Application of Cooperative Learning to Improve the Understanding of Mathematical Concepts in Junior High School

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ABSTRACT

The purpose of this study is to improve learning activities and understanding mathematical concepts by applying the Group Investigation of cooperative learning model in class VIII.6 SMP Negeri 4 Bengkulu City. This research was a Classroom Action Research. The instrument used was the student's activity observation sheet and the student's concept understanding test sheet. Improved learning activities can be done by: using props at each meeting, reminding students how to measure appropriately, distracting students' attention by provoking students' ideas, and lazy group members will be designated as presenter groups. Increased student' learning activities in the first cycle with an average of 21.5 (quite active), and the second cycle increased by an average of 28.75 (active). An increase in understanding of mathematical concepts can be done by: each student notes the important things presented by the presenter group, and is given practice questions at the end of each meeting. Increased students' understanding of mathematical concepts seen from the average test results of students' understanding concepts in the first cycle that was 60.61 and in the second cycle increased to 76.62. The percentage of mastery learning classically in the first cycle was 39.39% and in the second cycle was 63.64%.

Keywords: Classroom Action Research, Learning Activities, Concept Understanding, Group Investigation,

INTRODUCTION

Education plays an important role in advancing the nation and state. In Indonesia, the government requires every child to get at least nine years of education. One of the important subjects in education is mathematics. The purpose of mathematics subject is to be able to produce the students who have a good understanding. Learning mathematics does not only understanding the numbers, but students should understand first these mathematical concepts. Conceptual understanding can be defined as an integrated and functional grasp of mathematics ideas (Kilpatrick, Swafford, & Findell, 2001: 118). According to NCTM (2000: 20), students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge. Conceptual understanding is an important component of proficiency.

Based on observations were made at SMP Negeri 4 Bengkulu City when learning mathematics in class VIII.6, it was found that the problem is still tends to place the teacher as the center of learning (learning is still conventional) and the limitations of learning support tools. This makes students do not explore much their knowledge, because the material is directly from teacher to student, and students only receive information which conveyed by the teacher. Moreover many students use memorization methods, such as memorizing mathematical formulas without understanding the concepts.

The results of the preliminary survey conducted in mathematics in 2019/2020 by giving questions on the material of straight-line equations to measure understanding of concepts. Based on

the analysis of the results of tests on 30 students who took the test in class VIII.6 SMP Negeri 4 Bengkulu City showed that there are still many students who do not understand the concept of a problem. The results of the analysis of the tests are presented in Table 1.

Table 1. Students' Understanding of Mathematical Concepts

The number of students who take the test	30
Grades of all students	1190
Average	39.67
The highest score	90
Many students complete	3
Lowest Value	20
Variance	18.66

To overcome these problems, it is necessary to apply a student-centered learning model that is a cooperative learning model. Based on the problems obtained, a research with the title "Application of Cooperative Learning Model Group Investigation Type to Improve the Understanding of Mathematical Concepts in Class VIII.6 SMP Negeri 4 Kota Bengkulu" should be carried out which can be an effort to improve students' understanding of mathematical concepts, especially the material on flat side space.

According to Arinda, Wilujeng, and Kuswanto (2019), learning model that is expected to be able to overcome the existing problems is cooperative learning model. Cooperative learning in question is Group Investigation (GI). The GI learning model is considered appropriate to be applied in the learning process because it can improve students' scientific working skills. Not only that, learning that uses this kind of learning models can also facilitate the limited time provided by the school. In cooperative learning there are several types that can be applied, one of which is Group Investigation. Type of Group Investigation provides an opportunity for students to be directly involved from the beginning of learning (planning) until the end of learning (implementation), as well as in recognizing and understanding learning material. As a result, the material that learned can be more directed and students interpret the learned material because students are involved in the investigation process. This model involves students from the planning, both in determining the topic as well as a way to learn through investigation, and requires the students to have good skills in communication and also group process skill. Therefore, this model requires students to have a good ability to communicate or in group process skills. Group Investigation model is based on democratic processes and decision-making in groups. Teachers play a role in helping students to plan, implement the plan, organize group, and serves as academic counselor (Sangadji, 2016). Different groups may be formed based on students' different skills, needs and learning styles, and students may keep learning in these groups. Every student in a group should be allowed to interact with other students and share his / her tools, knowledge and skills (Baki, Yildiz, Aydin, Köğce, 2010).

