IMPROVING JUNIOR HIGH SCHOOL STUDENT'S MATHEMATICAL UNDERSTANDING ABILITY USING DISCOVERY LEARNING MODEL ON RELATION AND FUNCTION MATERIAL

Rusmawan[1], Harry Dwi Putra[2], Heris Hendriana[3]

[1]MA Darussyifa Buninagara, Sindangkerta, Bandung Barat, Indonesia.
rusmawan@student.ikipsiliwangi.ac.id
[2]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
harrydp@ikipsiliwangi.ac.id
[3]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
herishen@ikipsiliwangi.ac.id

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ABSTRACT

The ability of students' mathematical understanding is one of the aspects needed by students in learning mathematics. With the ability to understand mathematics will make it easier for students to solve problems because students will be able to relate and solve these problems with the concepts they have understood. This study aims to see the improvement of the mathematical understanding ability of junior high school students using a discovery learning model on Relation and Function material. The type of this research is Classroom Action Research with the research sample being all grade VIII students in one of the junior high schools in West Bandung. This study consists of 2 cycles where each cycle consists of planning, action and implementation, observation and reflection stages, with before and after the study given 2 test instrument in the form of a description. In each cycle there is an activity observation sheet. Meanwhile, to analyze the data, it is seen from the test results provided, then all data and data results are processed using SPSS software. The results of this study showed that there was an increase in the completeness of learning scenarios for teachers by 92.31% and for students by 81.25%. In addition, the results of filling out the tests given each cycle showed good results with the number of students who scored above the minimum completeness criteria in cycle I by 73.08% and cycle II by 81.88%, meaning an increase of 8.8%. Based on this, it is expected that educators can apply the Discovery Learning Model with good planning and implementation so that student learning outcomes on relation and function material can increase.

Corresponding Author:

Rusmawan,
MA Darussyifa Buninagara,
Sindagkerta, Bandung Barat, Indonesia
Email: rusmawan@student.ikipsiliwangi.ac.id

INTRODUCTION

Education is a learning experience that people do deliberately to change their attitudes and behaviors as needed (Arfani, 2016). In order to improve the quality of education, we must

direct various matters related to education. Behind that, optimal and quality learning efforts are needed. Quality learning is learning that includes all the main components of the teaching and learning process: teachers, students and their interactions, and is supported by various learning components (Punaji, 2014).

Mathematics is one of the fields of science that plays an important role in the development of science and technology (Rahmawati & Permata, 2018). Understanding mathematical concepts is important because it is the foundation of many other fields of science, such as economics, physical science, and technology. The ability to understand mathematics can also help students in solving problems related to numbers and mathematical operations, and can improve their logical and analytical thinking skills (La'ia & Harefa, 2021). This ability can also help students in making the right decisions in everyday life (Maryati, 2018).

According to Putra et al., (2018) Mathematics is one of the subjects that are useful in everyday life, so it is important for students to master the basic concepts. Mathematics is studied by students at the secondary school level. High school students still have a lot of difficulty understanding math because the material is abstract to them, so they have difficulty when completing it. Teachers are expected to create meaningful, fun learning, and actively involve students in producing their own ideas or answers according to their own abilities. Students who are actively involved in participating in classroom learning have satisfactory learning outcomes compared to students who only silently record the teacher's explanation (Putra & Purwasih, 2016).

Understanding is a conception that can be digested or understood by students so that students understand what is meant, are able to find ways to express these conceptions, and can explore related possibilities (Parhusip & Hardini, 2020). It is not easy to understand something, let alone the understanding of mathematics. School Mathematics Study Group (Syarifah, 2017). According to Mastie and Johson Sariningsih, (2014), understanding occurs when people are able to recognize, explain and interpret a problem. Mathematics is one of the compulsory subjects in every formal education starting from the lowest level to the highest level of education, be it simple mathematics or complex mathematics (Rohaeti & Bernard, 2018).

Mathematics has an abstract nature consisting of facts, operations or relationships, concepts and principles (Martunis, Ikhsan & Rizal, 2014). So to learn mathematics requires good comprehension skills . According to Wulandari, (2018) there are seven indicators of mathematical comprehension ability, these indicators are students able to : (1) Define concepts verbally and in writing; (2) Identify and create examples and non-examples; (3) Use models, diagrams, and symbols to present a concept; (4) Change one form of representation to another; (5) Recognize various meanings and interpretations of concepts; (6) Identify the properties of a concept and recognize the conditions that determine a concept; (7) Compare and contrast concepts. The ability to understand mathematics is an important goal in learning (Ompusunggu, 2013).

