COMPARISON OF STUDENTS' MATHEMATICAL PROBLEM SOLVING ABILITY USING GROUP INVESTIGATION LEARNING WITH PROBLEM BASED LEARNING CLASS VIII SMP NEGERI 1 PADANG

ESSAY

To partially fulfill the requirements for a Bachelor of Education degree

By

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Hereby declare that my thesis is with a title "Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Class VIII SMP NEGERI 1 Padang" is really my work and is not a plagiarism from someone else's work or an excerpt in a way that is not in accordance with the prevailing ethics with the scientific tradition. If someday I am proven plagiarism then I am willing to be processed and receive academic and legal sanctions in accordance with the applicable laws and regulations, both at the Padang State University institution and in the community and state. Thus I make this statement with full awareness and sense of responsibility as a member of the scientific community.

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ABSTRACT

Anisa Safitri : Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Class VIII SMP NEGERI 1 Padang.

The ability to solve mathematical problems is one of the goals that students must master in learning mathematics. The reality in the field found that the mathematical problem solving ability of students of class VIII SMP NEGERI 1 Padang is still low. One of the efforts that can overcome these problems is to use the Group Investigation and Problem Based Learning model in the mathematics learning process. The purpose of this study was to determine whether there were differences in the mathematical problem solving abilities of students who took Group Investigation learning with the mathematical problem solving abilities of students who took Problem Based Learning, whether the mathematical problem solving abilities of students who took Group Investigation learning were better than the solving abilities mathematical problems of students who take conventional learning, and whether the mathematical problem solving abilities of students who take Problem Based Learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII of Junior High School 1 Padang.

This type of research is a quasi-experimental research design with a Static Group Design. The study population was the eighth grade students of SMP NEGERI 1 Padang. The sample class was taken by using simple randomized sampling technique, namely using a lottery system. The data was collected using a mathematical problem solving ability test which was analyzed using the Mann-Whitney U test.

Based on the analysis of research data, it can be concluded that the mathematical problem solving abilities of students who take Group Investigation learning are no different from the mathematical problem solving abilities of students who take Problem Based Learning learning, the mathematical problem solving abilities of students who take Group Investigation learning are better than their ability. mathematical problem solving of students who take conventional learning, the mathematical problem solving ability of students who take Problem Based Learning learning is better than the mathematical problem solving ability of students who take conventional learning in class VIII of SMP NEGERI 1 Padang.

PREFACE

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

Praise and gratitude are expressed for the presence of Allah SWT who has bestowed His grace and gifts so that researchers can complete the thesis entitled "**Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Class VIII SMP NEGERI l Padang**". This thesis writing aims to fulfill one of the requirements in obtaining a Bachelor of Education degree at the Mathematics Department, Faculty of Mathematics and Natural Sciences, Padang State University. In addition, thesis writing is an additional insight for students in conducting research and making research reports.

This thesis can be completed properly with the help and cooperation of various parties. Therefore, the researchers would like to thank:

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It is fully realized that what is stated in this thesis is still far from perfect. Therefore, it is hoped that constructive suggestions and criticisms are for the perfection of this thesis. Thank you for suggestions and criticism

Padang, 31 January 2018

Researcher

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CHAPTER I

PRELIMINARY

A. Background

Mathematics is a science that has a role in improving critical and creative thinking skills. Students need high critical thinking skills, because this ability plays an important role in solving a problem regarding mathematics lessons. In addition, mathematics skills are also part of the life skills that students should have, namely in reasoning, communicating, and solving problems in everyday life.

Based on the Regulation of the Minister of Education and Culture (Permendikbud) Number 58 of 2014, there are eight mathematics learning objectives that must be achieved. One of them is using reasoning in nature, performing mathematical manipulation both in simplification, and analyzing the components that exist in problem solving in the context of mathematics and outside mathematics (real life, science, and technology) which includes the ability to understand problems, build mathematical models, solve problems. model and interpret the solutions obtained, including in order to solve problems in everyday life.

Based on the objectives of learning mathematics, students are expected to be able to solve problems in everyday life through their mathematical skills. In order to meet these expectations, students must have good mathematical problem solving skills. Therefore students should be accustomed to study and think logically, critically, and systematically in solving problems.

Teaching mathematics is not only a lesson about formulas, but which can develop students' problem solving abilities. If mathematics is taught as a lesson about formulas, it will make a group of people good memorizers, not good at seeing causal relationships, and not good at solving problems. Knowledge aspect alone is not sufficient to face rapid future changes, but it requires the ability to study and think logically, critically and systematically in solving problems related to everyday life.

Based on the results of observations in class VIII SMP NEGERI 1 Padang from 24 July to 9 August 2017, namely in class VIII.B, VIII.D, and VIII.E. Learning carried out by the teacher has used a scientific approach. This can be seen from the learning steps carried out by the teacher in the classroom in accordance with the 5M activities in the scientific approach, where these activities are observing, asking questions, gathering information, associating, and communicating. At the time of learning, information was obtained that in mathematics learning, the teacher explained the subject matter and examples well in front of the class, then the students recorded the material described. After the students finished taking notes, the teacher gave questions to work on, then some students were asked to discuss the questions that had been worked on in front of the class. Students have a fairly good willingness in learning mathematics. This is shown by students being able to work on the questions given by the teacher which are generally routine. Students are quite enthusiastic when the teacher asks to work on these practice questions independently.

The ability of students to work on questions that require understanding of the material is generally good, but when the teacher asks students to work on non-routine questions and demands problem-solving skills, the students' willingness to solve these questions is reduced. This can be seen when learning takes place, when the teacher provides non-routine practice questions and then asks students to work on the questions independently, then there are some students who try to solve the practice questions and there are some students just waiting for explanations or work results. from other students. This indicates that students tend to prefer routine and non-challenging questions.

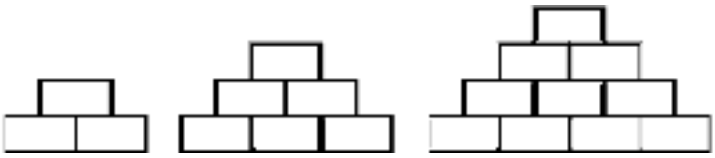
Students consider these non-routine questions difficult and take a long time to solve them. Even though the non-routine questions given are aimed at optimizing students' abilities, so that they are skilled in solving math problems. In addition, the lack of involvement of students during the learning process results in not optimal mathematical problem solving abilities of students. This can be seen when learning in the teacher's class has tried to invite students to be active in learning, but students have not been able to fully play an active role in the learning process. Even though SMP NEGERI 1 Padang has implemented the 2013 curriculum, in learning it appears that the elements in the scientific approach have not been fully implemented.

Lack of interest of students in working on practice questions and daily test questions that are different from the example questions, resulting in low ability of students to solve math problems. When evaluating the answer sheet of the student's mathematical problem solving ability test, it can be seen from several

indicators of unfulfilled problem-solving abilities, namely students do not understand the problems given, so that students are unable to organize data and select relevant information in identifying problems. Students have not been able to choose the right approach and strategy to solve problems, so that students cannot use or develop appropriate problem-solving strategies and solve problems.

This is evident when the daily tests of Number Pattern Material. To see to what extent the problem-solving abilities of class VIII students of Junior High School 1 Padang, an observation was made of the results of the students' daily test completion as follows.

Question 1
A worker arranges the bricks to form an arithmetic sequence as shown in the following picture:



Determine the number of bricks in the 20th arrangement.

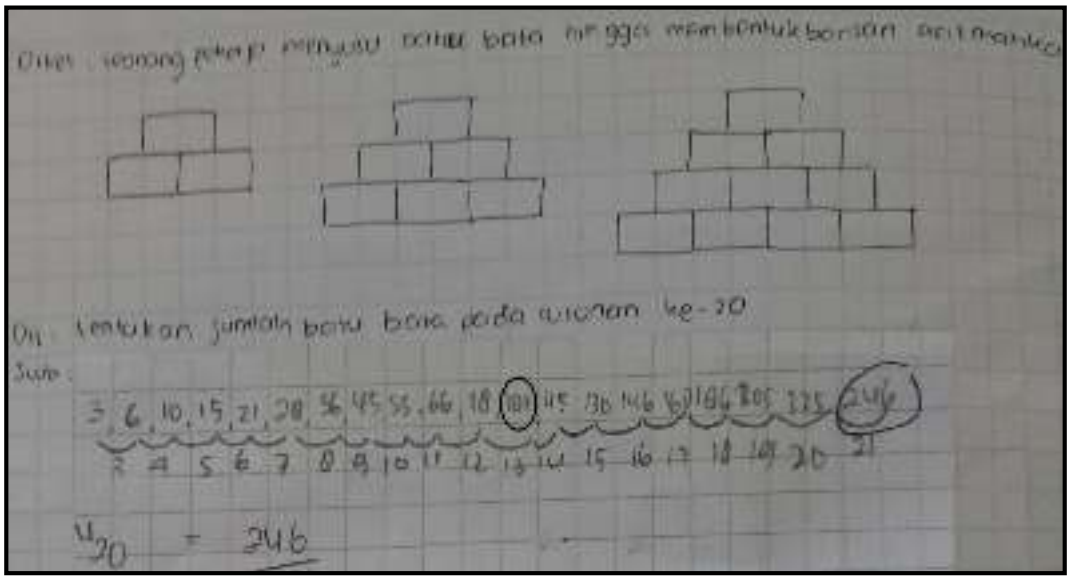


Figure 1. One Example of Students' Wrong Answers

Based on Figure 1, it can be seen that students have begun to be able to organize data and select relevant information in identifying problems well. However, students experience errors when choosing and using the right approaches and strategies to solve problems. Students who can answer correctly on this question are 37.5% of the 32 students. This shows the ability of students in problem solving is still low. The following is an example of the expected answer to the problem in Figure

It is known: A worker arranges bricks to form an arithmetic sequence of patterns 3, 6, 10.
Wanted: What is the number of bricks in the 20th arrangement?
Answer:

3, 6, 10, 15, 21, 28, 36, 45,
+3 + 4 + 5 + 6 + 7
+ 8 + 9

55, 66, 78, 91, 105, 128, 136,
+10 + 11 + 12 + 13 + 14
+ 15 + 16

153, 171, 190, 218, 231
+17 + 18 + 19 + 20
+ 21

Or,

3, 6, 10
+3 + 4
+1

$2a = 1$ …… equation (1)
$3a + b = 3$ …… equation (2)
$a + b + c = 3$ ……equation (3)

$$2a = 1$$
$$a = \frac{1}{2}$$

Value substitution $a = \frac{1}{2}$ into the equation (2):

$$3a + b = 3$$
$$3\left(\frac{1}{2}\right) + b = 3$$
$$\frac{3}{2} + b = 3$$
$$b = 3 - \frac{3}{2}$$
$$b = \frac{3}{2}$$

Value substitution $a = \frac{1}{2}$ and $b = \frac{3}{2}$ into the equation (3):

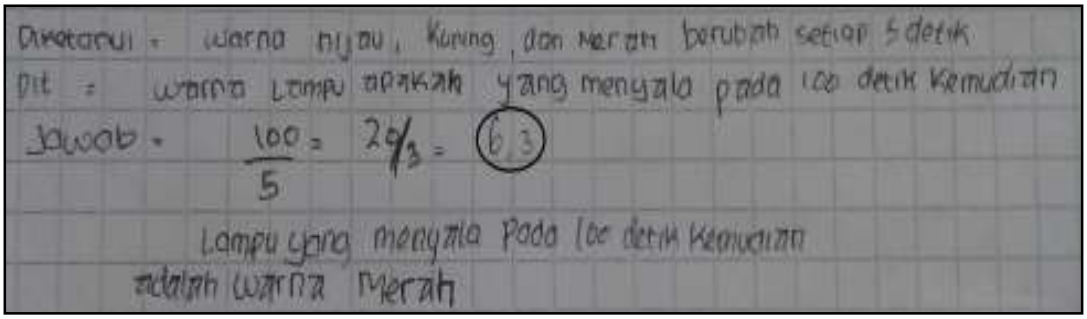
$$a + b + c = 3$$
$$\frac{1}{2} + \frac{3}{2} + c = 3$$
$$2 + c = 3$$
$$c = 3 - 2$$

$$U_n = an^2 + bn + c$$
$$U_{20} = \frac{1}{2}(20)^2 + \frac{3}{2}(20) + 1$$
$$U_{20} = \frac{1}{2}(400) + 30 + 1$$
$$U_{20} = 200 + 30 + 1$$
$$U_{20} = 231$$

So, the number of bricks in the 20th arrangement is 231.

Another problem encountered was that students had difficulties in presenting mathematical problem formulations in various forms, so that students were unable to solve the problems given. This can be seen in the results of the second problem solving students' math daily tests.

Question 2
A decorative light changes color from green, to yellow, then red, and so on, changing for 5 seconds with the same pattern. What color is the lamp that turns on 100 seconds later.



You know: the colors green, yellow, and red change every 5 seconds.
asked: what color the lamp turns on 100 seconds later.
answer: 100/5 = 20/3 = 6,3

so, the light that turns on at 100 seconds later is red

Figure 2. One Example of Students' Wrong Answers

In Figure 2, it can be seen that students have been able to organize data and select relevant information in identifying problems well. Then students have also been able to choose and use the right approach or strategy in problem solving. However, students experience errors when solving problems. Students who can answer correctly on this question are 57% of the 32 students. This shows that there are still many students who do not have good mathematical problem solving skills. Examples of expected answers are:

Known: Decorative lights change color from green, to yellow, then red, and so on, changing 5 seconds with the same pattern.

Wanted: What color does the lamp turn on 100 seconds later?

Answer:

Suppose the green light color is "h", the yellow light color is "k", and the red light color is "m",

Decorative Light Color Sequences

Lights up for 5 seconds	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Color	h	k	m	h	k	m	h	k	m	h	k	m	h	k	m	h	k	m	h	k

So, the color of the light that turns on 100 seconds later is yellow.

