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Comparison of the group investigation learning model and the eliciting activities model in improving mathematical critical thinking ability

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Abstract
This research was conducted based on the low critical mathematical thinking abilities of class VIII students at SMP Negeri 1 Kutasari. Researchers chose the group investigation model and eliciting activities model to address students' critical mathematical thinking abilities. The aim of this research was to find out whether there was a difference in the average mathematical critical thinking abilities of class VIII students at SMP Negeri 1 Kutasari who were taught using the group investigation model and the eliciting activities model. The type of research used is quasi-experimental research with a nonequivalent control group research design. The population of this research were all students in class VIII of SMP Negeri 1 Kutasari, totaling 256 students, with a sample of 32 students in class VIII A and 32 students in class VIII B. Data collection methods were carried out by interviews, observation, tests and documentation. Data analysis techniques include normality tests, homogeneity test, n-gain test and t test. Based on the results of the t test on the results of the n-gain score, a value of 0.000 < 0.05 was obtained, so H_1 was accepted. So, it can be concluded that there is a difference in the average mathematical critical thinking ability of class VIII students at SMP Negeri 1 Kutasari who are taught using the group investigation learning model and the eliciting activities model.

Keywords: *Eliciting Activities Learning Model, Group Investigation Learning Model[2], Mathematical Critical Thinking Ability[3]*

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INTRODUCTION

According to Law Number 12 of 2012, education is an effort that enables students to actively develop mental strength, self-discipline, character, intelligence and potential skills needed for themselves and the community, nation and state in creating an atmosphere and learning process (Danyanti, 2016). Efforts to improve the quality of education are one of the strategic points in efforts to create quality education (Heriyanto, 2021).

Mathematical abilities have a role for students in the mathematics learning process because they are the abilities needed by every student to respond to a problem. This mathematical ability is critical thinking. Mathematical critical thinking ability is the ability to combine previous knowledge, mathematical reasoning, and cognitive strategies to generalize, prove, or reflectively evaluate unknown mathematical situations, where a person cannot directly understand mathematical concepts and solve problems (Maulana, 2017).

Based on an interview with one of the mathematics teachers at SMP Negeri 1 Kutasari, he said that students still lack critical mathematical thinking skills. Students cannot yet explain the problem, so they cannot decide which strategy or technique to use, and cannot draw conclusions about the results. The mathematics teacher also explained that it was still difficult to improve these abilities because they did not know what learning models could be used. Students become less enthusiastic about learning and their views on mathematics become less critical. Apart from interviews, preliminary tests are also carried out on students. The preliminary test was carried out in class VII-D by researchers with a total of 34 students, namely 32 students took the test and 2 students could not participate due to permission. Based on the results of the preliminary test, the highest point was 50.0, the lowest point was 11.1, and the average point was 32.8 from the ideal value of 100. So the student's mathematical critical thinking ability score can be categorized as very low.

The lack of critical mathematical thinking skills is influenced by five factors, namely internal, external, learning approaches, and the school and community environment. Internal factors come from within the

student. External factors arise from the student's environment, including family relationships. Learning approach factors include strategies and models used by students in learning activities. School factors include the curriculum. Community environmental factors include students' social activities, mass media, friends they associate with, and forms of community life (Muhibbin, 2005). Of these five factors, students' learning approaches are the main driver of learning. As explained in the observations, the learning model is the main problem that reduces students' mathematical critical thinking abilities. Therefore, a good learning model is needed to improve students' mathematical critical thinking skills.

There are several learning models that can be considered with indicators of mathematical critical thinking skills, namely the Group Investigation (GI) learning model. The GI learning model is a very complex form of cooperative learning that combines several main ideas where students participate in groups to investigate a particular topic or object. Therefore, the focus of this learning model is on exploring mathematics topics (Sugiani, 2022). The reason this model can be used to improve mathematical critical thinking skills is found in the steps, namely: (1) identifying topics and organizing students into groups, (2) designing tasks to be studied, (3) carrying out investigations, (4) prepare the final report, (5) present the final report, (6) provide a review (Andi & Nining, 2020).

