88.889%
Control	6.982	12.139	72.222%

The N-Gain test is used to see the improvement of students' critical thinking skills from the application of each lesson. The data used are pre-test and post-test value data. It is clearly presented in Table 7 that the improvement of students' critical thinking skills in the experimental class is in the medium category. This shows that the use of LMS is better for improving students' critical thinking skills than learning that only uses WAG.

TABLE 7. Improved students' critical thinking

Critical Thinking	N-Gain			
	Control Class	Interpretation	Experiment Class	Interpretation
Giving Basic				
Explanation	0.11	Low	0.39	Medium
Analyze	0.36	Medium	0.42	Medium
Strategy	0.38	Medium	0.43	Medium
Conclude	0.20	Low	0.37	Medium
Average	0.263	Low	0.408	Medium
N-Gain				

The results showed that the critical thinking ability of students who learned to use LMS was better than the critical thinking skills of students who learned to use WAG. However, the results of this study provide a different perspective compared to the research of Purnama [15] and Susilowati [16] which concludes that online learning using WAG is better than using LMS by paying attention to the system applied during learning. This is very possible because online learning using LMS greatly facilitates students to exchange information with students quickly and flexibly [15][18][19]. Students get learning materials, practice questions, assignments, interact with teachers, or with other students, and get other sources or teaching materials related to the learning materials being discussed during the learning process using LMS [7][8][20]. This is supported by the majority of students (88.889%) completing the KKM as determined by the school. Furthermore, this fact is also strengthened by increasing students' critical thinking skills. The advantage of using LMS is that there is a discussion forum menu and chat. Through this menu, there is interaction between students and students, students and teachers, so that student activity in learning is higher [6][8][9][21].

Differences in students' critical thinking abilities are caused by differences in features in the use of LMS and WAG [8]. In the use of LMS, material can be presented in each woman so that teaching materials can be divided into small

units and these materials can be stored neatly so that students can access them anytime, anywhere. WAG as a means of learning mathematics online can also exchange information, exchange photos, videos, and voice notes [10][13][14]. However, there are several advantages of LMS, namely the existence of video conferencing for face-to-face learning of students with teachers and quizzes at the end of the subject matter so that students can measure their understanding. Students can answer the questions that have been provided and can find out the correct answers and the scores they get [7][8][12][19][21].

CONCLUSION

This research shows that the use of LMS is more effectively applied in online learning than online learning using WAG. This is in line with the critical thinking ability of students who received learning using LMS better than the critical thinking skills of students who received learning using WAG. Most of the students finished studying and improving their critical thinking skills in the medium category. The results of this study become a new perspective compared to the results of previous studies which show that the use of WAG is more effective in online learning. Furthermore, further research is needed to see the consistency of the results of previous studies so that the consistency of the effectiveness of using LMS in online mathematics learning is obtained.

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