Or, $\frac{100\ second}{15\ second} = 6\ rest\ 10$ second

So that the remaining 10 seconds can be defined as follows: that is, in the first 5 seconds the color of the light is green, and in the second 5 seconds the color of the light is yellow.

So, the color of the light that turns on 100 seconds later is yellow.

Based on the initial test of problem-solving abilities and the evidence found during the observation, it appears that students have been able to understand the

concept of a given two-variable system of linear equations. However, students are constrained by several indicators of mathematical problem solving abilities, including: choosing and using the right approaches and strategies to solve problems, and solve problems.

The obstacles that are still found cause students to have difficulty solving math problems completely. Based on the facts found during observation and from the initial tests given it can be said that the mathematical problem solving of class VIII students at SMP Negeri 1 Padang is still low.

Teachers should find solutions and design better learning so that students' mathematical problem-solving abilities develop optimally. One of the efforts that the teacher can make is by designing learning that is more student-centered, so that students are active in building their knowledge so that learning becomes more meaningful and the teacher is only a facilitator and motivator. The learning model that can demand the activeness of students and can help students practice developing students' problem solving abilities is the Group Investigation learning model, the Problem Based Learning model.

At the time of learning the teacher has not carried out learning that involves students in group learning. After conducting interviews with students which one preferred individual learning or group learning, most of the students answered that they preferred group learning. Because according to the students, they can discuss with their friends the material they don't understand. Therefore the researcher uses the Group Investigation learning model, the Problem Based Learning model which at the stages carries out group learning so that it involves students to

actively participate in learning where students both investigate the real problems around them so that they get a good impression. deep and more meaningful about what they learn.

Group Investigation learning model, Problem Based Learning model which is considered able to improve students' mathematical problem solving abilities. The Group Investigation model, the Problem Based Learning model, is a learning model that requires students to independently find both concepts and solutions from a material or problem through teaching materials and also through the investigation process. So that through the process of investigation students can master the concept and can find out how to find solutions to problems related to non-routine questions.

Slavin (2005: 218) suggests that the Group Investigation type cooperative learning model consists of six stages including: grouping, planning, investigation, organizing, presenting, and evaluating. At the grouping stage, students are asked to identify the topic presented by the teacher by understanding the problem / topic. At the planning stage, students are invited to explore their knowledge through a question and answer process which causes students to organize data and select relevant information in identifying problems, so that they can present a problem formulation mathematically in various forms. At the investigation stage, students could improve their ability to set strategies and tactics to determine solutions to problems and be able to write down the answers. In addition, at the investigation stage students could also improve their skills in providing further explanations such as analysis and synthesis. Then at the organizing stage, students plan what

they will report and how they will make presentations that can help students use the right strategies to solve problems. At the presenting and evaluating stages, students can improve their ability to draw conclusions from solving a problem and determine alternatives for other ways of solving problems.

According to Nurhadi (2004: 109), the Problem Based Learning model is one of the learning models in which authentic assessment (real or concrete reasoning) can be applied comprehensively, because there is an element of finding a problem and solving it at the same time (an element contained in it, namely problem posing or finding problems). and problem solving or solving problems). The purpose of Problem Based Learning is to challenge students to pose problems and also solve problems that are more complicated than before, can increase the activeness of students in expressing their opinions, foster cooperation and cohesiveness of students in groups, develop student leadership and develop analytical pattern skills and can help students develop their reasoning process.

Problem-based teaching is used to stimulate higher-order thinking in problem-oriented situations, including learning how to learn. Problem-based teaching cannot be implemented if the teacher does not develop a classroom environment that allows for an open exchange of ideas. In essence, students are faced with authentic and meaningful problem situations that can challenge students to solve them.

The Problem Based Learning model consists of five phases. In the phase of orienting students to the problem, students are invited to be involved in the problem solving activities they choose so that students can understand the

problems posed by the teacher. In the phase of organizing students to learn, students are invited to define and organize the learning tasks they get in relation to these problems, so that students are trained to be able to organize data and select relevant information in identifying problems. Furthermore, in the guiding phase of individual and group investigations, students are invited to collect appropriate information, carry out experiments to get explanations and problem solving so that students are trained to present a mathematical problem formulation in various forms and choose the right strategy to solve the problem. Then in the phase of developing and presenting the work, students expand their knowledge by planning and preparing appropriate work such as reports, videos, and models so that students are trained in using the right strategies to solve problems. Finally, in the phase of interpreting the answers obtained to solve problems, students reflect or evaluate their investigations by interpreting the results of the answers obtained to solve problems.

Both learning models involve students in group learning where students both investigate the real problems around them so that they get a deep and more meaningful impression about what they are learning. So it is expected that students are able to hone and improve their mathematical problem solving abilities. However, there are some differences between the two learning models. The Group Investigation model emphasizes that students seek their own discovery problems. Then each group discusses the problems that have been found together, and a spokesperson from the group presents the results of the group discussion. In the cooperative learning model type Group Investigation, students are motivated to be

involved in problem solving activities selected by the teacher and formulate hypotheses of the problems given by the teacher.

Based on the description, the Group Investigation learning model, the Problem Based Learning model can be used as an alternative to develop students' mathematical problem solving abilities. Therefore, to see whether there are differences in mathematical problem solving abilities using Group Investigation learning and mathematical problem solving abilities using Problem Based Learning, a study was conducted with the title "**Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Classroom.VIII Junior High School 1 Padang".**

B. Problem Identification

Based on the background, the problems are identified as follows:

1. Students do not participate actively in the learning process.

At the time of learning the teacher had not carried out learning that involved students in group learning and learning was still dominated by the teacher.

2. Students are not familiar with problem solving problems.

3. Students are not familiar with non-routine questions.

4. The problem solving ability of students is still low, causing the learning outcomes of students' mathematical problem solving abilities to be low.

C. **Scope of problem**

Based on the identification of the problems above, the problem to be studied is limited to the mathematical problem solving abilities of class VIII students of SMP Negeri 1 Padang in mathematics learning using Group Investigation learning, mathematics learning using Problem Based Learning.

D. Problem Formulation

The formulation of the problem in this research are:

1. Are there differences in the mathematical problem solving abilities of students who take Group Investigation learning with the mathematical problem solving abilities of students who take Problem Based Learning in class VIII SMP NEGERI 1 Padang?
2. Is the mathematical problem solving ability of students who take Group Investigation learning better than the mathematical problem solving abilities of students who take conventional learning in class VIII SMP NEGERI 1 Padang?
3. Is the mathematical problem solving ability of students who take Problem Based Learning better than the mathematical problem solving ability of students who take conventional learning in class VIII SMP NEGERI 1 Padang?

E. Research purposes

Based on the problem formulation described, the objectives of this research are:

1. To find out and describe whether there are differences in the mathematical problem solving abilities of students who take Group Investigation learning with the mathematical problem solving abilities of students who take Problem Based Learning in class VIII Junior High School 1 Padang.

2. To find out and describe whether the mathematical problem solving abilities of students who take Group Investigation learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII of SMP NEGERI 1 Padang.

3. To find out and describe whether the mathematical problem solving abilities of students who take Problem Based Learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII of SMP NEGERI 1 Padang.

F. Research assumptions

The research assumption is the initial conditions that already apply at the research site. The assumptions of this study are as follows:

1. All students have the same time and opportunity in following the learning process.

2. Teachers are able to use the Group Investigation learning model in mathematics learning.

3. Teachers are able to use the Problem Based Learning learning model in mathematics learning.

4. The results of the final test are a description of the students' mathematical problem solving abilities.

G. Benefits of Research

This research is expected to be useful for:

1. For researchers, as additional knowledge and experience that can be applied in carrying out the teaching profession later.

2. For students, in order to improve their mathematical problem-solving skills and improve social skills in mathematics learning groups.

3. For teachers, so that it can be used as an alternative in choosing variations that can be applied in mathematics learning to improve students' mathematical problem solving abilities which makes the teaching and learning process more effective, efficient, and meaningful.

4. For the principal, as input to always make learning innovations in order to achieve school goals and educational goals.

For other researchers, as reference material

CHAPTER II

THEORETICAL FRAMEWORK

A. Theory Study

1. The Scientific Approach to the 2013 Curriculum

Suherman (2006: 74) states that the mathematics learning approach is the way that teachers carry out learning in the classroom so that the concepts presented can adapt to students. Thus it can be said that the approach is our point of view towards the implementation of learning.

The learning process in the 2013 curriculum for all levels of education is carried out using a scientific approach or a scientific process-based approach. Activities contained in the scientific approach are known as 5M activities, namely observing, questioning, gathering information, associating, and communicating. The following is an explanation of each activity.

a. Observe

The activity of observing gives priority to the meaning of the learning process (meaningful learning). Teachers provide opportunities for students to carry out observational activities, through activities of seeing, listening, listening, and reading.

b. Hence

The teacher opens up opportunities widely to ask questions about what has been seen, listened to and read. The teacher guides students, so they can ask questions. In questioning activities the teacher encourages students to become

good learners. Through questioning activities, a teacher can arouse the curiosity of their students, encourage, and inspire their students to learn well.

c. Gathering Information

Students collect information from various sources by paying attention to an object, conducting experiments, and reading books.

d. Associating / Reasoning

Information that has been obtained in previous activities becomes the basis for subsequent activities. Reasoning is a logical and systematic thought process on empirical facts that can be observed to obtain conclusions in the form of knowledge.

e. Communicate

Students write or present what they find in activities to seek information and associate.

The following is a description of the learning steps with the scientific approach (5M) in Table 1.

Table 1. Description of Learning Steps with a Scientific Approach

Learning Steps	**Activity Description**	**Form of Learning Outcomes**
observing	Observing with the senses (reading, listening, listening, seeing, watching, etc.) with or without tools	Attention when observing an object / reading an article / hearing an explanation, notes made about what is being observed, patience, time (on task) used to observe
questioning	Create and ask questions, ask and answer questions, discuss information that is not understood, additional information that you want to know, or as clarification.	Types, quality, and number of questions asked by students (factual, conceptual, procedural, and hypothetical questions)

Learning Steps	Activity Description	Form of Learning Outcomes
eksperimenting	Exploring, trying, discussing, demonstrating, imitating form / motion, conducting experiments, reading sources other than textbooks, collecting data from resource persons through questionnaires, interviews, and modifying / adding / developing	Number and quality of sources reviewed / used, completeness of information, validity of information collected and instruments / tools used to collect data.
associating	Processing information that has been collected, analyzing data in the form of creating categories, associating or connecting related phenomena / information in order to find a pattern, and concluding.	Develop interpretations, arguments and conclusions regarding the relationship of information from two facts / concepts, interpretation of arguments and conclusions regarding the relationship of more than two facts / concepts / theories, synthesizing and arguing and concluding the relationship between various types of facts / concepts / theories / opinions; developing interpretations, new structures, arguments, and conclusions that show the relationship of facts / concepts / theories from two or more sources that are not contradicting; develop interpretations, new structures, arguments, and conclusions from different concepts / theories / opinions from various types of sources.
communicating	Present reports in the form of charts, diagrams or graphs; compile a written report, and present a report covering the process of results, and conclusions orally	Presenting the results of studies (from understanding to reasoning) in the form of writing, graphics, electronic media, multi media and others.

Source: Permendikbud no. 103 of 2014

Junior High School 1 Padang is one of the schools that uses the 2013 curriculum. So the implementation of Group Investigation learning model and Problem Based Learning learning model that is applied uses a scientific approach.

The lessons that are often carried out in schools so far are students as recipients of information from the teacher. This means that learning is carried out with one-way communication. Students in learning simultaneously carry out two activities, namely listening and taking notes. The questions given are not able to facilitate students in developing their mathematical problem solving abilities. In this learning, students also do not ask questions and hold discussions about things that are not understood. Students only copy the answers presented in the notebook and the questions given are less varied. The questions given are discussed by having one or two people write their answers on the board.

According to Stahl in Dalais (2012, 167-168) during conventional learning, students work for themselves, eye to the blackboard and are attentive, listen to the teacher carefully, and learn only from the teacher or teaching materials, and only the teacher makes decisions. and passive learners. It appears that in learning the teacher plays a more role as the subject of learning and students as an object, and learning has not been linked to the daily life of students. As a result, most of them are unable to connect what they learn with how this knowledge will be used.

2. Conventional Learning with a Scientific Approach in the 2013 Curriculum

Conventional learning carried out by teachers in the classroom based on observations that have been made is learning with a scientific approach. The

learning process begins with students observing the problems displayed by the teacher through power points in front of the class or reading and observing their textbooks, then the teacher presents information related to the material that students have read on the board.

After that the teacher asks students to collect information related to the material that has been explained by the teacher who is on the board. Next, the teacher provides examples of questions based on the material and its discussion. Then for the process of reasoning or associating the teacher, give some practice questions to students to check whether students understand what the teacher previously explained. After the students have finished working on these exercise questions, the teacher asks several students to communicate the answers to the exercises they have tried to complete. The following is a description of conventional learning steps with a scientific approach (5M) in Table 2.

Table 2. Description of Conventional Learning Steps with the Scientific Approach of the 2013 Curriculum

Learning Steps	Activity Description
Observing	Students begin learning by observing the appearance of a problem in front of the class.
Questioning	Students ask the teacher regarding the display of the problems in front of the class.
Eksperimenting	The teacher explains the meaning of a relationship and gives several examples of other relationships such as the favorite food relationship, the less than relation, or the factor relation from. Students collect information by listening to the explanation from the teacher and recording it related to the material explained and explained.

Learning Steps	Activity Description
Questioning	Students are given the opportunity to ask questions related to the material described.
Eksperimenting	The teacher asks students to record an explanation of the material that has been delivered by the teacher.
Associating	Students are asked to do some practice questions related to the material by way of peer discussion.
Communicating	And after finishing the discussion, students are asked to write the results of their answers in front of the class and other students respond

3. Cooperative Learning Model

According to Artzt & Newman in Asma (2006: 1) cooperative learning is defined as "a small group of learners working together as a team to solve a problem, complete a task, or accomplish a common goal". Meanwhile, according to Slavin in Asma (2006: 4) cooperative learning is learning that is carried out in groups, students in one class are made into small groups of 4 to 5 people to understand the concepts facilitated by the teacher. The cooperative learning model is a learning model with a small group setting by paying attention to the diversity of group members as a forum for students to work together and solve a problem through social interaction with their peers, providing opportunities for students to learn something well at the same time and students. be a resource for other students.