Apart from the GI learning model, there is another learning model that contains four indicators of mathematical critical thinking abilities in learning, namely the Eliciting Activities Model (MEAs). This model is a learning model that focuses on student activities to solve a problem by creating a mathematical model and testing the model (Bilqis, 2020). The reason this model can be used to improve mathematical critical thinking skills is in the steps, namely: (1) the educator reads the question sheet which develops the students' situation, (2) the students are prepared to answer questions based on the question sheet, (3) the educator reads the questions with the students and ensures that each group understands what is being asked, (4) the students try to solve the problem, and (5) students discuss and review the solution before presenting their mathematical model (Eva, 2019).

From the general learning model class, each learning model can improve students' mathematical critical thinking abilities. Like in Eva Rusdiana and Sucipto's research entitled "Improving Mathematical Critical Thinking Abilities Through the Application of the Group Investigation Type Cooperative Learning Model", explained that the GI model can improve mathematical critical thinking abilities (Rusdiana & Sucipto, 2018). Apart from that, in research conducted by Junaidi and Taufik entitled "Application of the Eliciting Activities Model Approach in Mathematics Learning to Improve Junior High School Students' Critical Thinking Abilities" it was also explained that the MEAs model is an alternative learning model that can influence students' mathematical critical thinking abilities, because presentation of realistic mathematical problems. So that students can be actively involved in the mathematics learning process in class (Junaidi & Taufiq, 2019).

The aim of this research is to find out whether there are difference in the average mathematical critical thinking ability of class VIII students at SMP Negeri 1 Kutasari who are taught using the Group Investigation (GI) learning model and the Eliciting Activities (MEAs) model. The hypothesis in this research is:
H_0: There is no difference in the average mathematical critical thinking ability of class VIII students at SMP Negeri 1 Kutasari who are taught using the GI learning model and the MEAs model.
H_1: There is a difference in the average mathematical critical thinking ability of class VIII students at SMP Negeri 1 Kutasari who are taught using the GI learning model and the MEAs model.

METHOD

The method used in this research is quasi-experimental research with the Nonequivalent Control Group research type. The population of this study was all students in class VIII of SMP Negeri 1 Kutasari, totaling 256 students in a total of 8 classes. The samples in this study were class VIII-A with a total of 32 students and class VIII-B with a total of 32 students. The sampling technique in this research was carried out using convenience sampling where the researcher took respondents as samples based on class which could be used during the research to determine the first experimental class and the second experimental class. This research was conducted in two groups, namely experimental group I which used the group investigation learning model and experimental group II which used the eliciting activities model. The design of this research uses the pretest-posttest method, namely the pretest is carried out at the beginning of the treatment and the posttest is carried out after the treatment, with the aim of finding out the differences in the conditions of the two classes. The research design used is shown in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment I (group investigation model)	O_1	X_1	O_2
Experiment II (eliciting activities model)	O_3	X_2	O_4

Information (Wahyuni et al., 2017):
X_1 = Experimental treatment 1 using the group investigation model
X_2 = Experimental treatment II using the eliciting activities model
O_1 = Student scores before being taught using the group investigation model
O_2 = Student score after being taught using the group investigation model
O_3 = Student scores before being taught using the eliciting activities model
O_4 = Student score after being taught using the eliciting activities model

Before being given treatment, both classes were given a pretest ($O1$ and $O3$) to determine the initial condition of the class. After that, both classes received treatment. The first experimental class was treated using the group investigation model. Meanwhile, the second experimental class was treated using the eliciting activities model. At the end of the research, both groups were given a posttest ($O2$ and $O4$) to find out the results.

The data collection used is in the form of tests, and tests are used to develop students' mathematical critical thinking abilities. This test was carried out by using test description questions including pretest and posttest which on each instrument consisted of 3 questions and had been validated and proven to be reliable, with results of a validity level in the range of 0,718 to 0,804, and a reliability in the range 0,758 to 0,795. To test the hypothesis using the N-Gain test and t-test for two independent samples, the prerequisite analysis tests are first carried out in the form of normality tests and homogeneity tests.

RESULTS

The mathematical material used in this research is the System of Linear Equations in Two Variables (SPLDV) with 1 meeting for the pretest, 4 meetings for treatment, and 1 meeting for the posttest. This research was carried out to find out whether there was a difference in the average of students' mathematical critical thinking abilities between students who were taught using the Group Investigation (GI) learning model and the Eliciting Activities (MEAs) learning model. The pretest was given before the two experimental classes were given treatment, and the posttest was given after the two experimental classes were given treatment. Table 2 is research data in the form of a comparison of pretest and posttest results in experimental class I and experimental class II.

