Understanding of Mathematical Concepts Reviewed from The Use of The Cooperative Learning Model Group Investigation (GI)

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Abstract

This study aims to find out whether there is a significant relationship between the understanding of mathematical concepts of students who use the group investigation type cooperative learning model and students who receive conventional learning at SMP Muhammadiyah 3 Bandar Lampung. In this study, the research population consisted of two classes with a total of 30 students, each categorized as a control class and an experimental class. The purposive sampling method was used for this study. The pretest-posttest control group is the research design used. In addition to using tools such as tests, observation sheets, and interview sheets, data is collected through documentation, observation, and interviews. The test consists of five essay questions that are tested for validity, reliability, discriminating power, and difficulty level. After the data were declared to meet the requirements of normality and homogeneity, the hypothesis test was carried out by independent sample test t. Independent random t-tests are used to check the validity, reliability, discriminating power, difficulty level, normality, and hypothesis of the data. The results showed that students in the experimental class had an average score of 84.33 after the test, and students in the control class had an average score of 73.50. Based on these findings, it can be concluded that students who use the Group Investigation type cooperative learning model have a better understanding of mathematics compared to students who use conventional learning methods.

Keywords: group investigation; learning model; mathematical concepts

INTRODUCTION

Understanding mathematical concepts is an important component of the learning process in schools (Hardianti et al., 2023; Fitria Lestari et al., 2021). The use of learning models is essential to enable students to access these concepts (Devita et al., 2023; Efendi et al., 2023). The Group Investigation (GI) type cooperative model is an interesting learning model because it encourages students to actively participate in the learning process and not just receive information. This article discusses more about how using cooperative GI models can improve understanding of mathematical concepts. How the GI learning model encourages cooperation and mutual understanding, and creates an inclusive and student-centered learning environment. Armed with a better understanding of this model, educators are expected to find effective approaches to teaching mathematics.

The purpose of this article is to provide an in-depth overview of the relationship between understanding mathematical concepts and using the GI cooperative learning model. How the Group Investigation type cooperative learning model is effective in improving students' understanding of mathematical concepts. One of the advantages of this model is that it can help students create learning methods that suit their own learning style (Marhamah, 2017). Additionally, the model leverages a variety of educational resources, such as literature, the internet, and discussions between students in class, allowing students to access content at their

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own pace. This is expected to help students understand mathematical concepts visually (Hardianti et al., 2020; Noprisa et al., 2024). Creating an active and interactive learning environment to improve the learning process (F Lestari, 2019).

The main purpose of teaching is to help students understand the core concepts of a subject, not just memorize (Hardianti & Desmayanasari, 2022; Nugroho et al., 2017). Learning objectives cannot be achieved if students do not understand mathematical concepts well (Aini Asyhara et al., 2018; Hardianti et al., 2023). This is supported by observation data that shows that the average daily test score of Social Arithmetic in class VII-D is only 51.38, far below the Minimum Completeness Criteria (MCC) of 75. Only 12 percent of students met these criteria. Data on the Results of Mathematics Daily Test Scores on the Subject of Social Arithmetic for Students of Grade VII-A SMP Muhammadiyah 3 Bandar Lampung 2022/2023 can be seen in the following table:

Table 1. Data on Daily Test Results

No	Score	Criteria	Total	Percentage (%)
1	> 75	Complet	4	12
2	< 75	Not Complet	32	88
Total			36	100

Source: Data Organizer

Teachers serve as facilitators in the learning process and are responsible for choosing learning models that will encourage the active participation of students and the application of what they know. The GI cooperative learning model is one of the effective models to encourage students to work together (Dalimunthe & Risma Delima Harahap, 2021; Jimatul Rizki et al., 2024). Teachers can increase student engagement and encourage them to share other ideas during the learning process by using the GI model (Fitriyah et al., 2018; Nugroho et al., 2017).

In addition to expressing opinions, students also talk and work together with friends to overcome problems (Hartikainen, 2019; Nae & Niculina, 2017). Thus, it helps students think critically, cooperate, and be social and helps understand the concepts taught (Anwar, 2019; Desmawati & Farida, 2018). The application of the GI model in experimental classrooms can increase students' interest in learning, encourage students to discuss, find solutions, and ask each other (Marhamah, 2017; Rosyidah, 2024).

Therefore, teachers have an important role in determining effective learning models to encourage students to participate more actively in the learning process (Hsu, 2017; Intan Putri & Widi Wardani, 2024). Types of cooperative learning models such as GI allow students to actively participate, work together, and talk to each other. Students not only acquire critical thinking skills and social skills, but also better understand what is being taught (Desmayanasari & Hardianti, 2021).

RESEARCH METHODS

The design used in this study is One Group Pre-Test-Post-test The research procedure can be seen in the following table.

Table 2. Research Design

Group	Pre-Test	Treatment	Post Test
Experiment	Y_{11}		Y_{21}
Control	Y_{12}	$\sqrt{}$	Y_{22}

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Source: Data Organizer

$\sqrt{}$: providing treatment (learning model)(Hartikainen, 2019; Nae & Niculina, 2017)

Y_{11} : pre test for group A

Y_{12} : pre test for group B

Y_{21} : post test for group A

Y_{22} : post test for group B

The population in this study is all grade VII students at SMP Muhammadiyah 3 Bandar Lampung. The method used to select the sample is the purposive sampling method.