In the cooperative learning model, two or more individuals depend on each other to achieve a common goal. According to Ibrahim (2000: 3), students believe that their goals will be achieved if and only if other students also achieve these goals. For that each member of the group is responsible for the success of his group. Students who work in cooperative learning model situations are encouraged to cooperate on a joint task and they must coordinate their efforts to complete the task. So the cooperative learning model is a learning model that prioritizes cooperation among students to achieve learning goals.

According to Ibrahim (2000: 6-7) the cooperative learning model has the following characteristics:

a. To complete the learning material, students learn in groups cooperatively.

b. The group is formed from students who have high, medium, and low abilities.

c. If in the class there are students who consist of several races, ethnicities, cultures of different sexes, then efforts are made to ensure that each group consists of different races, ethnicities, cultures, and genders.

d. Reward (reward) is prioritized on groups rather than individuals.

The six main steps or stages in the lesson that apply the cooperative learning model according to Lie in Asthma (2006: 9) are shown in Table 3 below:

Table 3.Stages in Applying the Cooperative Learning Model

Phase	Teacher's Behavior
Phase 1 Convey goals and motivate students	The teacher conveys all the learning objectives to be achieved in these lessons and motivates students to learn.
Phase 2 Presenting information	The teacher presents information to students by way of demonstrations or through reading material..
Phase 3 Organizing students into cooperative groups	The teacher explains to students how to form study groups and helps each group make the transition efficiently.
Phase 4 Guide work and study groups	The teacher guides study groups as they work on their assignments.
Phase 5 Evaluation	The teacher evaluates the learning outcomes of the material that has been studied or each group presents the results of their work.
Fase 6	Teachers look for ways to reward both individual

Give awards	and group learning efforts and outcomes.

According to Ibrahim (2000: 6), the basic elements of the cooperative learning model are as follows:

a) Students in the group must assume that they live together with the responsibility.

b) Students are responsible for everything in the group.

c) Students must see that all members in the group have the same goal.

d) Students must divide the same duties and responsibilities among group members.

e) Students will be subject to evaluation or given an award which will also be imposed on all group members.

f) Students share leadership and they need skills to learn together during the learning process.

g) Students will be asked to individually account for the material handled in a cooperative group.

Cooperative learning models are developed to achieve at least three important learning objectives. According to the Ministry of National Education, the first goal of cooperative learning is to improve academic results by increasing the performance of students in academic tasks. Students who are more capable will become resource persons for less capable students, who have the same orientation and language. The second objective, cooperative learning provides opportunities for students to accept friends who have different learning backgrounds. These differences include differences in ethnicity, religion, academic ability, and social level. The third important goal of cooperative learning is to develop students' social skills. The social skills in question include sharing tasks, actively asking

questions, appreciating other people's opinions, stimulating friends to ask questions, wanting to explain ideas or opinions, working in groups and so on.

According to Ibrahim (2000: 7-8) cooperative learning has a positive impact on students who have low learning outcomes so that they can provide a significant increase in learning outcomes. Cooper (in Slavin, 2009: 115) reveals the advantages of cooperative learning methods, including:

a. Students have responsibilities and are actively involved in learning.
b. Students can develop higher order thinking skills.
c. Increase the memory of students.
d. Increase students' satisfaction with learning materials.

4. Cooperative Learning Model Type Group Investigation

The Group Investigation (GI) cooperative learning model is the most complex cooperative learning model (Trianto, 2015: 127). This model was first applied by Thelan. During its development this model was expanded and sharpened by Sharan from Tel Aviv University. The cooperative learning model type Group Investigation is a form of cooperative learning from task specialization methods. Group Investigation is a form of cooperative learning that dates back to the era of John Dewey (1970). But it has been updated by Shlomo and Yael Sharan, and Rachel Lazarowitz. In cooperative learning type Group Investigation, students are involved in planning both the topic to be studied and how their investigation will proceed. This approach requires a more complex classroom structure and norms than a more teacher-centered approach. This approach requires good learner communication skills and group process.

According to Winataputra (1992: 63) the nature of democracy in the cooperative type of Group Investigation is characterized by decisions that are developed or at least reinforced by group experiences in the context of problems that are the central point of learning activities. Teachers and students have the same status when faced with problems that are solved in different roles. So the

main responsibility of the teacher is to motivate students to work cooperatively and think about social problems that take place in learning and to help students prepare supporting facilities. Supporting facilities used to implement this model are anything that touches the needs of students to be able to dig up various information that is appropriate and needed to carry out the group problem solving process.

Asma (2006: 105) states that in the cooperative model type Group Investigation, the Group Investigation model is a cooperative learning model carried out by searching and finding information (ideas, opinions, data, solutions) from various sources (books, institutions). , people) inside and outside the classroom. Students evaluate and synthesize all the information conveyed by each group member and finally be able to produce a product in the form of a group report.

Slavin in Taniredja et al (2014: 79-80) suggests the stages in applying the Group Investigation cooperative learning model which is illustrated in Figure 3 below.

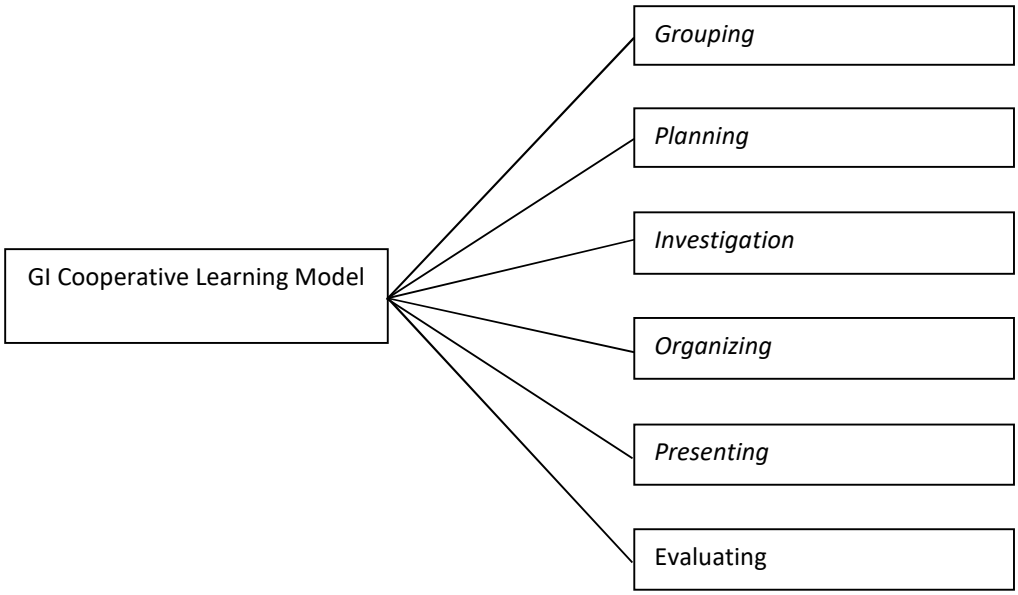


Figure 3. Chart of Group Investigation Type Cooperative Learning Stage

Based on Figure 3, the following information can be described:

Stage I Identify the topic and organize it into research groups (Grouping).

a. Students research several sources, propose a number of topics, and categorize suggestions.

b. Students join the group to study the topic they have chosen.

c. The group composition is based on the interests of students and must be heterogeneous.

d. Teachers assist in gathering information and facilitate the research arrangements of learners.

Stage II Planning tasks to be studied (Planning)

a. Students plan together to:

- What did we learn?
- How do we learn?
- Ready to do what (division of tasks)
- For what purposes and interests are we investigating this topic?

Stage III Carrying Out an Investigation

a. The students collect information, analyze data, and make conclusions.

b. Each group member contributes to the group's efforts.

c. The students discuss with each other, clarify, and synthesize all ideas.

Stage IV Preparing the Final Report (Organizing)

a. Group members plan what they will report, and how they will make the presentation.

b. Group representatives form an event committee (presentation) to coordinate presentation plans

Stage V Presenting the Final Report (Presenting)

a. Presentations made for all classes in various forms.

b. This part of the presentation must be able to involve the audience actively.

c. The listeners evaluate the clarity and appearance of the presentation based on predetermined criteria by all class members.

Stage VI Evaluation (Evaluating)

a. The students give each other feedback on the topic and about the tasks they have done.

b. Teachers and students collaborate in evaluating student learning.

Based on the explanation of the stages of Group Investigation cooperative learning according to Slavin above. The stages of cooperative learning in the Group Investigation type applied in this study are the same as the stages of cooperative learning described by Slavin.

Table 4. The relationship between the phases of the cooperative learning model and the stages of the group investigation model

Cooperative Learning Model Phase	Model Group Investigation Stage
Phase 1 Convey goals and motivate students	
Phase 2 Presenting information	
phase 3 Organizing students into cooperative groups	**Stage I** Identifying topics and organizing into research groups (Grouping)
	Stage II Planning the task to be studied (Planning)

Cooperative Learning Model Phase	Model Group Investigation Stage
Phase 4 Guide work and study groups	**Stage III** Carrying out an investigation (Investigation)
	Stage IV Preparing the Final Report (Organizing)
	Stage V Presenting the Final Report (Presenting)
Phase 5 Evaluation	**Stage VI** Evaluating
Phase 6 Give awards	

According to Istarani (2012: 87), he describes some of the advantages of the Group Investigation learning model, namely as follows:

a. Can combine students with different abilities through heterogeneous groups.

b. Training students to increase cooperation in groups.

c. Train students to be responsible because they are given tasks to be completed in groups.

d. Students are trained to find new things from the results of the group they do.

e. Train students to come up with new ideas and ideas through the discoveries they find.

According to Istarani (2012: 87-88), the Group Investigation learning model besides having advantages there are also several drawbacks, namely:

a. In discussions, only some of the students are active.

b. There is a conflict between students who are difficult to put together because in groups often have different opinions.

c. It is difficult for students to find new things because they are not used to doing it.

d. the materials available to carry out a complete lack of discovery.

The Group Investigation Learning Model is one of the cooperative learning models. The cooperative learning model type Group Investigation is a learning model in which students carry out investigations and experiments with the aim of obtaining solutions to problems they are facing in groups. According to Anggraini, Siroj, and Putri (2013) that the Group Investigation learning model is an alternative learning model that can improve mathematical problem solving abilities.

5. Group Investigation Type Cooperative Learning Model with a Scientific Approach in Problem Solving

Group Investigation is a learning model that is suitable for integrated study projects related to matters such as mastery, analysis, and synthesizing information in connection with efforts to solve multi-aspect problems. In general, the teacher designs a topic that is broad in scope, where the students then divide the topic into subtopics. This subtopic is a result of the development of students' interests and backgrounds, as well as the exchange of ideas among students.

As part of the investigation, students seek information from various sources both inside and outside the classroom. Sources such as (various books, institutions, people) offer a series of ideas, opinions, data, solutions, or positions related to the problem being studied. The students then evaluate and synthesize the information contributed by each group member so that they can produce group work (Slavin, 2009: 215).

This is in line with the scientific approach in that the scientific approach requires active students to construct concepts, laws / principles through the stages

of observing (identifying or formulating problems), proposing or formulating hypotheses, collecting data with various techniques, drawing conclusions, and communicating concepts, laws. or "discovered" principle. The application of the scientific approach to learning involves the skills of the process of observing, questioning, reasoning, trying, and communicating.

The Group Investigation learning process with the scientific approach is interrelated with one another. At the Group Investigation stage (1) identifying the topic and entering into research groups (grouping) At this stage, the teacher can lead students in conducting research discussions, then the teacher provides basic material, facilitating students to be sensitive to the problems presented by the teacher so that it can arouse the curiosity of students by providing opportunities for students to make observations through seeing, listening, listening, and reading activities. Furthermore, the teacher can coordinate students in the preparation of subtopic options that students take to be investigated, (2) plan the tasks to be studied (planning). Group Investigation learning is characterized by students working together with one another, most often in groups of 5-6 people. For this reason, the teacher can guide and help groups formulate plans for the reality of the problems to be studied on predetermined subtopics and exchange opinions can train students' abilities to ask questions and communicate ideas. Cooperating in maintaining cooperative norms and helping the group find appropriate sources for the subtopics to be studied, (3) carrying out the investigation. In this stage the teacher can help students to develop their skills in researching, then guide students to collect information, analyze data, and make conclusions. Each member of the

group contributes to the efforts the group will undertake. Students discuss with each other, clarify, and synthesize all ideas about the subtopics being studied. Activities to communicate and gather information are very supportive of the success of this stage.

Stage (4) prepares the final report. At this stage the teacher must encourage students to determine the main idea of the findings they get. Cooperate in explaining, comparing, evaluating the findings. Next, the teacher guides the group members to plan what they will report, and how they will make presentations. Then group representatives formed an event committee (presentation) to coordinate presentation plans. In this stage the activities of reasoning, communicating and associating are highly required in the problem solving process, (5) presenting the final report (presenting). This stage the teacher guides students to make presentations that will be delivered to all other students who are in the class in various forms, where the presentation part must be able to actively involve the listener, so that listeners can evaluate the clarity and appearance of the presentation based on the criteria predetermined by all class members. The skills of students in associating and communicating the findings of their group strongly support the achievement of this stage, (6) evaluating the process of group investigation of problems or subtopics found (evaluating), this stage is intended to provide opportunities for students to analyze and evaluate their own processes and skills. investigations with the intellectuals they use. The teacher's task in this phase is to guide and assist students in investigating the processes they use.

A summary of the description can be seen in Table 5. Which describes the activities that students and teachers will undertake in implementing the stages of Group Investigation.