Slavin (2005: 218) describes several steps of cooperative learning with Group Investigation type, namely:

Stage 1: identify topics and organize students into groups.
Stage 2: plan the tasks to be learned.
Stage 3: carry out an investigation.
Stage 4: prepare the final report.
Stage 5: present the final report.
Stage 6: evaluation.

Understanding the concept is the main thing in the learning process. It needs to be emphasized on students so they can understand the meaning of a concept from learning. According to NCTM (2000: 21), conceptual understanding is an essential component of the knowledge needed to deal with novel problems and settings. According to Regulation of the Director General of Primary and

Secondary Education Number 506 / C / Kep / PP / 2004 in Hendriana, Rohaeti, and Sumarmo (2017: 7), detailed indicators of understanding mathematical concepts are able to:

a. Restate a concept.
b. Classify objects according to certain properties based on the concept.
c. Give examples and not examples of concepts.
d. Present concepts in various forms of mathematical representation.
e. Develop the necessary or sufficient conditions of a concept.
f. Utilize and choose certain procedures or operations.
g. Apply concepts or algorithms in problem solving.

Learning activities involve all psychophysical effects of students both of physical and spiritual activities, and physical and mental activities. Both are highly interrelated, because learning activities will not succeed if only involves one of these psychophysical effects. Thus, it must involve both activities in order to create optimal learning activities. According to Sardiman (2014: 100), what is meant by learning activities are physical and mental activities. In this study the activity criteria emphasized are visual activities, oral activities, listening activities, writing activities, and mental activities that are tailored to the steps of Group Investigation learning. Mathematics learning that will be studied in junior high school (SMP) especially in class VIII Even Semester is to build flat side space. This material has Basic Competencies, namely:

3.9 Differentiate and determine the surface area and volume of flat side spaces (cubes, beams, prisms, and pyramid).
4.9 Solve problems related to surface area and volume of flat side spaces (cubes, beams, prisms, and pyramid), and their combinations.

In its application, the Group Investigation of cooperative learning model uses visual aids to build flat side spaces. As a result, students become more active in learning and the material that has been studied will make a longer imprint because students are involved in the investigation process. In the learning phase above, it is expected that with using the cooperative learning model Group Investigation can improve students' learning activities and students' understanding in mathematical concepts.

RESEARCH METHODS

This research is a Classroom Action Research (CAR). This research was conducted at SMPN 4 Bengkulu City. The subjects in this study were Class VIII.6 students of SMP Negeri 4 Bengkulu City with a total of 33 students, with 19 male students and 14 female students. Assessment of student learning activities through observation sheets observing student learning activities carried out by teachers and peers.

$$\text{Average score of students' learning activities} = \frac{Sum\ of\ Score}{Observer\ number}$$

Source: Aqib (2016)

After obtaining the student's score, the range of assessment scores for the student activity observation sheet can be found in table 2 below.

Table 2 Range of Student Learning Activity Scores

Assessment criteria	Score Range
Inactive (K)	$12 \leq <20.33x$
Active Enough (C)	$20.33 \leq <28.66x$
Active (B)	$28.66 \leq \leq 36.99x$

Source: Modified from Aqib (2016)

The range of scores for the calculation or analysis of activities per observed activity is also determined based on the interval division formula as follows:

$$\text{Interval} = \frac{3-1}{3} = \frac{2}{3} \approx 0{,}67$$

Thus, the score interval for student's activities per activity observed is 0.67. Grading criteria for analyzing student's activities per observed activity can be seen based on the following score range:

Table 3 Assessment Criteria for Observation of Student's Activities Per Observed Activity

Range of Student Activity Scores for Each Activity	Assessment criteria
$1.00 \leq <1.67x_i$	Less
$1.67 \leq <2.34x_i$	Enough
$2.34 \leq 3.00x_i$	Well

Source: Adaptation from Aqib (2016)

In order to see the percentage categories of achievement of all students for each indicator of concept understanding can be seen in the following Table 4.