Two classes were selected based on certain standards suggested by the school's mathematics teacher. The class consists of an experimental class and a control class that have the same or not significantly different level of ability, namely class VII D is used as an experimental class and class VII C is used as a control class.

The data collection method uses tests, both for learning that uses a cooperative group investigation model and those that do not. The test is in the form of an essay to measure students' understanding of mathematical concepts. The test is tested to meet standards of validity, reliability, differentiation, and difficulty to ensure data quality.

The steps carried out in this study use a GI-type cooperative learning model which can be seen in the following figure.
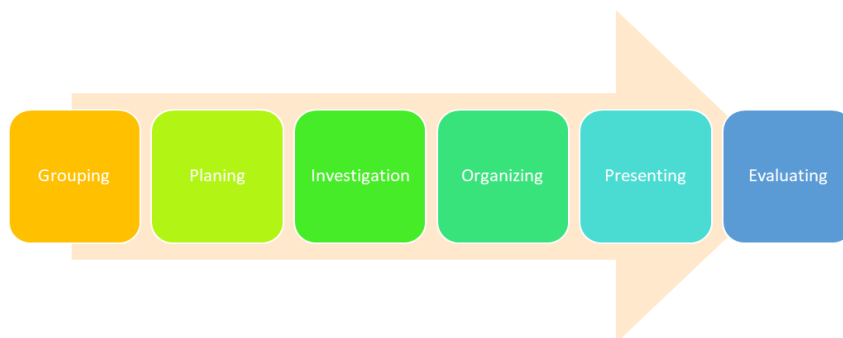

Figure 1. Research steps

Grouping   : categorize students in heterogeneous groups to evaluate the extent to which each student understands the concepts learned.

Planning   : Pre-test to assess students' initial understanding of mathematical concepts then students enter a collaborative stage where they jointly plan the learning process, including learning objectives, methods to be applied, and explanations of mathematical concepts or topics that are in accordance with the Learning Implementation Plan (LIP).

Investigation   : Students collect data, analyze information, and draw conclusions based on the problems they investigate.

Organizing   : At the stage of preparing the final report, each group forms a team to organize class discussions during the presentation of the investigation results. Students will identify the relationship between the findings of the investigation and the concepts they have learned before, as well as divide the tasks in groups.

Presenting   : The final report submission stage involves each group in presenting the results of its investigation using various forms of presentation, accompanied by discussion and question and answer sessions among group members.

Evaluating   : Student project assessments are carried out through cooperation between

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teachers and students in evaluating the work process and results. Then, a post-test is given to measure students' understanding of concepts.

RESEARCH RESULTS

The application of the GI type cooperative learning model was carried out after the pre-test in the experimental class. The results of the mathematics pretest showed that the highest score of students was 70 and the lowest score was 30, with an average of 50.83, a median of 52.50, and a mode of 55. Then, a post-test was carried out after the implementation of the GI learning model. The results show an increase. The highest score in the post-test reached 95, while the lowest score was 75, with an average of 84.33, a median of 85.00, and a mode of 80. Further details regarding the distribution of this data can be found in the following table.

Table 3. Pre-test and Post-test Experiment Class

Experiment Class	Pre-Test	Post-Test
Maximum Value	70	95
Minimum Value	30	75
Mean	50.83	84.33
Standard Deviation	12.804	6.789

Source: Data Organizer

The Recapitulation of the percentage of mathematical concept comprehension test Indicators can be seen in the following table.

Table 4. Recapitulation of Percentage of Mathematical Concept Comprehension Test Indicators

Indicators understanding of mathematical concepts	Question number	Number of participants educated people who understand the concept		Percentage	
		Pre-Test	Post-Test	Pre-Test	Post-Test
Re-explaining the concept	2	8	13	26,67 %	43,33 %
Grouping objects based on specific characteristics or characteristics	3	7	15	23,33 %	50 %
Give an example and the non-example	1	11	23	36,67 %	76,67 %
Presenting concepts through various forms of representation	4	6	14	20 %	46,67 %
Performing, using, and selecting specific steps or actions, and applying concepts or algorithms to solve problems	5	5	12	16,67 %	40 %

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Source: Data Organizer

An independent t-test was used to find out whether the post-test scores of students in the experimental group and the control group were different. The test results obtained a Sig value (2-tailed) of 0.002, less than 0.05. Thus, it can be concluded that there is a significant difference in the average learning outcomes between the use of the Group Investigation type cooperative learning model and the conventional learning model.

Based on the evaluation of the pre-test and post-test scores of the experimental class (VII D) using the Group Investigation model and the control class (VII C) using conventional learning, the students in the experimental class obtained an average score of 50.83 in understanding mathematical concepts, while the students in the control class obtained a score of 49.50. This showed that both groups had almost the same ability to understand mathematical concepts before the intervention, although the average score of students in the experimental class increased to 84.33 after the intervention, while the average score of students in the control class only reached 73.50. This shows that, compared to the control class, the experimental class understands mathematical concepts better. Thus, the application of the Group Investigation type cooperative learning model has a significant impact on students' mathematical understanding.

CONCLUSION

The results of the study show that this model increases students' desire to learn and their involvement in the lesson which has a positive impact on the mastery of concepts and application of subject matter.

Based on the results of the study, it was concluded that the average score of the post-test understanding of mathematical concepts of students in the experimental class was 84.33, while in the control class was 73.50. With a Sig (2-tailed) value of 0.004 based on an independent t sample test, it means that it shows a significant influence of the application of the Group Investigation type cooperative learning model on students' mathematical understanding.

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