Table 5. Group Investigation Stage with a Scientific Approach in Problem Solving

Cooperative Phase	Teacher Activity	Student Activities	Group Investigation Stage
Phase 1 Convey goals and motivate students	Convey goals and motivate students	Observing learning objectives	
Phase 2 Presenting information	Presenting information	Observing information	
Phase 3 Organizing students into cooperative groups	Assist in gathering information and facilitating learner research arrangements.	Research multiple sources, suggest a number of topics, and categorize suggestions. And study the topics they have chosen. (observing and asking)	**Stage I** Identify topics and organize them into research groups (Grouping).
	Guiding and helping groups formulate plans for the reality of the problems to be studied in the subtopics that have been determined	Planning together regarding; what do we learn?, how do we learn?, who does what (division of labor) ?, and for what purposes and interests are we investigating this topic? (ask)	**Stage II** Planning the task to be studied (Planning)
Phase 4 Guide work and study groups	Encourage students to collect data and build ideas in solving problems	gather information, analyze data, and draw conclusions. And discuss, clarify, and synthesize all	**Stage III** Carrying out an investigation (Investigation)

Cooperative Phase	Teacher Activity	Student Activities	Group Investigation Stage
		ideas. (communicating and gathering information)	
	Encourage students to determine the main idea of the findings they get. And guide students to plan what they will report, and how they will make a presentation	Plan what they will report, and how they will make the presentation. And form an event committee (presentation) to coordinate presentation plans (communicate and associate)	**Stage IV** Preparing the Final Report (Organizing)
	Guiding students to make presentations	Create presentations made for the entire class in a variety of forms. And evaluate the clarity and appearance of the presentation based on predetermined criteria (associate, and communicate)	**Stage V** Presenting the Final Report (Presenting)
Phase 5 Evaluation	Evaluating learners' learning.	Give each other feedback on the topic and on the work they have done. And evaluate the learning of other learners (associate and communicate)	**Stage VI** Evaluating
Phase 6 Give awards	Give awards	Give awards to other students	

6. Problem Based Learning Model

The learning process in schools is basically the students who play an active role, while the teacher acts as a facilitator. Therefore, the teaching method should change from lectur-based format to student-active approach or student-centered

instruction. One form of learning that applies a student-active approach or student-centered instruction is the Problem Based Learning model. With the application of the Problem Based Learning model which is an innovative learning model, the role of the teacher as an educator must be able to arouse students 'interest in learning, learning motivation and participation of students in the learning process so that it is expected that students' learning achievement will increase compared to the previous one who still applied the method. conventional lecture.

According to Nana Sudjana (2009: 85), "the practice of problem-solving learning models based on the objectives and teaching materials, the teacher explains what students have to achieve and the learning activities that must be carried out (the steps)". Through lectures and aids or demonstrations, the teacher explains the concepts, principles, laws, rules, and the like, sourced from the materials they have to teach. Give the opportunity to ask questions if students are not clear about the concepts, principles, laws, rules that have been explained, and the teacher formulates problems in the form of questions.

The problems posed can be in the form of applying these concepts, principles, laws, rules, it can also be in the form of the process of how these concepts or principles operate. The teacher and the students determine the temporary answer to the problem. Determining temporary answers, the teacher should provide the widest possible opportunity for students so that students themselves together formulate the alleged answer. The teacher has a more role in providing direction and guiding the opinions of students. The next stage, students are asked to find

information, information, materials, data, etc. needed to test the answers to the problems above to prove whether the presumptions or temporary answers they have formulated true or false. Searching for data and information can be done individually or in groups. Usually it is better if it is in the form of a group so that there is discussion among students.

Based on data, information, information obtained by students to discuss the information, whether the data is true or false, then collect the data to be matched with answers or provisional assumptions. This means testing whether the predetermined answer or provisional assumption is true or false based on the data and information it has obtained. This process the teacher provides assistance and guidance to each group. The teacher explains and concludes the correct answer to each problem and its explanations for the students to record. Likewise, the temporary answers that were rejected, the mistakes were explained so that students would know about them. End the lesson by giving homework assignments about the application of concepts, principles, laws, and rules or examples in the practice of everyday life. The assessment is carried out by the teacher at each step, both at work or learning carried out by students and the learning outcomes they achieve (Sudjana, 2009: 86).

Meanwhile, according to Anies (2003), "The problem-based learning model is an instructional model that has the characteristics of using real problems as a context for students who learn critical thinking and problem solving skills". Problem Based Learning is learning that involves students directly in a subject that requires practice. According to Boud and Felleti (1997), "Problem Based

Learning is an approach to structuring the curriculum involves confronting students with problems from practice with providing a stimulus from learning". (Problem Based Learning is an approach to compiling a curriculum that involves students in dealing with problems from practice that provide a stimulus for learning).

Based on the description above, it can be concluded that the Problem Based Learning model is a learning model that involves students with real problems that match their interests and concerns, so that motivation and curiosity increase. Thus students are expected to develop higher ways of thinking and skills. Like other learning methods, Problem Based Learning has strengths and weaknesses. Problem Based Learning is a learning model that empowers thinking, creativity, and student participation in learning. This is in line with the concept of learning that learning is a change in behavior.

According to Putra (2013: 82) there are several advantages of the Problem Based Learning model, namely as follows:

a. Students better understand the concepts being taught because they find the concept.

b. Involve students actively in solving problems and demand higher thinking skills of students.

c. Embedded knowledge based on schemata owned by students, so that learning is more meaningful.

d. Students can feel the benefits of learning, because the problems that are solved are directly linked to real life. This can increase the motivation and relevance of students to the material they are learning.

e. Make students more independent and mature, able to give aspirations and accept other people's opinions, and instill positive social attitudes with other students.

f. Conditioning of students in group learning that interacts with each other and their friends, so that the achievement of students' learning completeness can be expected.

g. Problem Based Learning is also believed to be able to foster the creativity skills of students, both individually and in groups, because almost every step requires the activeness of students.

According to Putra (2013: 83) the Problem Based Learning model besides having advantages there are also several drawbacks, namely:

a. For students who are lazy, the purpose of this method cannot be achieved.

b. Requires a lot of time and funds; and

c. Not all subjects can be applied with the Problem Based Learning method.

The developers of Problem Based Learning or problem-based learning according to Trianto (2015: 66) have suggested the characteristics of the problem-based learning model, namely:

a. Asking questions or problems.

b. Focusing on interdisciplinary linkages.

c. Authentic investigation.

d. Produce products or works and show them off.

e. Cooperation.

In order to clarify the characteristics of the problem-based learning model, it will be described as follows:

a. Asking questions or problems. Problem-based learning begins with asking questions or problems, rather than organizing around or around specific principles or skills. Problem-based learning organizes teaching around a question or problem that is both socially important and personally meaningful to learners. They propose authentic real-life situations to avoid simple answers, and allow a wide variety of solutions to those situations.

b. Focusing on interdisciplinary linkages. Although Problem Based Learning may be centered on certain subjects. The selected problem is really real so that in solving the student, the problem is reviewed from many subjects.

c.Authentic investigation. The problem-based learning model requires students to carry out authentic investigations to find real solutions to real problems. They must analyze then define problems, develop hypotheses and make predictions, gather and analyze information, conduct experiments (if needed), make references, and formulate conclusions.

d. Produce products or works and show them off. Problem Based Learning requires students to produce certain products in the form of real work and demonstrations that explain or represent the form of problem solving they find.

This form can be a report, a physical model, a video or a computer program. The real work is then demonstrated or presented to other friends about what they have learned and provides an alternative to the report or paper.

e. Cooperation. Problem-based learning models are characterized by students working together with one another, most often in pairs or in small groups. Working together provides motivation to be continuously engaged in complex tasks and increases opportunities for sharing inquiry and dialogue to develop social skills and thinking skills.

Problem-based learning usually consists of five main stages starting with the teacher introducing students to a problem situation and ending with the presentation and analysis of the students' work. In brief, the five stages of Problem Based Learning are as follows:

Table 6. Problem Based Learning Model

Problem Based Learning Model	Teacher Behavior Stage
Stage 1 The orientation of students on the problem	The teacher explains the learning objectives, explains the logistics needed, motivates students to be involved in the problem-solving activities they choose. The teacher discusses the assessment rubric that will be used in assessing the activities / work of students.
Stage 2 Organizing students to learn	The teacher helps students define and organize learning tasks related to these problems.
Stage 3 Guiding individual and group investigations	Teachers encourage students to collect appropriate information, carry out experiments to get explanations and problem solving.
Stage 4 Develop and present the work	The teacher helps students plan and prepare appropriate work such as reports, videos, and models and helps them to share assignments with their friends.
Stage 5 Analyze and evaluate the problem solving process	The teacher helps students to reflect or evaluate their investigations and the processes they use.

(Ibrahim dan Nur dalam Trianto, 2015:72)

7. Problem Based Learning Model with Scientific Approach in Problem Solving

Problem Based Learning is a learning model designed in which students work on auntetic problems with the intention of compiling their own knowledge, developing inquiry and high skills, developing independence and trust. The learning model is based on problems that require real investigation and resolution so that students are encouraged to solve problems by expressing their ideas or ideas in class discussions.

This is in line with the scientific approach in that the scientific approach requires active students to construct concepts, laws / principles through the stages of observing (identifying or formulating problems), proposing or formulating hypotheses, collecting data with various techniques, drawing conclusions and communicating concepts, laws or the "discovered" principle. The application of the scientific approach to learning involves the skills of the process of observing, questioning, reasoning, trying, and communicating.

The learning process of Problem Based Learning with the scientific approach is interrelated with one another. In the Problem Based Learning phase, (1) orienting students to the problem, the teacher can raise real questions in the environment of students and students can investigate. Presenting certain phenomena or demonstrating an event can arouse the curiosity of students by providing opportunities for students to make observations through seeing, listening, listening, and reading activities. The teacher can also guide students to

be able to ask questions about the problems presented, (2) organize students to learn. Problem-based learning is characterized by learners working together with one another, most often in pairs or in small groups. For this reason, the teacher can guide students to be active in the group to solve the problems given. Working together to get involved and exchange opinions can train students' ability to ask questions and communicate ideas.

Phase (3) guides individual and group investigations. In this phase the teacher encourages students to collect data and carry out experiments (mental and actual) until they understand the dimensions of the problem situation. The goal is for students to gather enough information to create and build their own ideas, thus arriving at problem solving. The activity of asking questions and associating really supports the success of this phase, (4) developing and presenting the work. At this stage students write down solving problems from a series of information that has been obtained. A series of concepts are collected in group activities and the appropriate strategy and approach in problem solving is selected. In this phase, the activities of trying, reasoning, and communicating are highly demanded in the problem solving process, (5) analyzing and evaluating the problem-solving process. This phase is intended to provide opportunities for learners to analyze and evaluate their own processes and intellectual inquiry skills that they use. The teacher's task in this phase is to guide and assist students in investigating the processes they use.

A summary of the description can be seen in Table 7. Which explains the activities that students and teachers will do in implementing the phases of Problem Based Learning.

Table 7. Phases of Problem Based Learning with Scientific Approach in Problem Solving

Phase	Aktifitas Guru	Aktifitas Peserta Didik
Phase 1 Orienting students on the problem	Presenting / raising real questions that are investigated by students	Observe and ask questions about the problem (Observe and ask questions)
Phase 2 Organizing students to learn	Guiding students to form a group and work together in solving problems	Cooperate and exchange opinions with fellow group members (ask and communicate)
Phase 3 Guiding individual and group investigations	Encourage students to collect data and build ideas in solving problems	Gather information to get the clarity needed to solve the problem (observe and associate)
Phase 4 Develop and present the work	Helping students to prepare for the problem solving process	Write down each stage of problem solving from a series of information obtained (associating and reasoning)
Phase 5 Analyze and evaluate the problem solving process	Guiding and assisting students with investigations in the processes they use	Analyze and evaluate their own processes and the inquiry and intellectual skills they use (questioning and communicating)

8. Troubleshooting

Problems arise because there is a gap between what is expected and reality, between what is known and what one wants to know, and what is owned and what is needed. Therefore this gap must be overcome. The process of overcoming these gaps is called the problem solving process. Not all problems can be used to measure problem-solving abilities. The problem in question is a problem that involves a mental process to solve it.

Talking about problem solving, mathematical experts refer to Polya's opinion a lot. Polya (in Jainuri) defines problem solving as "an attempt to find a way out of a difficulty in order to achieve a goal that is not immediately achievable". In Assessing 21st Century Skill, "Problem Solving is the basic process for identifying problems, considering options, and making informed choice". That is, problem solving is the basic process of identifying problems, considering options, and making informed choices.

Problem solving is part of the mathematics curriculum which is very important because in learning and in solving students it is possible to gain experience using the knowledge and skills they already have to be assigned to solving problems that are not routine (in Suherman, 2006: 89). Based on the learning theory proposed by Gagne (in Suherman, 2006: 89), high-level intellectual skills can be developed through problem solving.

Based on some of the opinions above, it can be concluded that problem solving is an attempt to find a way out of a difficulty (new situation) or irregular problem in mathematics. This is done by finding a combination of previously learned rules to deal with the new situation. If a person is able to find rules to deal with the new situation, it means that he is not only successful in solving the problem, but also discovering something new. This new thing according to Gagne in Wena (2012: 52) is "a set of procedures or strategies that enable a person to increase independence in thinking".

The benefits that will be obtained by students through problem solving in Fauzan (2011) are:

a. students will learn that there are many ways to solve a problem (divergent thinking) and there is more than one possible solution of a problem,

b.trained students to explore, think comprehensively, and reason logically,

c. develop the ability to communicate and shape social values through group work.

Problem solving will not just develop in students without training or getting used to problem solving problems. The more often students are trained with non-routine problems, the more experience students have in solving problems. In addition, students are also familiar with the steps they must take to solve math problems.