The ability to understand mathematics provides an understanding that the materials taught to students are not just rote memorization. Students who have an understanding of mathematics have a more solid foundation or foundation in learning mathematics. The importance of students ' mathematical comprehension ability is stated by Nirmala (Wijayanto et al., 2018) that building understanding in every mathematics learning activity will develop one's mathematical knowledge. (Andriani et al., 2017) stated that there are many students who after learning mathematics, are unable to understand even the simplest parts. Many concepts are misunderstood so that mathematics is considered a difficult, complicated, and difficult science. Though mathematical understanding is the most important part in learning mathematics (Oktoviani et al., 2019).

Students' mathematical understanding is one of the aspects needed by students in learning mathematics. Having the ability to understand mathematics will make it easier for students to solve math problems because students will be able to solve these problems with the concepts they already understand. (Mulyani et al., 2018). Conversely, if students do not understand a given concept, students will tend to have difficulty in using and choosing certain procedures in applying concepts and problem-solving algorithms. As the learning principles advocated by the National Council of Teachers of Mathematics (NCTM, 2000: 11) say that, "in learning mathematics students must learn with understanding and actively build new knowledge from previous experience and knowledge".

Based on the data, junior high school students' mastery of mathematics material in Indonesia can be seen from the results of the reports of The Trends International in Mathematics and Science Study (TIMSS) in 1999, 2003, and 2007 and the results of the Program for International Student Assessment (PISA) tests in 2003 and 2006 which coordinated by the Organization for Economic Cooperation and Development (OECD) revealed that the mathematical abilities of Indonesian students for non-routine questions and understanding of concepts were still very weak, but relatively good at solving questions of fact and procedures (Pratiwi, 2019). On the other hand, in Putra et al., (2018) research suggested that students could not solve word problems correctly. The ability of the majority of students' mathematical understanding is in the low criterion, so it is necessary to seek improvement. Students who can solve mathematical understanding questions are only students who enjoy math lessons.

Mulyani et al., (2018) suggested that students had difficulty understanding questions, were not challenged to solve non-routine math problems, were nervous about answering questions about math material that they did not understand, were hesitant to be able to study difficult math material on their own, were unable to find new ways when it's hard to do math problems and avoid choosing difficult math practice questions. In response to this, researchers need to conduct research to determine the mathematical understanding ability of class VIII students at one of the junior high schools in West Bandung on the subject matter of relations and functions.

METHOD

The type of research carried out in this study is Classroom Action Research. This research model consists of plans, actions, observations and reflections on each cycle, the research will be stopped if the objectives of the research carried out have been achieved.
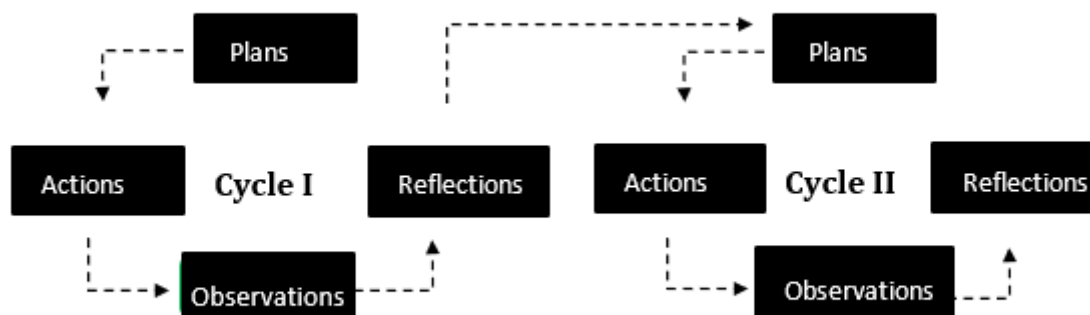

Figure 1. Research Model

The subjects in this study were 26 grade VIII students in one of the junior high schools in West Bandung. The success indicators of this study are seen from two indicators, namely (1) The learning process both in students and teachers with a minimum achievement of the success of implementing actions in accordance with the learning implementation plan is 80%, (2) In terms of learning success if at least 75% of students individually get scores above minimum completeness criteria. As for the data collection technique carried out is to providea written test question in the form of a description question. All data and results provided by students are processed using statistical tests assisted by SPSS software. Researchers look at suitability based on student test results that match indicators of mathematical understanding. (Roswahyuliani et al., 2022) suggests that the results of the increase are adjusted in the form of pepercentage, and are classified in 5 student completeness criteria.