Table 4 Guidelines for Assessment of Understanding Mathematical Concepts

Percentage of score obtained	Category
0% ≤ p <33.33%	Low
33.33% ≤ p <66.67%	Is
66.67% ≤ p <100%	High

Source: Arikunto (2009:)

Final student scores were obtained from the end of the cycle test. While the overall average grade of students or the grade average value was calculated using the formula:

$$\overline{X} = \frac{\sum x}{N}$$

Source: Sudjana (2016)

Based on the curriculum applied by SMP Negeri 4 Bengkulu City, completeness of individual learning is if students get a grade of 75 (KKM). To find out the classical completeness of students from many students who scored 75, the data were analyzed using the following formula:

$$p = \frac{\sum finished\ studying\ student}{\sum student} \times 100\%$$

Source: Aqib, et al (2014)

Students' learning activities are said to be successful if the score of student's activities at each meeting resulted in the range of 28.66 ≤ 36.99. At the end of each cycle, a concept understanding test was carried out. Concept understanding test data was analyzed using the average test score. Understanding of mathematical concepts is said to increase if the average test scores increase in each cycle. Classically the average value of students reaches 75 and the percentage of classical learning completeness 80% of the number of students who score 75.$x \geq \geq \geq$.

RESULTS AND DISCUSSION

Observation Student's activities in the learning process with the Group Investigation cooperative learning model for each meeting were observed by two observers. Observation of learning activities in class was using a student activity observation sheet with 12 statements.

Table 5. Comparative Scores of Classical Learning Activity Outcomes for Each Cycle

Observer	Cycle	
	Cycle I	Cycle II
Observer 1	21.5	28.25

Observer 2	21.5	29.25
Average	21.5	28.75
Category	Quite active	Active
Information	Not achieved yet	Reached

Based on table 5 above, it shows that the learning activities of students in the learning process with the Group Investigation cooperative learning model as a whole have increased each cycle. The average score in the first cycle was 21.5, and the average score in the second cycle was 28.75. In cycle II student's learning activities have reached the criteria of success. Based on learning activities, students have different or varying numbers.

Furthermore, the results of students' understanding concepts are obtained based on students'' final test scores, namely the final test of each cycle. Concept understanding tests are conducted to see the teacher's success in applying the Group Investigation cooperative learning model in learning. Based on the analysis of the students' understanding of the test results, the following results are obtained:

Table 6. Comparison of Classics Understanding Results for Students in Each Cycle.

Cycle	Average value	Number of Students Completed	Classical Learning Mastery
I	60.61	13	39.39%
II	76.62	21	63.64%

Based on table 6 above, it can be seen that an increase in the results of students' understanding concepts in succession from cycle I to cycle II, namely the average value of students in the first cycle of 60.61 increased in the second cycle of 76.62. The percentage of mastery learning in table 4.10 above also increased in each cycle. In the first cycle, which was 39.39%, this means that only 13 students received grades. In the second cycle increased to 63.64%, this means there are 21 students who get grades. Although in the second cycle the classical percentage of students has not reached 80%, but overall, it has been achieved and increased in each cycle. Overall percentage for each indicator of understanding the concept of students per cycle can be seen in the table below:$\geq 75 \geq 75$

Table 7. Percentage of Each Indicator on Understanding the Concept of Each Cycle

No	Indicator	Percentage Per Indicator (%)	
		Cycle I	Cycle II
1	Restate a concept	63.64	83.33
2	Classify objects according to certain properties according to the concept	72.73	81.82
3	Give examples and not examples of concepts	46.97	80.30
4	Present concepts in various forms of mathematical representation	53.03	71.21
5	Develop the necessary or sufficient conditions of a concept	53.03	65.15
6	Utilize and choose certain procedures or operations	72.73	80.30
7	Apply concepts or algorithms in problem solving	62.12	74.24

Based on table 7 above, it shows that the results of the concept understanding test increase in every cycle. This increase occurred for each indicator. It can be said that the Group Investigation type

cooperative learning model can improve students' understanding of mathematical concepts. So, the Group Investigation type cooperative learning model can be used to improve students' understanding of mathematical concepts. The following are the results of the test of understanding each individual's concept in cycle I and cycle II.