9. Mathematical Problem Solving Ability

Problem solving is the target of learning mathematics. Meanwhile, the result of a mathematics learning process is problem solving ability. Problem solving skills are very important for students. Experts agree that problem-solving abilities within certain limits can be formed through the fields of study and disciplines taught (Suharsono 1991, in Wena, 2012: 53). A student is said to have good problem solving skills if he meets the problem solving indicators. Problem solving indicators in Permendikbud Number 58 of 2014, namely:

a. understand the problem,

b. organize data and select relevant information in identifying problems,

c. presenting a problem formulation mathematically in various forms,

d. choose the right approach and strategy to solve the problem,

e. use or develop problem-solving strategies,

f. to solve problems,

g. interpret the answers obtained to solve the problem.

Sumarmo in Gusmiyanti (2015) also suggests problem solving indicators:

a. identifying the elements that are known, in question, and the adequacy of the elements needed,

b. formulate mathematical problems or compile mathematical models,

c. implement strategies to solve various problems (types and new problems) in or outside mathematics,

d. explain or interpret the results according to the original problem,

e. use mathematics meaningfully.

In this study, the indicators of problem-solving abilities used are:

a. organize data and select relevant information in solving problems,

b. presents a mathematical problem formulation in various forms,

c. choose and use the right strategy to solve the problem,

d. solve problems,

e. interpret the results of the answers obtained to solve the problem.

To measure the score of students' mathematical problem solving abilities, the rubric of scoring the problem solving abilities was used. Table 8 below is a rubric used in this study.

Table 8. Scoring Rubric for Problem Solving Ability Indicators

Indicator	score				
	0	1	2	3	4
Organizing data and selecting relevant information in identifying problems.	There is no answer.	Not true in identify information that given and that asked	Be able to identify a fraction of the information provided and that's being asked	Able to identify the information provided and asked for but almost complete and correct	Able identify ication information that given and that asked with complete and correct
Presenting	There	Not correct	If only	If there are	If correct in

Indicator	score				
	0	1	2	3	4
a mathematical problem formulation in various forms.	is no answer	in making a picture of the problem and writing the formula to be used	partially correct in drawing and writing the formula that will be used	a few mistakes in drawing and writing the formula that will be used	making pictures and writing down the formulas that will be used
Choose and use the right strategy to solve the problem	There is no answer	Not right in choosing a strategy to solve the problem	The strategy used is in accordance with the procedure, but there are errors when implementing the procedure	The strategy used is in accordance with the procedure but there are slight errors in the calculations	The strategy used is in accordance with the procedure and does the calculations correctly
Solve the problem	There is no answer	There is a final answer but the completion procedure is not clear	Carry out the correct procedure but there is an error in the implementation of the procedure so that the answer is wrong	Carry out the correct procedure but the end result is obtained not true	Carry out the correct procedures as well get the final result right
Interpret the results of the answers obtained for solve the problem	There is no answer	Not properly interpreting the results of the answers obtained to solve the problem	Be able to interpret the results of the answers obtained but the results wrong answer	Be able to interpret the results of the answers obtained by more than half	Be able to interpret the answers obtained to solve problems

Source: modified from Sri Wardhani in Nurdiani (2013: 38)

B. Relevant Research

Here are some studies that are relevant to this research. First, research conducted by Muhandaz (2014) also uses Group Investigation. But the difference is, Muhandaz's (2014) research was used to see whether the representation and problem solving abilities of students who learn to use the cooperative learning model of the Group Investigation type are better than the representation and problem solving skills of students who learn using conventional learning approaches. The results showed that the mathematical problem-solving abilities of students who studied with the cooperative learning model of the Group Investigation type were significantly better than those who studied with the conventional approach.

Furthermore, research conducted by Erlinda (2013) also used Problem Based Learning where the results of the study showed that the mathematical problem solving abilities of students who studied with the Problem Based Learning Model were significantly better than students who learned with conventional approaches. The equation of this research with research conducted by Erlinda (2013) is that both use the Problem Based Learning model. While the difference with this study is that the dependent variable studied in this study is the mathematical problem solving ability of students, the place of research, and in this study using 2 independent variables, namely the Group Investigation model and the Problem Based Learning model.

Then the national research relevant to this research was also conducted by Wijayanti et al (2016), Rusman et al (2013), Laelasari et al (2013). These three

studies also compare the Group Investigation model with the Problem Based Learning model. But the difference is, the research conducted by Wijayanti et al. (2016) was used to see whether there were differences in the geographic learning outcomes of students who followed the Group Investigation model based on multiple intelligence with the geographic learning outcomes of students who followed Problem Based Learning based on multiple intelligence. The results of research conducted by Wijayanti et al (2016) show that there are differences in the ability to solve students' problems using Group Investigation and Problem Based Learning based on Multiple Intelligences, where the average Group Investigation learning outcome is 4.2 higher than Problem Based Learning.

Then the research conducted by Rusman et al (2013) was used to determine whether there were differences in economic learning outcomes between those learning using the Group Investigation type cooperative learning model with the Problem Based Learning model. Rusman et al (2013) show that there are differences in economic learning outcomes where learning using the Group Investigation type cooperative learning model is compared to the Problem Based Learning type cooperative learning model and the average economic learning outcomes where learning using the Group Investigation type cooperative learning model is higher 4 , 2 compared to Problem Based Learning,

Furthermore, the research conducted by Lielasari et al (2013) was used to see whether there were differences in mathematical abilities between students who used the Problem Based Learning learning model and the Group Investigation learning model, to determine students' responses to mathematics learning using

the Problem Based Learning learning model. as well as to determine the response of students to mathematics learning using the Group Investigation learning model. Lealasari et al (2013) show that there are differences in the mathematical understanding of students who use the Problem Based Learning learning model and the mathematical understanding abilities of students who use the Group Investigation learning model in the subject of relations and functions. The similarity between this research and the research conducted by the three researchers above is that they both use the Group Investigation model and the Problem Based Learning model. While the difference with this study is the dependent variable studied in this study is the mathematical problem solving ability of students and the place of research.

In addition, there are several other national studies relevant to this research which were also conducted by Gangga et al (2015) and Faqihi et al (2015). These two studies also compare the Group Investigation model with the Problem Based Learning model. But the difference is, the research conducted by Gangga et al. (2015) was used to see which of the Group Investigation models, Problem Based Learning models, and direct learning models provided better mathematics learning achievement. The results of research conducted by Gangga et al (2015) showed that the mathematics learning achievement of students with the Group Investigation model was better than the Problem Based Learning model, as well as the direct learning model, and the mathematics learning achievement of students with the Problem Based Learning model was better than the direct learning model. .

Then the research conducted by Faqihi et al (2015) was used to see which one gave better mathematics learning achievement, between the Group Investigation model, the Problem Based Learning model, or the classical learning model with a scientific approach. Furthermore, Faqihi et al. (2015) show that the Group Investigation learning model and the Problem Based Learning model with a scientific approach produce better mathematics learning achievement than classical learning moodel with a scientific approach, while the Group Investigation learning model and Problem Based Learning model with a scientific approach produce the same learning achievement. The similarity between this research and the research conducted by the two researchers above is that they both use the Group Investigation model and the Problem Based Learning model. While the difference with this study is the dependent variable studied in this study is the mathematical problem solving ability of students and the place of research.

Furthermore, international studies relevant to this study are Hmelo-Silver et al (2006), Stepien et al (1993), Janet et al (2003). These three studies also apply the Problem Based Learning model. But the difference is, research conducted by Hmelo-Silver et al (2006) was used to see how to use specific strategies to support the objectives of Problem Based Learning so that students can build their own causal explanations and can become independent learners while maintaining a learner-centered learning process. and this research also wants to show that being able to articulate this strategy is an important step in helping others learn the art of Problem Based Learning facilitation.

Then the research conducted by Stepien et al (1993) was used to see whether the Problem Based Learning model could increase the motivation and learning achievement of students by looking at the involvement of the roles of teachers, students and schools.

Furthermore, the research conducted by Janet et al (2003) was used to see whether using the Problem Based Learning model can improve the mathematical reasoning abilities of middle school students in science class. The equation of this research with the research conducted by the three researchers is that they both use the Problem Based Learning model. While the difference with this study is that the dependent variable studied in this study is the mathematical problem solving ability of students, the place of research, and in this study using 2 independent variables, namely the Group Investigation model and the Problem Based Learning model.

Other international research relevant to this research was also conducted by Thant (2008) and Tan et al (2007). Thant's (2008) research also applies a cooperative learning model. But the difference is, the research conducted by Thant (2008) aims to review research overcoming the effects of CL on the academic achievement of Asian students. More importantly, this study attempts to investigate the incongruity between CL philosophy and Asian cultural values. This will help Asian educators and future researchers to take cautious steps when applying this radical approach to local education settings.

Then the research conducted by Tan et al (2007) also applies the Group Investigation learning model. But the difference is, the research conducted by Tan

et al. (2007) was used to see whether using the Group Investigation learning model can increase the motivation, perception, and academic achievement of Singaporean students. The results of a study conducted by Tan et al (2007) concluded that: “In an experiment conducted in 7 eighthgrade (Ages 13-14) classes in Singapore, the authors evaluated the effects of the group investigation method of cooperative learning versus the effects of the traditional whole-class method of instruction on students' academic achievement and on their motivation to learn. The authors also investigated students' perceptions of group investigation. Students in group investigation and in whole-class instruction advanced to the same extent over the course of the experiment. Neither method was more effective academically than the other method. "

The research conducted by Tan et al (2007) also discusses cooperative learning type Group Investigation which is applied to evaluate and improve student academic achievement. The similarity between this research and the research conducted by Tan (2007) is that both Group Investigation type cooperative learning. While the difference with this study is that the dependent variable studied in this study is the mathematical problem solving ability of students, the place of research, and in this study using 2 independent variables, namely the Group Investigation model and the Problem Based Learning model.

C. Conceptual Framework

In the mathematics learning process, students are not only required to get a result of the problems given, but students are more emphasized to understand the

process carried out in achieving or getting the results of a problem. But in reality, in the mathematics learning process this is less of a concern. Lack of students' attention and interest in learning mathematics is the cause of the low learning outcomes of students. Students 'disinterest in students' lessons makes students unable to solve math problems. Lack of active participation of students in finding and the learning process results in meaningless learning.

Learning mathematics in schools has the aim of teaching students about logical, analytical, systematic, critical and creative thinking and having the ability to work together. From this learning mathematics must be able to improve the problem solving abilities of students. Based on that, an approach is needed that can facilitate mastery of mathematical material as well as be able to improve students' problem solving abilities. Learning that is expected to be able to improve students' problem solving skills is Group Investigation and Problem Based Learning. Both of these lessons are learning that requires the activeness of students and the cohesiveness of students. Both learning are also learning that will help students build critical thinking skills, improve students 'problem solving abilities, and improve students' understanding and intelligence abilities.

D. Hypothesis

The hypotheses in this study are:

1. The mathematical problem solving abilities of students who take Group Investigation learning are different from the mathematical problem solving abilities of students who take Problem-Based Learning in class VIII Junior High School 1 Padang.

2. The mathematical problem solving abilities of students who take Group Investigation learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII SMP Negeri 1 Padang.

3. The mathematical problem solving ability of students who take Problem-Based Learning is better than the mathematical problem solving ability of students who take conventional learning in class VIII SMP Negeri 1 Padang.

CHAPTER III

RESEARCH METHODOLOGY

A. Types and Research Design

Based on the problems studied, this study is a quasi-experimental study. According to Nana (2005: 203) quasi-experiment is research that cannot provide complete control of the variables studied, where the sampling of this experiment is carried out randomly on the condition that the sample has the same characteristics. Quasi-experimental research was used to compare the learning outcomes of students in experimental class I, experiment II, and control.

In the experimental class I was given treatment in the form of mathematics learning with the Group Investigation learning model, in the experimental class II it was given treatment in the form of mathematics learning with the Problem Based Learning learning model, while the control class was given treatment in the form of mathematics learning with conventional learning. Quasi-experimental research was conducted with the aim of finding out whether there were differences in the mathematical problem-solving abilities of students who took Group Investigation learning with the mathematical problem solving abilities of students who took Problem Based Learning.

At the end of this study, the sample was given a test to see the learning outcomes of students. The research design used was the Randomized Control-Group Posttest Only Design which is described in the following table.

Table 9. Research Design

Class	Treatment	Posttest
E_1	X_1	T_1
E_2	X_2	T_2
K		T_3

Source: Modification Seniati (2011: 125)

Information:

E_1 = experimental class I

E_2 = experimental class II

K = control class

X_1 = the treatment given to the experimental class I is mathematics learning with the Group Investigation learning model

X_2 = the treatment given to the experimental class II, namely mathematics learning with the Problem Based Learning learning model

T_1 = tes akhir yang diperoleh dari kelas eksperimen I

T_2 = tes akhir yang diperoleh dari kelas eksperimen II

T_3 = tes akhir yang diperoleh dari kelas kontrol

B. Population and Sample

1. Population

Population is all objects that become observations. The population in this study were all class VIII students of Junior High School 1 Padang in the 2017/2018 academic year except class VIII.G, because this class was included in the superior class. The number of students for the population class is 255 people. The distribution of the number of students for each population class can be seen in Table 10.

Table 10. Distribution of Total Class Population Students

No	Class	Number of Students
1	VIII.A	32
2	VIII.B	32
3	VIII.C	32

No	Class	Number of Students
4	VIII.D	32
5	VIII.E	32
6	VIII.F	32
7	VIII.G	25
8	VIII.H	31
9	VIII.I	32
total		280

Source: Administration of SMP Negeri 1 Padang

2. Sample

The sample required in this study consisted of three classes, namely the experimental class I, the experimental class II, and the control class. Sampling was done by simple random sampling. The steps taken are as follows.

a. Collecting Value Data

Collecting data on the math score of the final exam for even semester class VIII SMP Negeri 1 Padang for the 2016/2017 academic year. Complete value data can be seen in Appendix 1 on page 150.

b. Performing the Average Similarity Test.