Table 1. Interpretation of Student Completion Score

Predicate	Percentage Rate (%)
Very High	86% - 100%
High	76% - 85%
Keep	60% - 75%
Low	40% - 59%
Very Low	< 39%

This criterion is used as a research consideration, if the percentage of student completeness in completing the test is on the low or keep criterion, the researcher must return to take action in the next cycle.

Table 2. Interpretation of Teacher and Student Learning Activity Scores

Predicate	Score
Excellent	4
Good	3
Enough	2
Less	1
Very Lacking	0

This criterion is used as scoring material for teacher and student learning activities.

RESULTS AND DISCUSSION

Results

Cycle I

a. Plans

In the first cycle there are 2 meetings, namely the provision of initial tests and learning, while other things that are done are making a learning implementation plan for relationship and function material by using adiscovery learning model, observation sheets aimed at teachers and students, and further strengthening teachers' understanding and knowledge of the implementation of learning using , Discovery Learning Model.

b. Implementation of Actions

At the stage of implementing actions, there is a change of position between teachers and researchers, where researchers become teachers while mathematics teachers become observers. The implementation of learning activities at the first meeting was held on Friday, August 21, 2022 with Relations and Functions material, using the learning implementation plan discovery learning model that had been prepared previously.

Learning activities begin with preliminary activities where the teacher says greetings, checks student attendance and conditions the class so that it becomes conducive to the continuity of learning activities, then the teacher provides information about the learning process, during which the student's attention is still focused on the teacher in front of the class. In the core activity, the teacher begins learning by briefly explaining the concepts and relationships between Relations and Functions in students, to make it easier for students to better understand the teacher provides examples of Relations and Functions in everyday life in front of the class.

Furthermore, the teacher provides practice questions to see students' ability to do Relations and Functions using arrow diagrams, sequential pairs and cartesian diagrams. Then the teacher goes around and goes to one by one students to see the work of the students and guide students if there are difficulties, in this activity students do not hesitate to ask questions when there are parts of the work that are not understood. After the practice questions are completed, the results of the work are collected to the teacher for assessment, after which the work on the questions is discussed together while correcting if there are still incorrect student answers.

c. Observations

After carrying out the stages of implementing the action, teachers and researchers discuss the shortcomings that occur in learning activities, namely there are still many students who are less active in group discussion activities, less optimal management of learning time so that learning activities are cut off by changes in subject hours, and forget that teachers do not provide motivation to students, while the motivation aspect is very important to foster the spirit of following learning for students. The following are the results of observations on the implementation of Cycle I :

Table 3. Results of observations on teacher and student activities in Cycle I

Aspects observed in Teacher	Score		Aspects observed in Student
The teacher conveys material information and teaching objectives	4	3	Students pay attention to the teacher in conveying material information and learning objectives
Teachers provide motivation to students	0	0	Students pay attention to the teacher provide motivation
The teacher conducts apperception	3	2	Students actively respond In apperception activities
Teachers provide students worksheet for done by students in groups	4	2	Students pay attention to the teacher's Explanation
The teacher provides an explanation	4	2	Students actively answer

of the material to be taught			questions in the explanation of the material provided
Teachers motivate students to express opinions about the material provided	3	2	Students are active in discussion activities
The teacher directs students to solve the problem by discussing with Other group members	3	2	Students are brave and actively ask questions if they have difficulties
The teacher goes around observing and guiding students if there are difficulties	4	0	Students are given the opportunity to present the results of group discussions
The teacher asked the group representative to present the results of the discussion	0	0	Students are given the opportunity to respond to the results of other group discussions
Teachers provide opportunities students to respond to the results of discussions	0	0	Students and teachers summarize the results of the discussion
Teacher together students Summarizing the results of the discussion	0	0	Students with teachers summarize Learning outcomes
The teacher does reflection	0	0	Students reflect
Teachers give homework	4	-	-
Number of Scores	29	13	Number of Scores
Percentage of Learning Completeness	55,77%	27,08%	Percentage of Learning Completeness

Based on Table 3, the results of observations on teacher completeness in carrying out learning using learning implementation plan with the chosen approach are still very low at 55.77%. Meanwhile, the results of observations about student activities during learning activities have a lower percentage of 27.08%. But overall in this first cycle of learning, by looking at the implementation of learning that has been implemented, many students have begun to dare to ask questions and actively interact with fellow students and teachers.