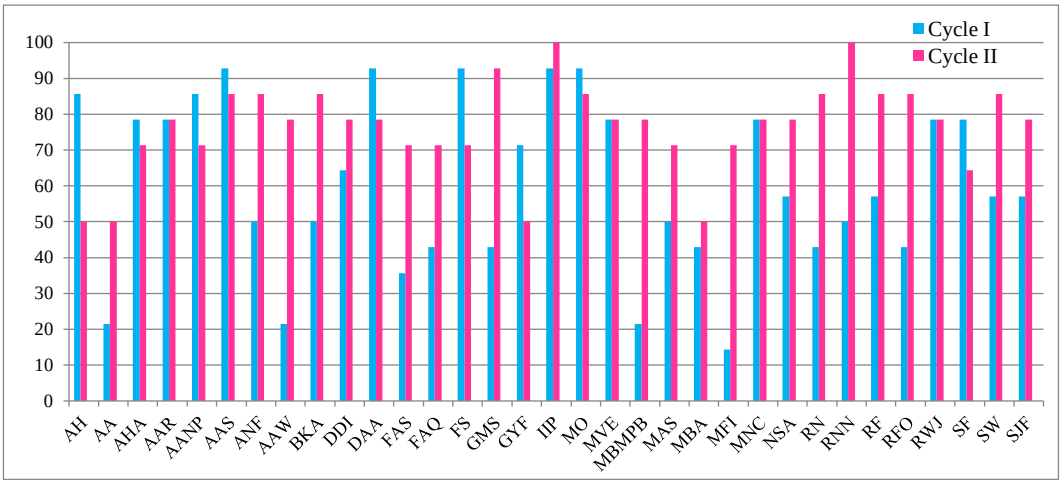

Figure 1. Test Results of Understanding the Concept of Each Individual in Cycle I and Cycle II

Based on Figure 1, it appears that there are 20 students whose grades always increase each cycle, then there were 4 students whose grades were stable, namely AAR, MVE, RWJ, and MNC. Furthermore, there were 9 students who experienced changes in the value that dropped, namely AH, AHA, AANP, AAS, DAA, FS, GYF, MO, and SF. Students who experience changes in grades dropped due to lazy in learning, less able to understand the concepts given, and the reason of forgetting the formula. Moreover, when given a question exercise, they look less serious in working on the question. It is still incorrect in writing the formula, and the workmanship that is done is still incomplete as a result of having an impact on the execution of the test cycle. The practice questions are given so that they are not surprised and more accustomed when facing questions on a cycle test. Analysis of the results of tests understanding students' concepts as a whole has shown that students' understanding of concepts has increased from cycle I to cycle II. Based on the data, it shows that the application of the Group Investigation cooperative learning model can improve the understanding of mathematical concepts in class VIII.6 SMP Negeri 4 Bengkulu City.

On the student's learning activities observation sheet consist of 12 observed activities. The observed activities are based on the stages of the Group Investigation type cooperative learning model observed by two observers for each cycle. Student's learning activities in this discussion section are analyzed based on observation sheets. The criteria for each activity observed are less active, quite active, and active. The following is a discussion of each of the stages in which there are a number of activities observed. The stage of Identifying Topics and Organizing Students into Observed Groups through activities number 1, 2, 3. The stage of planning the task to be studied is observed through activities number 4, 5. The stage of carrying out Investigations is observed through activities number 6, 7, 8.