The test of the average equivalence of the final test scores of even semester mathematics students of class VIII Junior High School 1 Padang in the 2016/2017 academic year was carried out with the aim of seeing whether the population has the same average or not. To perform the average similarity test, the statistics to be tested are first established. The statistical hypothesis specified in this average similarity test is as follows:

$H_0 : \mu_1 = \mu_2 = \cdots = \mu_8$

H_1: there are mean values that are not the same.

One of the statistical analysis techniques to test the average similarity is One Way Anava. According to Usman (1995: 151) before carrying out the average similarity test, the following steps are first carried out: (1) Test or assume that the respective data is randomly selected, (2) Test or assume that the respective data is

distributed normal, (3) Test or assume that the variance of each data is homogeneous. The following are the steps for the average similarity test.

1) Normality test

The normality test aims to determine whether the population data is normally distributed or not. The test used is the Anderson-Darling test. The hypothesis in this test is as follows.

H_0 : normally distributed data
H_1 : data is not normally distributed

The steps for calculating the Anderson-Darling statistical test include:

a) Sort data from low to high

b) Find the standard deviation with the following formula:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

Information:

s = standard deviation

xi = the value of student i

$\bar{x}$ = the average value of the number

n = number of students

Determining the average is used the following formula:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Information:

$\bar{x}$ = average value

n = number of students

xi = the value of student I\

c) Data$(x_1, x_2, \ldots\ x_n)$ is made into standard numbers $(z_1, z_2, \ldots\ z_n)$

$$z_i = \frac{(x_i - \bar{x})}{s}$$

d) Search $F(z_i)$by looking at the z table

e) Search $\ln(F(z_i)$

f) Search $F(z_{n+1-i})$ or it can also be obtained by sorting the value $F(z_i)$from highest to lowest.

g) Search $\ln(1 - F(z_{n+1-i}))$

h) Calculate the value $\frac{1-2i}{n}$; n = lots of data

i) Then calculate the value

$$AD = \left\{\sum_{i=1}^{n} \frac{1-2i}{n} [\ln F(z_i) + \ln(1 - F(z_{n+1-i}))]\right\} - n$$

With $Z_i = \frac{(x_1-\mu)}{\sigma}$

$$CV = \frac{0.752}{\left(1 + \frac{0.75}{n} + \frac{2.25}{n^2}\right)}$$

Where:

AD= Anderson Darling

F = The cumulative distribution function of a particular distribution

Z_i = Data of the order of it

n = Many data

CV= critical value

The testing criterion is that the hypothesis H0 is accepted, that is, the data is normally distributed if the value is $AD <$ value CV. In this study, the normality test was carried out using the help of Minitab software with the testing criteria, namely if the P value obtained was greater than the real level (α)which is defined is $\alpha = 0{,}05$ then H_0 accepted. The results of calculating the P value of each population class can be seen in Table 11.

Table 11. Calculation Results of Population Normality Test

Class	P value	Explanation
VIII.A	0,147	Data is normally distributed
VIII.B	0,350	Data is normally distributed
VIII.C	0,570	Data is normally distributed
VIII.D	0,094	Data is normally distributed
VIII.E	0,051	Data is normally distributed
VIII.F	0,328	Data is normally distributed
VIII.H	0,555	Data is normally distributed
VIII.I	0,478	Data is normally distributed

Based on the results of the calculation of the normality test in Table 11, it is obtained that the P-value of each population class is greater so that it is accepted or the data is normally distributed. The calculations can be seen in Appendix 2 on page 151.

2.) Variance homogeneity test

This test aims to determine whether the population has a homogeneous variance or not. The test that will be used is the Bartlett test.

The Bartlett test is chosen when the homogeneity test is carried out on more than two variances. The statistical hypothesis applied to this homogeneity test is:

H_0 : ${\sigma_1}^2 = {\sigma_2}^2 = \cdots = {\sigma_8}^2$
H_1 : there are unequal variances.

To find out the results of the homogeneity test of population variance, calculations are made using the formula contained in Walpole (1993: 391) with the following steps:

a) Counted 8 pieces of various samples $s_1, s_2, \ldots, s_8$ from the samples of the size $n_1, n_2, \ldots, n_8$ with $\sum_{i=1}^{8} n_i = N$

b) Combined all the sample variance values to produce a combined estimated value

$$s_p^2 = \frac{\sum_{i=1}^{7}(n_i - 1)s_i^2}{N - 8}$$

c) Furthermore, the value of b is determined using the formula

$$b = \frac{[(s_1^2)^{n_1-1}(s_2^2)^{n_2-1} \dots (s_8^2)^{n_8-1}]^{1/(N-8)}}{s_p^2}$$

Information:

b = Bartlett

n_i = Number of students in class VIII; i = 1,2, ..., 8.

s_i^2 = Class VIII variant; i = 1,2, ..., 8.

N = The number of students in class VIII

s_p^2 = The combined estimate for the population variance

d) The criteria for testing the hypothesis is reject H_0 at the real level α which is determined if $b < b_7(a, n)$, where:

$$b_8(a; n_1; n_2; \dots; n_8) \simeq \frac{[n_1 b_8(a; n_1) + n_2 b_8(a; n_2) + \cdots + n_8 b_8(a; n_8)}{N}$$

All values $b_8(a, n_k)$ for sized samples $n_1, n_2, \dots, n_8$ can be obtained from Table A.13. Barlett's Critical Value Test (Walpole, 1992: 486).

In this study, the homogeneity test of variance was carried out using the help of Minitab software with the test criteria, namely that the population was said to be homogeneous if the confidence intervals of each class intersected and the predetermined P> α (real level) value $\alpha = 0{,}05$.

The results of the variance homogeneity test showed that the P value = 0.394 was greater than $\alpha = 0{,}05$, so it could be concluded that the population had homogeneous variance. For more details, the results of the variance homogeneity test can be seen in Appendix 3 on page 155.

Based on the results of the normality test and homogeneity test, it is known that the population is normally distributed and has homogeneous variances. Therefore, the average similarity test was carried out using one-way analysis of ariance (ANOVA). Statistical analysis was performed with the following steps by Walpole (1993: 389):

a) Creating an observation table for the data

The observed data from the population can be made in the following Table 12.

Table 12. k Random Samples

	Population				
	1	**2**	**...**	***i***	
		...	***k***		
	x_{11}	x_{21}	...	x_{i1}	
		...	x_{k1}		
	x_{12}	x_{22}	...	x_{i2}	
		...	x_{k2}		
	⋮	⋮	...	⋮	
		...	⋮		
	x_{1n}	x_{2n}	...	x_{in}	
		...	x_{kn}		
Total	T_1	T_2	...	T_i	*T...*
		...	T_k		
Middle value	$\bar{x}_1$	$\bar{x}_2$	...	$\bar{x}_i$	$\bar{x}...$
		...	$\bar{x}_k$		

Source: Walpole (1992: 383)

b) Calculating the number of squares

$$JKT = \sum_{i=1}^{k}\sum_{j=1}^{N} x_{ij}^2 - \frac{T_{...}^2}{N'}$$

$$JKK = \frac{\sum_{i=1}^{k} T_i^2}{N} - \frac{T_{...}^2}{N'}$$

$$JKG = JKT - JKK$$

Information :

JKT = Total Sum of Squares

JKK = Sum of Squares for Column Middle Value

JKG = Sum of Squares of Errors

c) Creating a variance analysis table for one-way classification

The variance analysis table for one-way classification is shown in Table 13 below

Table 13. Analysis of Variance for One-Way Classification

Source of Variance	Sum of Squares	Free Degrees	Middle Square	f count

Source of Variance	Sum of Squares	Free Degrees	Middle Square	f count
Column Middle Value	JKK	$k-1$	$s_1^2 = \frac{JKK}{k-1}$	$\frac{s_1^2}{s_2^2}$
Error	JKG	$N-k$	$s_2^2 = \frac{JKG}{N-k}$	
Total	JKT	$N-1$		

Source: Walpole (1992: 387)

d) The f statistic is calculated by formula $f = \frac{s_1^2}{s_2^2}$

e) Interpretation of analysis results

The test criterion is reject H0 if $f > f_{\alpha(v_1,v_2)}$ from the distribution list f where $v_1 = k-1$ and $v_2 = N-k$. In this study, the average similarity test was carried out by utilizing the help of Minitab software with the testing criteria, namely if the P value was more than the real level α which was determined, namely $\alpha = 0{,}05$ then accept H0 or the population had an average similarity.

One-way ANOVA test results showed the value of P = 0.084. The P value is greater than, so it is accepted or the data have the same average. The results of the analysis of the average similarity test can be described in Appendix 4 on page 156.

c.Determine the sample

Based on the analysis that has been carried out on the data on the final test scores of even semester mathematics students of class VII SMP Negeri 1 Padang, it is found that the data have the same mean. Therefore, sampling is done by simple random sampling, namely sampling by drawing lots. According to Wasito in Triwani (2017: 40) that this way of drawing is done in the following steps:

1) each member of the population is arranged in a list and given a serial number,
2) each population member number in the list is written on a small piece of paper,
3) the paper is rolled up and put in a box, and
4) After shaking, paper rolls are taken according to the desired sample size.

The first roll of paper taken was class VIII.A as the experimental class I, then the first roll of paper was returned to the box, and then the second roll of paper was taken according to the steps above. After the drawing was carried out, class VIII.A was selected as the experimental class I, class VIII.B as the experimental class II, and class VIII.C as the control class.

C. Research Variables

The variables that are considered in this study consist of:

1. The independent variables in this study are mathematics learning with Group Investigation learning, mathematics learning using Problem-Based Learning, and conventional learning.
2. The dependent variable is the ability to solve mathematical problems.

D. Data types and surces

1. Type of Data

The types of data in this study consist of primary data and secondary data:

a. The primary data in this study is quantitative data in the form of test results of the mathematical problem solving abilities of class VIII students of SMP Negeri 1 Padang in the 2017/2018 academic year. Data on test scores can be seen in Appendix 22 on page 261, Appendix 23 on page 263, and Appendix 24 on page 265.

b. Secondary data from this research is the number of students and the score of the eighth grade mathematics even semester Final Examination at SMP Negeri 1 Padang in the 2016/2017 academic year.

2. **Data Sources**

a.Class VIII students of SMP Negeri 1 Padang for the 2017/2018 school year to get primary data.

b. Administration, curriculum representatives and class VIII mathematics teachers at SMP Negeri 1 Padang to obtain secondary data.

E. Research Procedures

To obtain data in this study, several stages were carried out, consisting of:

1. Preparation stage

The activities carried out at this preparation stage are:

a. Determine the place and schedule of research.

b. Manage research permits to the faculty and proceed to the head of SMP Negeri 1 Padang.

c. Determining the sample class after the average similarity test is carried out, namely class VIII.A is the experimental class I, class VIII. B is the experimental class II, and class VIII.C is the control class.

d. Setting a schedule of activities. The research was carried out at SMP Negeri 1 Padang starting from 23 August - 07 October 2017 with material on relations and functions.

e. Prepare learning tools in the form of Learning Implementation Plans (RPP) and Student Worksheets (LKPD) for Group Investigation models, Problem Based Learning models, and conventional learning. The complete RPP can be seen in Attachment 5 on page 157 and LKPD in Attachment 7 on page 199.

f. RPP and LKPD that have been prepared previously are validated by the validator. In this study, two lecturers of Mathematics and Natural Sciences UNP became validators, namely Drs. H. Mukhni, M.Pd and Drs. H. Yarman, M.Pd. The RPP validation sheet can be seen in Appendix 6 on page 195 and the LKPD validation sheet can be seen in Appendix 8 on page 207.

g. Arrange a grid of final test questions which are arranged based on indicators of mathematical problem solving abilities. Grid can be seen in Appendix 9 on page 209.

h. Prepare final test questions, in the form of essay questions. The final test questions for mathematical problem solving abilities can be seen in Appendix 10 on page 211.

i. Compiling answers and scoring rubrics for the final test of mathematical problem solving abilities can be seen in Appendix 11 on page 213.

j. Validating the final test questions to find out whether the test questions are valid and suitable for use. The problem solving ability test questions were validated by two Mathematics lecturers of UNP, namely Drs. H. Mukhni, M.Pd and Drs. H. Yarman, M.Pd. The validation sheet for the final test of mathematical problem solving abilities can be seen in Appendix 12 on page 224.

k. Improve the final test according to the validator's criticism and suggestions.

l. Prepare a final test of mathematical problem solving abilities. To find out that the test is valid and suitable for use, it is given to the mathematics lecturer to be validated.

m. Forming a study group of students in the experimental class I where the division is based on heterogeneous academic ability and experiment II where the division is based on seating and gender which is heterogeneous.

2.Implementation Stage

At the implementation stage, the following are the steps:

a. Implementation of learning in the sample class.

In this study, three classes of samples were taken randomly, namely the experimental class I, the experimental class II, and the control class. In the experimental class I carried out Group Investigation learning, the experimental class II conducted Problem Based Learning, and the control class carried out conventional learning. The learning model is combined with a scientific approach.

- **Learning Process in Class Experiment I**

Stage-1. Grouping

1) Students are asked to sit with their respective group friends. Each group consists of 5-6 heterogeneous people and one chairperson is appointed to lead the discussion.

2) The teacher conveys the tasks that must be done in groups using LKPD 1. (observing and asking questions)

Stage-2. Planning

1) Students before discussing LKPD 1 in groups first plan together regarding:

- What did we learn?
- How do we learn?
- Who did what (division of tasks)?
- For what purposes and interests are we investigating this topic?

2) The teacher begins the lesson by presenting a problem in front of the class. (ask)

Stage-3. Investigation

1) Students and their group friends try to complete the guide on the LKPD.

2) Students with group friends discuss answering questions in the LKPD, students share answers and opinions to formulate conclusions.

3) The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in the LKPD. (collect information)

Stage-4. Organizing

1) Students plan and prepare appropriate work such as reports and conclusions.

2) Students plan to distribute tasks with their friends. (associate and communicate)

Stage-5. Presenting

1) The teacher asks the group that gets topics about relations, examples of relations, and presents the relations in the form of arrow diagrams, consecutive sets of pairs, and cartesian diagrams to come to the front of the class to present the results of their group discussions.