In addition, the average initial test score of students who reach minimum completeness criteria is very small, where many students only answer 1 question and some answer only the final answer. The results of the students worksheet work aim to find out whether learning using the discovery learning model is successful.
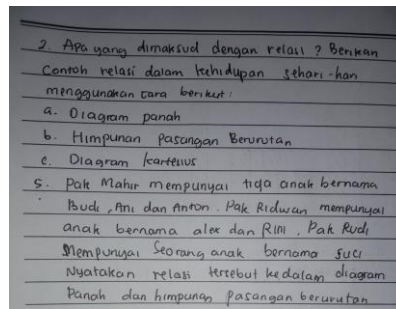
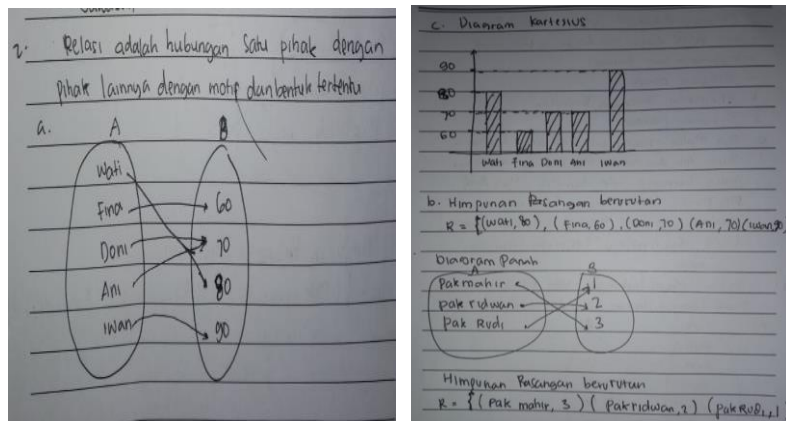**Figure 2**. Cycle I and Cycle II Test Questions

Figure 3. Cycle I Test Answers

Based on the answers to the initial test cycle 1, many students only answered part of the questions and some were able to answer only 1 question. Based on the results of observations, students only answered part of the questions because students did not understand what the questions meant. Then students also feel that the problem is difficult and also students do not understand the initial concept of relation and function material.

Figure 4. Cycle I Test Scores

From the picture above, the lowest student score data is 60 and the highest score is 80, the middle score is 76. The average score of students in cycle 1 is 73,08 and based on predetermined criteria, the level of student learning outcomes in cycle 1 is at a moderate level.

d. Reflections

At this stage, researchers and teachers jointly assess and conclude the shortcomings that occur during learning which result in learning using the discovery learning model is not fully optimal, this can be seen from the completeness of learning implementation plan only 57.69%. This happens, because of the lack of expert researchers in managing learning activities and learning time in the implementation of cycle I, besides that there are still many students who lack focus during learning and there are still many students who chat during learning. Given that there are still many shortcomings that occur during the implementation of Cycle I actions, researchers and teachers continue the action to the next stage, namely the Cycle II action stage, where at the cycle II stage researchers and teachers jointly prepare what must be improved or further improved from Cycle I activities.

Cycle II

a. Plans

Based on the results of observation, evaluation and reflection in Cycle I, researchers and subject teachers jointly plan cycle II so that existing weaknesses are overcome so as to achieve the desired results. At this stage, teachers prioritize guidance in solving problems and focus more on students who are less active in previous activities and are able to process time in cycle II learning . At this stage, as well as planning in cycle I, what is done is making a learning implementation plan using the discovery learning model, with observation sheets which then researchers make observation sheets that are the same as cycle I actions which are aimed at teachers and students during learning activities .

b. Implementation of Actions

In the implementation of actions in Cycle II, researchers remain teachers while mathematics teachers become observers. The class presentation at the second meeting was held onTuesday, August 28, 20 22 with Relations and Functions material, for the lesson plans prepared still using the discovery learning model.