Table 2. Comparison of Pretest and Posttest Results in Experimental Class I and Experimental Class II

Information	*Pretest*		*Posttest*	
	Experiment I	Experiment II	Experiment I	Experiment II
The number of students	32	32	32	32
The highest score	75	51	86	90
Lowest score	24	25	41	55
Average	38	34	62	73

The normality test in this study uses the Kolmogorov Smirnov test, with guidelines for decision making in the test, namely if you get a significance value of ≥ 0.05 for normal distribution data. Following normality test results for Experiment class I and Experiment class II.

Table 3. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	Df	Sig.	Statistic	Df	Sig.
NGain_Score	Experiment I	.099	32	.200	.959	32	.261
	Experiment II	.153	32	.055	.955	32	.206

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on Table 3, it can be seen that the significance value of the Kolmogorov Smirnov test in experimental classes I and II obtained values of 0.200 and 0.055, which indicates that both experimental classes are above the significance level, namely 0.05. Therefore, it can be concluded that the n-gain scores for experimental classes I and II are normally distributed.

After the two sample data are declared to be normally distributed, a homogeneity test is then carried out using the Levene test, with guidelines for decision making in the test, namely if the data results obtained are ≥ significance level = 0.05, then the resulting data are not homogeneous. Homogeneity tests are carried out to find out whether several population variants are the same or not. Following results of homogeneity tests for Experiment class I and Experiment class II.

Table 4. Homogeneity Test Results

Test of Homogeneity of Variances

NGain_Score

Levene Statistic	df1	df2	Sig.
.017	1	62	.898

Based on Table 4, it shows that the significance value is 0.898 where > 0.05, meaning that H1 is rejected and H0 is accepted, so it can be concluded that the n-gain scores for both classes are homogeneous.

The N-Gain score is used to help improve students' mathematical critical thinking skills. Following are the research data in the form of N-Gain score test results in experimental class I and experimental class II.

Table 5. Recapitulation of N-Gain Score Test Results for Experimental Class I and Experimental Class II

	Experimental Class I	Experimental Class II
The number of students	32	32
Highest score	0,79	0,84
Lowest score	0,09	0,31
Average	0,38	0,60

Based on Table 5, it is known that the average N-Gain score in experimental class I is 0.38 and the average N-Gain score in experimental class II is 0.60. If the average value of the N-Gain score is given as a percentage, the experimental class I is worth 38%, which if interpreted means that it can be interpreted as not being reflective, while the experimental class II is worth 60%, which if interpreted means that it could be interpreted as being quite reflective.

Next, a two independent sample t test analysis was carried out. The purpose of the t-test for two independent samples is to determine the comparison of the difference between two calculated means from two independent samples (Sugiyono, 2015). The following are the results of the t-test data analysis for two independent samples.

Table 6. Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
N-Gain Score	Equal variances assumed	.017	.898	-5.709	62	.000	-.216	.0378	-.2916	-.14035
	Equal variances not assumed			-5.709	61.34	.000	-.216	.0378	-.2916	-.14033

Based on Table 6, it is known that in the equal variances assumed and equal variances not assumed sections there are two significance values, namely 0.000, which in this study uses the equal variances assumed significance value because from the homogeneity test it is known that the data variants are the same. So, it can be concluded that the significance value means that H0 is rejected and H1 is accepted. So there is a significant difference between the mathematical critical thinking abilities of students who use it group investigation model and the eliciting activities model in the SPLDV material, where based on the comparison of the average n-gain value for experimental class II, it is 0.60 more than the average value. -The average n-gain for experimental class I was 0.38, so the results showed that the mathematical critical thinking abilities of experimental class II students who were taught using the eliciting activities model were better than experimental class I who were taught using the group investigation model.