Based on observations of overall students' learning activities, it can be seen that the students' learning activities increased from cycle I to cycle II. This increase in students' activity occurs because researchers always make corrective actions on any deficiencies that occur in the learning process that has been passed in each of its cycles. The actions taken for each activity at each cycle meeting will be discussed in detail below.

At activity 1, the students pay attention to the teacher's explanation about the student's worksheet that will be done by the student *(Listening Activities)*. Seen in the first cycle students pay

attention to the teacher's explanation about LKPD that will be done by students was quite well. It because the students look enthusiastic in observing, asking, and answering questions given by the teacher, but there are still students who are busy themselves and disturbing their peers especially students who sit behind. But in cycle II, activity 1 has increased. This is because the teacher gives more attention and the teacher reprimands noisy students. In Cycle II, the teacher appoints noisy students and asks them to repeat what the teacher says. So that with the teacher's attention slowly the student finally pays attention to the teacher's explanation well.

At activity 2, students pay attention to pictures or teaching aids and problems presented by the teacher in LKPD (Visual Activities). Before students are asked to work on LKPD, students are asked first to pay attention to the teaching aids or problems that exist in LKPD. In cycle I, it was still bad because students were still confused and not accustomed to learning to use LKPD and teaching aids. In this activity, the teacher always reminds each group to be serious and focused. In cycle II, the teacher invites students to ask questions if there is something that is not understood. Then in cycle II group members begin to be active and enthusiastic in paying attention to the teaching aids and problems presented by the teacher.

At activity 3, students discuss with their group friends about the topic to be studied (Oral Activities). In this activity is still bad, because only 1 to 3 people in a group who take a role in the discussion. In cycle II it increases slightly and there is a change. At activity 4, students read LKPD and determine what will be done (visual activities). In cycle I was still not good, because students were not accustomed to learning to use LKPD and were lazy to read the instructions listed in LKPD. In cycle II, lazy group members will be appointed to advance the presentation. Finally, they were enthusiastic to find out exactly what the content of the workload was given by the teacher.

At activity 5, namely students dividing assignments together with each group member (Oral Activities). In cycle I, it was good enough. The division of tasks in groups is very important to manage time efficiency in the work of the tasks given to be done with the group. The teacher gives a briefing that if the division of tasks is done it will speed up the work on the task in the discussion group. In cycle II as time goes by, students begin to get used to the distribution of tasks in LKPD. This is because teachers often remind about the application of the division of tasks. It can be seen that several groups implement this division of tasks are faster in completing the given task.

At activity 6, students and their group friends work together to conduct an investigation based on a given LKPD (Motor Activities). In cycle I was good enough, but there were still students who did not participate actively about the assignment. In cycle II, the teacher goes around and monitors group work, so that each group member discusses and works to investigate. At activity 7, students and their group friends collect data and information through literature and group discussions (Oral Activities). In cycle I was still not good, there were still many students who only focused on LKPD without looking for data information using sources such as the mathematics textbooks and there are still groups that were wrong in the measurement. In cycle II the teacher keeps reminding that students are not only focused on the LKPD, but students may use the resources in the textbook to help in completing the LKPD, and the teacher also reminds again how to measure using a ruler.

At activity 8, students solve problems in the LKPD (Mental Activities). In cycle I was good enough, but there were still some groups that were wrong in working on the problem. In cycle II, there are not too many problems in the form of questions so students can answer the questions correctly. At activity 9, namely students discussing with their group friends and write about the results of the investigation that will be presented (Mental Activities). In cycle I was good enough, but there were still students who did not participate in the discussion about the results of the investigation. In cycle II, all groups must divide each work to each group member, because each member in one group tells what they are investigating in order to be able to answer any results of the investigation that they have done.

At activity 10, of which students with their group friends deliver the results of the discussion in front of the class and students from other groups give opinions or rebuttal to the results of group

discussions who are presenting (Oral Activities). In cycle I was good enough, but there were still students who were silent and did not pay attention or respond to what was presented by the presenter group. In cycle II, each student is asked to record the things presented by the presenter's group in the notebook and after the presenter's group presents the results of their report, the teacher appoints one student to respond to what the presenter's group has delivered.