Learning activities begin with the opening of learning where the teacher checks student attendance and conditions the class so that it becomes conducive to learning continuity. Furthermore, the teacher provides information about the learning process and motivation to increase the enthusiasm of the students and it is expected that during the activity the attention of students is still focused on the teacher in front of the class. In the reception activity, it turned out that what was taught at the previous meeting some students already understood and could provide an explanation in line of what was learned at yesterday's meeting. The next activity is to provide an opportunity for one of the groups to present the results of yesterday's discussion which has not been presented and it turns out that many students want to present in the future the results of their group work .

Furthermore, the teacher provides examples of contextual questions to convey Relations and Functions material, at this stage many students begin to be active in asking questions about material that has not been understood. After giving the material, the teacher started the core activity by asking students to group with their deskmates, then the teacher gave students worksheet to discuss, it turned out that with the small group method with his deskmates, students' activeness in discussing went better, but there were still groups that were not enthusiastic in discussing the students worksheet given.

During the discussion activity, the teacher invites students to discuss and guide students if there are difficulties, in this activity students begin to actively ask the teacher which causes the class to start noisy but can still be controlled. By going around and helping students who

have difficulties, teachers know which students do not understand the material provided. After a while the teacher gave the opportunity to the group representatives to present the results of their discussions, many students were still embarrassed but wanted to present the results of their discussions, the teacher then guided the students not to be shy in conveying the results of their work, when representatives of one of the groups presented many students had started Asking questions about the results of group discussions in front of the class, group members explained with the help of the teacher in answering the questions.

The next activity carried out is closing, the teacher guides students to conclude the learning results that have been implemented, then the teacher asks students to collect the results of their group and conveys that at the next meeting a test will be held according to the material that has been taught.
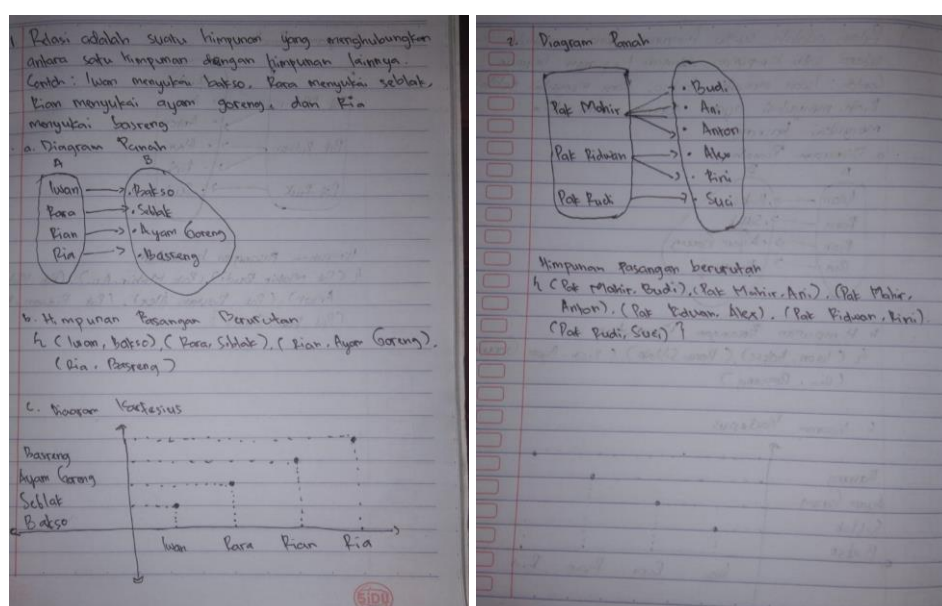

Figure 5. Cycle II Test Answers

Based on the results of the second cycle tests, the average student score was 81.88, which means that there was an increase from the initial test scores in cycle I. Based on the observation results, this increase occurred because after students received discovery learning, students felt that the questions were quite easy to work on. And students also feel happy because they can answer questions correctly.