DISCUSSION

This research was carried out at SMP Negeri 1 Kutasari, with the samples in the research being some of the class VIII students at the 2023/2024 school year. Class VIII students at SMP Negeri 1 Kutasari have the problem that their students' mathematical critical thinking skills are very low, this can be proven by the average result of student answers on the initial preliminary test of 32.8% from the final score of 100% and the results of interviews that can It was concluded that class VIII students were still lacking in mastering students' critical mathematical thinking skills. From all these points of view, it can be concluded that students' low critical mathematical thinking abilities originate from external factors which also have an impact on internal factors, namely the learning model. Learning models that can improve critical mathematical thinking skills are the Group Investigation 9GI) learning model and the Eliciting Activities (MEAs) model.

This research aims to understand the differences in students' mathematical critical thinking abilities between those provided by implementing the GI learning model and the MEAs learning model in class VIII of SMP Negeri 1 Kutasari. The sampling technique used in this research is a simple random sampling technique, with the reason that the level of mathematical critical thinking abilities of students in each class is considered homogeneous (the same). The samples in this study were two classes, namely class VIII-A as the Experiment I class which used the GI learning model with a total of 32 students and class VIII-B as the Experiment II class which used the MEAs learning model with a total of 32 students.

Based on pretest data, the mean result in experimental class I was 38 and in experimental class II was 34, while based on posttest data the mean result in experimental class I was 62 and in experimental class II was 73, this shows that students' mathematical critical thinking abilities are taught using a MEAs learning model were higher than students who were taught using the GI learning model. If based on the results of the t-test of two independent samples, a significance value of 0.000<0.05 is obtained, it can be concluded that there is a significant difference between the mathematical critical thinking abilities of students who are taught using the GI learning model and the MEAs learning model.

Based on the results of the data presented, there is a significant average difference in students' mathematical critical thinking abilities. The eliciting activities model is superior to use compared to the group investigation model, because in the learning process of the eliciting activities model there are steps that can have more impact on mathematical critical thinking skills than the steps contained in the group investigation

model. The steps in the eliciting activities model that can improve critical mathematical thinking skills are in groups of students solving story problems by producing mathematical models.

This is in line with research conducted by Apriyanto et al. (2020) which found that the mathematical critical thinking abilities of Class VII students at SMPN 196 Jakarta who received the eliciting activities model had a higher influence than the group investigation learning model on mathematical critical thinking abilities. This is also in line with research by Eva Rusdiana and Sucipto which states that students' mathematical critical thinking abilities using the group investigation learning model have an effect on students' mathematical critical thinking abilities (Rusdiana & Sucipto, 2018). This research is also in line with research conducted by Junaidi and Taufiq which states that the eliciting activities learning model approach for junior high school students has an effect on mathematical critical thinking abilities (Junaidi & Taufiq, 2019). This research is also in line with research conducted by Lilis Arini which states that the use of students' critical mathematical thinking skills influences the group investigation learning model (Lilis Arini, 2021). And this research is also in line with research conducted by Kurnia Illahi, Heni Pujiastuti, and Samsuri which states that the eliciting activities learning model approach for junior high school students has an effect on mathematical critical thinking abilities (Illahi et al., 2019).

CONCLUSION

Based on the results of the research and discussions that have been carried out, it can be concluded that there are differences in the average students' mathematical critical thinking abilities in classes VIII A and VIII B at SMP Negeri 1 Kutasari in learning taught with the group investigation model and the eliciting activities model. It can be seen that the average n-gain value during learning in experimental class I is equal to 0.38 and the average n-gain score during study in experimental class II was 0.60. From the results of the n-gain interpretation, it can be seen that the group investigation learning model is interpreted as ineffective with an average percentage value of 38%. Meanwhile, the eliciting activities model is interpreted as quite effective with an average percentage value of 60%. Meanwhile, based on analysis using the two independent samples t-test, states that there are significant differences between the two. This can be seen from the calculations carried out with SPSS Statistics 22, the results of the two independent samples t-test reached significance, namely if it is less than the significance limit of 0.05 then H0 is rejected and H1 is accepted. Therefore, the conclusion is that the eliciting activities learning model is better than the group investigation learning model in improving the critical mathematical thinking skills of class VIII students at SMP Negeri 1 Kutasari on SPLDV material. Based on the conclusion, it is recommended that in order for students' mathematical critical thinking skills to increase, the eliciting activities learning model can be used in the learning process. This is because the eliciting activities learning model provides students with the opportunity to develop their abilities in critical mathematical thinking.

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