At activity 11, students must pay attention and respect the opinions of other students (listening activities). In the first cycle, it was not good, because some students made a fuss and thought the learning had been completed. As a result, the students' opinions were not heeded. In cycle II, the teacher emphasizes more that after the presentation does not mean learning has been completed, and students who are not presenting should focus on listening and paying attention to what is delivered by the presenter group.

At activity 12, students have to summarize the conclusions of each group (Oral Activities). In the first cycle, it is bad and there are still many students who ask questions with other groups about the conclusions from the material that has been learned. In cycle II, students who ask questions will be appointed to express what conclusions have been obtained.

As is well known, the main purpose of this study is to describe the application of the Group Investigation type cooperative learning model to improve the ability of understanding mathematical concepts. The results of understanding the concepts are obtained from the test scores given at the end of each cycle. This test consists of 7 questions. Questions are made based on indicators of concept understanding. This test is given to find out students' understanding of mathematical concepts of the material taught in each cycle. The following is one of the concepts understanding test questions given in the test.

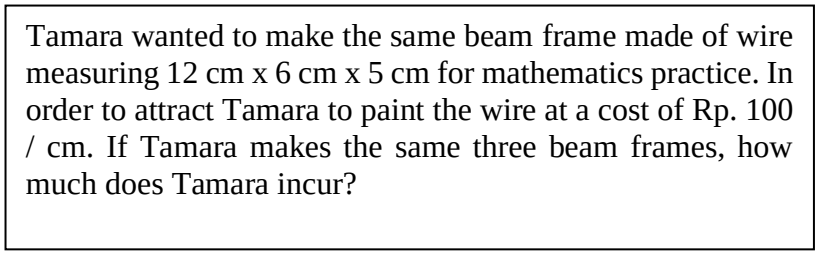

Figure 2: Concept Understanding Test Questions

Based on Figure 2, it can be seen that the first cycle test questions are arranged based on indicators of understanding concepts that are developing necessary or sufficient conditions of a concept. In this problem, there are still students who are still wrong in answering, because they put the formula in solving the problem. To overcome the possibility of students who are still answering incorrectly, then in the next cycle in the learning process the teacher will provide action by training students' thinking skills by giving practice questions to do, if students are unable to do so the teacher will guide the student. Furthermore, students are asked to note important things so that they understand the formulas that have been obtained in the work of LKPD so that they are not confused in determining the formula to be used. The improvement of the two cycles is the result of improving the learning process based on reflection and emphasizing some important things related to applying concepts or algorithms in problem solving. This is supported by research (Pranata, 2016) which concludes that by implementing the learning model of Investigation assisted by teaching aids, students' understanding ability will be increased. In addition, Anas, Hardeli, Anhar, and Sumarmin (2018) concluded that based on the result of the research, it can be concluded that there is improvement of students' biology learning competence through the application of cooperative learning model of Group Investigation (GI) type.

CONCLUSIONS

The increase in student learning activities, seen from the score of student learning activities in the first cycle with an average of 21.5 classified as quite active criteria, and for the second cycle of

student learning activities increased classified as active criteria with an average of 28.75. Furthermore, in the first cycle, the average value of students' understanding of mathematical concepts was 60.61 with the percentage of classical mastery learning that was 39.39%. In cycle II, the average value of students' understanding of mathematical concepts increased to 76.62 with a classical percentage of mastery learning at 63.64%.

1. The Group Investigation type cooperative learning model needs to be applied by mathematics teachers in class VIII.6 SMP Negeri 4 Bengkulu City, because this model is proven to be able to increase learning activities and students' understanding in mathematical concepts.
2. Pay more attention to time discipline so that the implementation of learning is more effective.
3. Pay more attention to the atmosphere of learning in order to remain conducive and students are more focused in the learning process.
4. Every activity and stage in learning must be given complete and clear instructions so that students do not always ask the teacher what they have to do.

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