Statistics

Nilai_Tes_Siklus_2

N	Valid	26
	Missing	0
Mean		81.88
Median		80.00
Mode		80
Std. Deviation		3.502
Variance		12.266
Range		17
Minimum		75
Maximum		92
Sum		2129

Figure 6. Cycle II Test Scores

From the picture above, it is obtained that the lowest student score data is 75 and the highest score is 92, the middle value is 80. The average student score in cycle II is 81.88 and based on predetermined criteria, the level of student learning outcomes in cycle II is at high level.

c. Observations

After presenting this second lesson, the teacher and researcher discussed that the learning activities in cycle II had been carried out optimally, one of which was appropriate time management. In the implementation of the second cycle, the results obtained were better than the first cycle, both in terms of the implementation of learning activities and the results of the students worksheet that were answered by students. The following are the results of observing the implementation of Cycle II:

Table 4. Results of observations on teacher and student activities in Cycle II

Aspects observed in Teacher	Score		Aspects observed in Student
The teacher conveys material information and teaching objectives	4	3	Students pay attention to the teacher in conveying material information and learning objectives
Teachers provide motivation to students	3	4	Students pay attention to the teacher provide motivation
The teacher conducts apperception	4	4	Students actively respond In apperception activities
Teachers provide students worksheet for done by students in groups	4	3	Students pay attention to the teacher's Explanation
The teacher provides an explanation of the material to be taught	4	3	Students actively answer questions in the explanation of the material provided
Teachers motivate students to express opinions about the material provided	4	2	Students are active in discussion activities
The teacher directs students to solve the problem by discussing with Other group members	4	3	Students are brave and actively ask questions if they have difficulties
The teacher goes around observing and guiding students if there are difficulties	4	3	Students are given the opportunity to present the results of group discussions
The teacher asked the group representative to present the results of the discussion	3	3	Students are given the opportunity to respond to the results of other group discussions
Teachers provide opportunities	4	3	Students and teachers summarize

students to respond to the results of discussions			the results of the discussion
Teacher together students Summarizing the results of the discussion	3	4	Students with teachers summarize Learning outcomes
The teacher does reflection	3	4	Students reflect
Teachers give homework	4	-	-
Number of Scores	48	39	Number of Scores
Percentage of Learning Completeness	92,31%	81,25%	Percentage of Learning Completeness

By paying attention to Table 4, in the implementation of learning based on the lesson plan that was previously made it has been implemented optimally, where in teacher activities there are only a few deficiencies. As for the results of student activities that have been carried out, almost all students have been brave and active in asking questions and actively interacting with fellow students and with the teacher during learning. However, there are still some students who don't pay attention and are still somewhat less active and don't focus on learning and choose to chat with their friends. In addition, the average results of working on worksheets have increased a lot when compared to the results of worksheets in cycle I.

d. Reflections

Reflection activities in cycle II provide good news which shows that the discovery learning model which was first applied by the teacher in class VIII at one of the junior high schools in West Bandung gave very good results. In addition, there is an increase in the ability to understand mathematics seen in students, one of which has started well in changing the existing indicators in story questions or problems into the form of mathematical expressions, and there are already many students who are active in participating in activities carried out during learning. However, there are still deficiencies that occur, for example there are still some students who chat not working on the students worksheet given.

Table 5. Recapitulation Completeness of Learning Scenario

Observation Data	Cycle I Results	Cycle II Results	Improving
Completeness of Learning Scenario (Teacher)	55,77%	92,31%	36,54%
Completeness of Learning Scenarios (Students)	27,08%	81,25%	54,17%

Based on Table 5, when compared to Cycle I, at this stage of Cycle II it experienced a very significant percentage increase. By looking at the increase in presentations, it can be shown that there are more problems related to the real world. As for the recapitulation of student learning outcomes can be seen in the graph below:
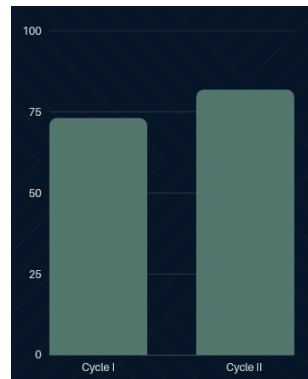
Figure 7. Recapitulation of Student Learning Outcomes

In the picture above, it can be seen that student learning outcomes from the initial test to the final test continue to increase in the number of students who have learning outcomes/grades exceeding the minimum completeness criteria that has been determined, so it can be said that student learning outcomes in relation material and function increases at each stage. So by looking at the percentage in learning completeness and student learning outcomes, it can be concluded that the specified class action research target has been achieved. So that the researcher and the subject teacher agreed to end the Cycle action until the Cycle II stage.