2) The selected groups present the results of their group discussions in front of the class. (associate and communicate)

Stage-6 Evaluating

1) Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. (associate and communicate)

- **Learning Process in Class Experiment II**

Phase-I Orientation of students to the Problem

1) The teacher begins the lesson by presenting a problem in front of the class. (observing and asking)

Phase-II Organizing students to learn

1) The teacher distributes LKPD to each group, students sit in groups to work on and solve problems given in the LKPD. (observing and asking)

Phase-III Guiding individual and group investigations

1) Students and their group friends try to complete the guide on the LKPD.

2) Students with group friends discuss answering questions in the LKPD, students share answers and opinions to formulate conclusions.

3) The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in the LKPD. (collect information)

Phase-IV Developing and presenting the work

1) The teacher asks one of the groups to come to the front of the class to present the results of the group discussion.

2) The selected groups present the results of their group discussions in front of the class.

3) Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. (associate and communicate)

Phase-V Analyze and evaluate the problem-solving process

1) Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers.
2) Students with the help of the teacher draw conclusions based on the results of the discussion. (associate and communicate)

- **Learning Process in Control Class**

1) Students begin learning by observing the appearance of a problem in front of the class. (observe)
2) The teacher explains the meaning of a relationship and gives several examples of other relationships such as the favorite food relationship, the less than relation, or the factor relation from.
3) Students collect information by listening to the explanation from the teacher and recording it related to the material explained and explained. (collect information)
4) Students are given the opportunity to ask questions related to the material described. (ask)
5) The teacher asks students to record an explanation of the material that has been delivered by the teacher.
6) Students are asked to work on some practice questions related to the material by way of peer discussion. (collect information)
7) Students are asked to discuss and after finishing the discussion students are asked to write down the results of their answers in front of the class and other students respond. (associate and communicate)

b.Carry out trials of test questions

Trial of test questions aims to make the test given of good quality. Testing of test questions is given to students who are not the object of research first. The test questions were tried out on students in other schools that also applied the 2013 curriculum and had the same student characteristics, namely having the same KKM as SMP Negeri 1 Padang, namely 80 and relevant to the mathematics ability

of the sample class, in this case it was carried out at SMP Negeri 8 Padang on September 25, 2017.

3.The final stage

At this stage, what the researcher does is as follows.

a. Give a final test (posttest) to the class that is the subject of research to see the ability to solve math problems after the subject has been studied.

b. Process the test data and the data is analyzed.

c. Draw conclusions from the results obtained in accordance with the analytical technique used.

F. Research Instruments

The research instrument used in this study was a test of mathematical problem solving abilities. The mathematical problem solving ability test used in this research is an essay test. The material tested in the test is in accordance with the material provided during the research. To get good mathematical problem solving ability test questions, the following steps are taken:

a. Preparation of grids for tests of mathematical problem solving abilities

The preparation of mathematical problem solving ability test questions is done by making a grid of mathematical problem solving abilities test questions first. The test grid is based on the curriculum and syllabus. The grid for tests of mathematical problem solving abilities can be seen in Appendix 9 on page 209.

b. Prepare test questions for mathematical problem solving abilities according to the question grid.

The preparation of test questions for mathematical problem-solving abilities is based on indicators related to the subject matter. The trial tests that are arranged can be seen in Appendix 10 on page 211. The answer keys for the trial test can be seen in Appendix 11 on page 213.

c. Validation of mathematical problem solving ability test questions

The final test question is said to be valid if the mathematical problem solving ability test questions can measure exactly what you want to measure. The

validation used in this research is content validation, where the questions are given to several experts, namely two lecturers.

The steps taken to obtain valid mathematical problem solving ability test questions are:

1) Creating a grid of mathematical problem solving abilities.

2) Arranging mathematical problem solving ability test questions based on the grid.

3) Validating mathematical problem solving ability test questions to several experts. In the case of a mathematics lecturer at the Faculty of Mathematics and Natural Sciences, UNP, Mr. Drs. H. Mukhni, M.Pd and Drs. H. Yarman, M.Pd. The validation was carried out with Drs. H. Mukhni, M.Pd, the part that needs to be fixed is the answer key to the test questions on the mathematical problem-solving ability which are not in accordance with the problem solving indicator. Then the validation was carried out with Drs. H. Yarman, M.Pd, the part that needs to be fixed is question number 1 which is not suitable to be said as a non-routine problem. The results of the validation of the test questions can be seen in Appendix 12 on page 224. In conclusion, the test questions for mathematical problem solving abilities can be used by making improvements according to the suggestions given.

d. Try out the mathematical problem solving ability test questions

Before the test questions of mathematical problem-solving abilities were given to students in the sample class, they were tested in other schools first. The trial was conducted at SMP Negeri 8 Padang. The school was chosen because it has several characteristics in common with SMP Negeri 1 Padang. Where the two schools use the 2013 curriculum, have the same school accreditation, namely A, and have the same KKM mathematics score, namely 80.

e. Analyze test test questions

Analysis of test questions in a trial was carried out to identify the questions that were used, revised or discarded. To determine the quality of the mathematical problem solving ability test questions, it is necessary to pay attention to the following matters:

1) Distinguishing Power of Question Items

The distinguishing power of a question item is a number that states the ability of a question to differentiate between high-skilled students and low-ability students. All test takers were grouped into two groups, namely the high-ability group and the low-ability group. According to Prawironegoro (1985: 11), to determine the distinguishing power of questions, the following methods are used:

a) Sort the data from the highest value to the lowest value

b) Take 27% of the group of students who got high scores and 27% of the groups of students who got low scores.

$$n_t = 27\% \times N$$

$$n_r = 27\% \times N$$

$$n_t = n_r = n$$

c) Calculating degrees of freedom (df) with the formula:

$$df = (n_t - 1) + (n_r - 1)$$

d) Finding the defender index with the following formula:

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^2 - \sum X_r^2}{n(n-1)}}}$$

Information:

I_p = problem differentiating index

I_t = average score of the high group

M_r = average score of the low group

$\sum X_t^2$ = the sum of the squares of the high group score deviations

$\sum X_r^2$ = the sum of squares of the deviation of the low group score

n = 27% × N

N = number of students

The question will have a significant (significant) distinguishing power if $I_{p\ hitung} \geq I_{p\ tabel}$ it $df = (n_t - 1) + (n_r - 1)$ has been determined

Table 14. Results of the Calculation of Differentiating Index of Trial Questions

Question Number	I_p
1	2,854
2a	53,404
2b	4,232
3	3,384
4a	2,146
4b	2,214
4c	3,021

From Table 14 it can be concluded that the seven questions tested have a significant index of difference because $I_{p\ hitung} \geq I_{p\ tabel}$ Where $I_{p\ tabel}$ is 2.12. The results of calculating the complete differentiation index for questions can be seen in Appendix 15 on page 231.

2) Problem Item Difficulty Index

The difficulty index is used to see whether the question is easy, medium or difficult. According to Prawironegoro (1985: 14) to determine the difficulty index, the formula is used:

$$I_k = \frac{D_t + D_r}{2mn} \times 100\%$$

Information :

I_k = question difficulty index

D_t = total score of the high group

D_r = total score of the low group

m = score for each question if correct

n = 27% x

N = number of students

To determine easy, medium or difficult questions, criteria are set as in Table 15 below:

Table 15. Criteria for Problem Difficulty Index

Difficulty Index(I_k)	Qualification

$I_k < 27\%$	Hard
$27\% \leq I_k \leq 73\%$	Medium
$I_k > 73\%$	Easy

The results of the calculation of the difficulty index of the test items can be seen in Table 16:

Table 16. Results of the Test Item Difficulty Index Calculation

Question number	I_k	Information
1	17,222%	Hard
2a	39,722%	Medium
2b	22,222%	Hard
3	25,833%	Hard
4a	59,722%	Medium
4b	73,611%	Easy
4c	29,167%	Medium

Based on Table 16, it can be concluded that from the results of the test questions analysis, it was obtained one question with the easy category, three questions in the medium category, and three questions with the difficult category. The results of the difficulty index calculation can be seen in Appendix 16 on page 236.

3) Question Acceptance Criteria

Based on the results of the calculation of the defender power and the difficulty index, it can be determined which questions are used, repaired or discarded, as stated by Prawironegoro (1985: 16) with the following criteria:

a) A question that is good or remains in use if the item against I_p is significant and $0 < I_k < 100\%$

b) Problem is corrected if:

I_p significant and $I_k = 0\%$ or $I_k = 100\%$

I_p insignificant and $0\% < I_k < 100\%$.

c) Problem is corrected if:

I_p insignificant and $I_k = 0\%$ or $I_k = 100\%$.

The criteria for receiving the questions for each item can be seen in Appendix 17 on page 240. Based on the results of the test test analysis, it was found that the seven items had significant I_p so these seven items could be used as an instrument for this research.

4) Reliability test

Test reliability is a measure of whether the test can be trusted. A test is said to be reliable if several times the test shows relatively the same results. To determine the reliability index of the test in the form of a description can be calculated using the Alpha formula proposed by Arikunto in Hamzah (2014: 233), namely:

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right)$$

With Variance $\sigma_t^2 = \frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n}$

Information:

r_{11}: reliability value

k : number of question items

$\sum \sigma_i^2$: the number of grain variances

σ_t^2 : total variance

x: score for each question

n : number of students

To determine which questions have very high, high, medium, low or very low reliability criteria are set as in Table 17 below:

Table 17. Test Reliability Criteria

r_{11} (Reliability)	Qualification
$0{,}80 < r_{11} \leq 1{,}00$	Very high
$0{,}60 < r_{11} \leq 0{,}80$	High
$0{,}40 < r_{11} \leq 0{,}60$	Medium
$0{,}20 < r_{11} \leq 0{,}40$	Low
$0{,}00 \leq r_{11} \leq 0{,}20$	Very low

Based on the results of the calculation of the reliability of the final test test questions obtained $r_{11} = 0{,}650$ are in the interval $0{,}60 < r_{11} \leq 0{,}80$ then the test questions have high reliability. The complete calculation of the reliability of the final test questions can be seen in Appendix 18 on page 241.

G. Data Analysis Techniques

To draw a conclusion from the assessment of the results, a statistical hypothesis testing was carried out, namely the Mann-Whitney U test. Before carrying out the Mann-Whitney U test, it is necessary to first test the normality and homogeneity test of the variance of the two groups of data.

1. Normality Test

The normality test aims to see whether the sample data is normally distributed or not. The test used is the Anderson-Darling test. The statistical hypothesis is as follows:

H_0: data on the results of the test of mathematical problem solving ability of the sample class is normally distributed

H_1: data from the test results of mathematical problem solving abilities in the sample class are not normally distributed

The test data is normally distributed if $AD < CV$ so H_0 be accepted. Otherwise, the population is not normally distributed or rejected H_0. In this study, the normality test was carried out using the help of Minitab software with the testing criteria, namely if the P value obtained was greater than the real level (α) which was determined, namely $\alpha = 0{,}05$ then H_0 it was accepted.

Based on the results of the calculation of the normality test for experimental class I and experimental class II, the P value is less than $\alpha = 0{,}05$ so H_0 it is rejected, so it can be concluded that the data from the test results of mathematical problem-solving abilities for the experimental class I and experimental class II are not normally distributed, whereas The results of the calculation of the control class normality test obtained that the P value is more than $\alpha = 0{,}05$ so that H_0 it is accepted, so it can be concluded that the results of the mathematical problem solving ability test results for the control class are normally distributed. The complete sample class normality test results can be seen in Appendix 25 on page 267.

2. **Hypothesis Test**

Hypothesis testing is carried out to find out whether there are differences in the mathematical problem solving abilities of students who take Group Investigation learning with the mathematical problem solving abilities of students who take Problem Based Learning, whether the mathematical problem solving abilities of students who take Group Investigation learning are better than the problem solving abilities mathematics of students who take conventional learning, and whether the mathematical problem solving abilities of students who take Problem Based Learning learning are better than the mathematical problem solving abilities of students who take conventional learning.

Based on the normality test conducted, the final test data for the experimental class I and the experimental class II were not normally distributed and the final test data for the control class were normally distributed, so there was no need to carry out the homogeneity test anymore. Then the hypothesis test is carried out using non-parametric statistics, applying the Mann-Whitney U test. According to Walpole (1995: 693) the testing hypothesis is:

H_0: $\eta_1 = \eta_2$
H_1: $\eta_1 \neq \eta_2$

Information:

η_1= median test results of mathematical problem solving abilities of groups of students whose learning uses Group Investigation learning

η_2 = median of the results of the mathematical problem solving ability of the group of students whose learning uses Problem Based Learning

$$H_0: \eta_1 = \eta_3$$
$$H_1: \eta_1 > \eta_3$$

Information:

η_1= median test results of mathematical problem solving abilities of groups of students whose learning uses Group Investigation learning

η_3= the median of the test results of the mathematical problem solving ability of the group of students whose learning uses conventional learning

$$H_0: \eta_2 = \eta_3$$
$$H_1: \eta_2 > \eta_3$$

Information:

η_2= median of the results of the mathematical problem solving ability of the group of students whose learning uses Problem Based Learning

η_3= the median of the test results of the mathematical problem solving ability of the group of students whose learning uses conventional learning

The Mann Whitney test formula (Siegel, 1985: 150) is:

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

Or

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

Choose the formula that yields the smallest U value. If $n_2 > 20$ then the significance of the price U is approached according to the normal distribution by converting U into numbers z with the formula:

$$z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$$

If the proportion of the same rankings is very large then a correction is made to z and it is calculated by the formula:

$$z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\left(\frac{n_1 n_2}{N(N-1)}\right)\left(\frac{N^3 - N}{12} - \sum T\right)}}$$

Where

$$T = \frac{t^3 - t}{12}$$

Information

t: many of the same values for a given rank.