Discussions

Based on the description of the results of the research above, the scientific approach in helping improve students' mathematical understanding skills in the subject of Relations and Functions is quite optimal. This can be seen in the implementation of the pretest, previously students obtained an average score less than the minimum completeness criteria score or was in the sufficient indicator. Because the percentage of achievement was not good in terms of lesson implementation and student learning outcomes had not been exceeded, the research continued to the next stage, namely the implementation of cycle II.

In the implementation of the cycle II, the achievement of the implementation of learning was in accordance with the prepared learning implementation plan, previously students obtained an average score below the minimum completeness criteria or were in the indicators quite then in this second cycle, after carrying out learning using a scientific approach to the material relations and functions students had an increase where in cycle II students have an average score of more than minimum completeness criteria or are in the sufficient indicator. It can be said that in cycle II the implementation of learning using a scientific approach is close to optimal, this can also be seen from the normality test scores which are processed with the help of SPSS software and also the number of students who are active in learning, interactions between fellow students or students and teachers have been starting to improve, as well as material that is easy to understand because concepts or problems are related to the real world.

The increase in achievement was also seen in student learning outcomes in cycle II where students who had scores above the minimum completeness criteria or were on the Enough indicator. Because the achievement of the implementation of learning has exceeded the indicators of research success, the researchers and teachers agreed that the implementation of the action was stopped in cycle II. In the next stage, namely the implementation of the posttest, where students managed to have an average score above the minimum completeness criteria with a sufficient percentage, indicating that the indicator of success in terms of student learning outcomes had been achieved.

From the results of observations in the implementation of cycle II, researchers continued to try to analyze what was lacking in cycle I, namely when in cycle II the teacher was able to condition the class well and control every student activity in the class. Students have participated actively in learning, especially in working on advanced questions. Activeness motivates students to learn mathematics from what is obtained. Student activity is an important issue for every teacher that must be understood, realized and developed (Ramlah et al., 2014). The core learning activities, namely group discussions, have been running optimally by first forming groups with students in each group having different ability levels. Here students have had good group discussions and worked together to complete student worksheets, not forgetting that the teacher also motivates and directs if there are difficulties in the process.

This group discussion encourages students to work together and actively argue in their groups. After the time for working on student worksheets in groups is finished, the teacher invites each group representative to take turns presenting in front of the class regarding the results of their work, here students are active and enthusiastic about presenting because they already understand what they have done. After the presentation is over, the teacher does not forget to give appreciation for the students' active efforts during the learning activities. Appreciating students can be done by commenting with positive words. Then when students have done a task, the teacher can comment positively, for example "Good Job" or "Increase your efforts" or something else. These positive comments can make students more motivated to learn (Suharni & Purwanti, 2019).

In the second cycle, the implementation of learning in accordance with the learning implementation plan that has been prepared has a high achievement, this can also be seen in the second cycle, the implementation of learning has gone very well, especially with the scientific approach that has been used. Activeness, cooperation and communication between students is very visible in cycle II. This is in accordance with research (Ramadhania et al., 2022) which states that if most students are active in learning, learning is said to be successful. In addition, students in cycle II have scores above the minimum completeness criteria and continue to increase so that there is an increase.

Based on the description above, where the completeness of the implementation of learning is in accordance with the learning implementation plan and the achievement of student learning outcomes achieving indicators of research success, it can be concluded that learning mathematics using the discovery learning model can improve the mathematical understanding abilities of class VIII students in one of the junior high schools in West Bandung on the material Relation and Function.

CONCLUSION

Based on the results described in the results and discussion, it can be concluded that the mathematical understanding abilities of class VIII students in one of the junior high schools in West Bandung in the subject of Relations and Functions, can be improved through the discovery learning model, this conclusion can be seen from the SPSS statistical test scores and also the increasing number of students who actively interact with fellow students or teachers, and are better at converting information on questions or problems into the form of mathematical models or in mathematical expressions. Based on this, it is hoped that other educators can apply better learning models with good planning and implementation so that student learning outcomes in the material relations and functions can increase.

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