The test criteria are H_0 rejected if $z \leq z_{1-\alpha}$ If the observed price U has a probability which is equal to or less than the real level α which is determined then H_0 is rejected. In this study, hypothesis testing was carried out with the help of Minitab software with an interpretation of the P value. If the P value obtained was less than the real level (α) which was determined, namely $\alpha = 0{,}05$ then rejected H_0

CHAPTER IV
RESEARCH RESULT

After the data collection process, a description and analysis of the data is carried out. This description and analysis aims to reveal the mathematical problem solving abilities of students after implementing Group Investigation learning in the experimental class I, Problem Based Learning learning in the experimental class II, and conventional learning in the control class.

A. Data Description

1. Mathematical Problem Solving Ability

Problem solving ability test data were obtained through essay-shaped tests. The test was conducted at the end of the study, namely on Saturday, October 7, 2017. The number of students who took the test was 32 people for the experimental class I, 31 people for the experimental class II where 1 person was not present, and 32 people in the control class. Based on the test results, details can be made as in Table 18.

Table 18. Descriptive Statistics of Mathematical Problem Solving Ability Test Results

Class	Number of Students	Lowest Value	The highest score	Average	Standard Deviation
Experiment I	32	41,3	88,0	70,2	12,2
Experiment II	31	25,0	89,1	69,7	14,1
Control	32	31,5	79,3	57,1	13,1

Table 18 shows that the experimental class I had a higher average test than the experimental class II and control class. The standard deviation of the experimental class I was lower than that of the experimental class II and the control class. This shows that the scores in the experimental class I are more uniform than those in the experimental class II and the control class. More complete test results are attached in Annex 22 on page 261, Annex 23 on page 263, and in Annex 24 on page 265.

2. Mathematical Problem Solving Ability in Each Indicator

In this section, we will describe the results of the mathematics problem solving ability test of students in the experimental class and the control class. To measure students' mathematical problem-solving abilities, a problem-solving ability test was given. The test questions used to measure mathematical solving ability in the form of essays consist of 5 items. Each test question contains five indicators of mathematical problem solving ability. The results of the indicator assessment of organizing data and selecting relevant information in identifying problems are expressed in terms of the percentage and number of students for the experimental class I, experiment class II, and control class which can be seen in Table 19 below.

Table 19. Distribution of Students' Mathematical Problem Solving Ability Scores Based on Indicators of Organizing Data and Selecting Relevant Information in Identifying Problems

Class	no. question	Score 0		Score 1		Score2		Score3		Score 4	
		J	P	J	P	J	P	J	P	J	P
Experiment I	1	0	0,0	0	0,0	1	3,1	2	6,3	29	90,6
	2a	0	0,0	0	0,0	3	9,4	6	18,8	23	71,9
	3	0	0,0	1	3,1	2	6,3	3	9,4	26	81,3
	4a	0	0,0	0	0,0	0	0,0	4	12,5	28	87,5
average		**0**	**0,0**	**1**	**0,8**	**2**	**4,7**	**4**	**11,8**	**27**	**82,8**
Experiment II	1	0	0,0	0	0,0	4	12,9	9	29	18	58,1
	2a	1	3,2	0	0,0	9	29	11	35,5	10	32,3
	3	1	3,2	0	0,0	8	25,8	4	12,9	18	58,1
	4a	2	6,5	3	9,7	0	0,0	3	9,7	23	74,2
average		**1**	**3,2**	**1**	**2,4**	**6**	**16,9**	**7**	**21,8**	**18**	**56,8**
Control	1	1	3,1	5	15,6	0	0,0	6	18,8	20	62,5
	2a	5	15,6	3	9,4	12	37,5	8	25	4	12,5
	3	0	0,0	1	3,1	5	15,6	12	37,5	14	43,8
	4a	1	3,1	15	46,9	1	3,1	7	21,9	8	25
average		**2**	**5,5**	**6**	**18,8**	**5**	**14,1**	**9**	**25,8**	**12**	**36**

Information:

J: Number of Students

P: Percentage

Based on Table 19 above, it can be seen that in indicator 1, the number of students in the experimental class I who achieved the highest score was more than the number of students in the control class and the number of students in the experimental class II who achieved the highest score was more than the number of students in the control class. In indicator 1, the number of students in the experimental class I who achieved the highest score was 27 students, while for the experimental class II there were 18 students, and for the control class there were 12 students.

Then for the results of the indicator assessment presents a mathematical problem formulation in various forms expressed in the form of a percentage and number of students for the experimental class I, experiment class II, and control class which can be seen in Table 20 below.

Table 20. The Distribution of Students' Mathematical Problem Solving Ability Scores Based on Indicators Presenting a Mathematical Problem Formulation in Various Forms

Class	No. Question	Score 0		Score 1		Score 2		Score 3		Score 4	
		J	P	J	P	J	P	J	P	J	P
Experiment I	1	1	3,1	0	0,0	2	6,3	3	9,4	26	81,3
	2a	1	3,1	0	0,0	2	6,3	0	0,0	29	90,6
	3	12	37,5	3	9,4	12	37,5	2	6,3	3	9,4
	4a	0	0,0	0	0,0	18	56,3	0	0,0	14	43,8
Average		**4**	**10,9**	**1**	**2,4**	**9**	**26,6**	**2**	**3,9**	**18**	**56,3**
Experiment II	1	3	9,7	1	3,2	1	3,2	6	19,4	20	64,5
	2a	3	9,7	0	0,0	1	3,2	0	0,0	27	87,1
	3	0	0,0	0	0,0	26	83,9	0	0,0	5	16,1
	4a	0	0,0	0	0,0	12	38,7	0	0,0	19	61,3
Average		**2**	**4,9**	**1**	**0,8**	**10**	**32,3**	**2**	**4,9**	**16**	**57,3**
Control	1	0	0,0	0	0,0	0	0,0	4	12,5	28	87,5
	2a	3	9,4	0	0,0	6	18,8	1	3,1	22	68,8
	3	5	15,6	0	0,0	15	46,9	1	3,1	11	34,4
	4a	0	0,0	0	0,0	22	68,8	0	0,0	10	31,3
Average		**2**	**6,3**	**0**	**0,0**	**11**	**33,6**	**2**	**4,7**	**18**	**55,5**

Based on Table 20 above, it can be seen that in indicator 2, the number of students in the experimental class I who achieved the highest score was more than the number of students in the control class and the number of students in the experimental class II who achieved the highest score was more than the number of

students in the control class. In indicator 2 the number of students in the experimental class I who achieved the highest score was 18 students, while for the experimental class II there were 16 students, and for the control class there were 18 students.

After that, for the results of the indicator assessment of choosing and using the right approach or strategy to solve the problem expressed in terms of the percentage and number of students for the experimental class I, experimental class II, and control class which can be seen in Table 21 below.

Table 21. The Distribution of Students' Mathematical Problem Solving Ability Scores Based on Indicators Choosing and Using the Right Approach or Strategy to Solve Problems

Class	No. Question	Score 0		Score1		Score2		Score3		Score4	
		J	P	J	P	J	P	J	P	J	P
Exsperiment I	1	2	6,3	3	9,4	1	3,1	2	6,3	24	75
	2a	3	9,4	0	0,0	1	3,1	0	0,0	28	87,5
	3	15	46,9	0	0,0	5	15,6	4	12,5	8	25
	4a	1	3,1	0	0,0	1	3,1	3	9,4	28	87,5
average		**6**	**16,4**	**1**	**2,4**	**2**	**6,2**	**3**	**7,1**	**22**	**68,8**
Exsperiment II	1	3	9,7	1	3,2	1	3,2	4	12,9	22	71
	2a	4	12,9	0	0,0	2	6,5	0	0,0	25	80,7
	3	0	0,0	0	0,0	0	0,0	28	90,3	3	9,7
	4a	0	0,0	0	0,0	0	0,0	9	29	22	71
average		**2**	**5,7**	**1**	**0,8**	**1**	**2,4**	**11**	**33,1**	**18**	**58,1**
Control	1	0	0,0	0	0,0	2	6,3	6	18,8	24	75
	2a	4	12,5	1	3,1	5	15,6	2	6,3	20	62,5
	3	4	12,5	2	6,3	2	6,3	3	9,4	21	65,6
	4a	13	40,6	1	3,1	1	3,1	6	18,8	11	34,4
average		**6**	**16,4**	**1**	**3,1**	**3**	**7,8**	**5**	**13,3**	**19**	**59,4**

Based on Table 21 above, it can be seen that in indicator 3, the number of students in the experimental class I who achieved the highest score was more than the number of students in the control class and the number of students in the experimental class II who achieved the highest score was more than the number of students in the control class. In indicator 3 the number of students in the experimental class I who achieved the highest score was 22 students, while for the experimental class II there were 18 students, and for the control class there were 19 students.

Meanwhile, the results of the problem solving indicator assessment are expressed in terms of the percentage and number of students for the experimental class I, experiment class II, and control class which can be seen in Table 22 below.

Table 22. Distribution of Students' Mathematical Problem Solving Ability Scores based on Problem Solving Indicators

Class	No. Question	Score 0		Score1		Score2		Score3		Score 4	
		J	P	J	P	J	P	J	P	J	P
Exsperiment I	1	6	18,8	3	9,4	1	3,1	0	0,0	22	68,8
	2a	1	3,1	1	3,1	2	6,3	0	0,0	28	87,5
	2b	0	0,0	2	6,3	13	40,6	4	12,5	13	40,6
	3	26	81,3	1	3,1	3	9,4	0	0,0	2	6,3
	4a	3	9,4	1	3,1	2	3,1	15	46,9	11	34,4
Average		**7**	**21,3**	**2**	**5**	**4**	**12,5**	**5**	**13,1**	**16**	**47,5**
Exsperiment II	1	5	16,1	2	6,5	1	3,2	2	6,5	21	67,7
	2a	2	6,5	2	6,5	4	12,9	14	45,2	9	29
	2b	2	6,5	3	9,7	4	12,9	7	22,6	15	48,4
	3	6	19,4	1	3,2	2	6,5	8	25,8	14	45,2
	4a	5	16,1	3	9,7	7	22,6	12	38,7	4	12,9
Average		**4**	**12,9**	**3**	**7,1**	**4**	**11,6**	**9**	**27,8**	**13**	**40,6**
Control	1	2	6,3	0	0,0	2	6,3	1	3,1	27	84,4
	2a	5	15,6	0	0,0	3	9,4	5	15,6	19	59,4
	2b	10	31,3	2	6,3	7	21,9	3	9,4	10	31,3
	3	6	18,8	7	21,9	7	21,9	4	12,5	8	25
	4a	19	59,4	8	25	2	6,3	3	9,4	0	0,0
Average		**9**	**26,3**	**4**	**10,6**	**5**	**13,2**	**4**	**10**	**13**	**40**

Based on Table 22 above, it can be seen that in indicator 4, the number of students in the experimental class I who achieved the highest score was more than the number of students in the control class and the number of students in the experimental class II who achieved the highest score was more than the number of students in the control class. In indicator 4, the number of students in the experimental class I who achieved the highest score was 16 students, while for the experimental class II there were 13 students, and for the control class there were 13 students.

Furthermore, for the results of the indicator assessment interpreting the results of the answers obtained to solve the problem is expressed in terms of the

percentage and number of students for the experimental class I, experiment class II, and control class which can be seen in Table 23 below.

Table 23. Distribution of Students' Mathematical Problem Solving Ability Scores Based on Indicators Interpreting the Results of Answers Obtained to Solve Problems

Class	No. Question	Score 0		Score 1		Score 2		Score 3		Score 4	
		J	P	J	P	J	P	J	P	J	P
Exsperiment I	1	11	34,4	3	9,4	0	0,0	1	3,1	17	53,1
	2a	1	3,1	1	3,1	5	15,6	18	56,3	7	21,9
	2b	2	6,3	6	18,8	10	31,3	3	9,4	11	34,4
	3	22	68,8	4	12,5	3	9,4	1	3,1	2	6,3
	4b	2	6,3	5	15,6	1	3,1	14	43,8	10	31,3
	4c	3	9,4	16	50	9	28,1	1	3,1	3	9,4
Average		**7**	**21,4**	**6**	**18,2**	**5**	**14,6**	**7**	**19,8**	**9**	**26.1**
Exsperiment II	1	7	22,58	1	3,2	3	9,7	0	0,0	20	64,5
	2a	1	3,2	7	22,6	3	9,7	19	61,3	1	3,2
	2b	5	16,1	15	48,4	0	0,0	6	19,4	5	16,1
	3	7	22,6	2	6,5	4	12,9	10	32,3	8	25,8
	4b	8	25,8	5	16,1	4	12,9	9	29	5	16,1
	4c	14	45,2	10	32,3	0	0,0	3	9,7	4	12,9
Average		**7**	**22,6**	**7**	**21,5**	**3**	**7,5**	**8**	**25,3**	**8**	**23,1**
Control	1	2	6,3	0	0,0	5	15,6	4	12,5	21	65,6
	2a	20	62,5	0	0,0	5	15,6	7	21,9	0	0,0
	2b	21	65,6	5	15,6	0	0,0	1	3,1	5	15,6
	3	27	84,4	1	3,1	3	9,4	1	3,1	0	0,0
	4b	21	65,6	1	3,1	6	18,8	3	9,4	1	3,1
	4c	26	81,3	6	18,8	0	0,0	0	0,0	0	0,0
Average		**20**	**61**	**4**	**6,8**	**4**	**9,9**	**3**	**8,3**	**5**	**14,1**

Based on Table 23 above, it can be seen that in indicator 5, the number of students in the experimental class I who achieved the highest score was more than the number of students in the control class and the number of students in the experimental class II who achieved the highest score was more than the number of students in the control class. In indicator 5, the number of students in the experimental class I who achieved the highest score was 9 students, while for the experimental class II there were 16 students, and for the control class there were 5 students.

B. Data Analysis

Analysis of the final test results of students' mathematical problem solving abilities in the sample class was carried out to draw conclusions about the problem-solving abilities of students in class VIII of SMP Negeri 1 Padang in the 2017/2018 academic year. Before carrying out the Mann-Whitney U test, it is necessary to first test the normality of the two groups of data.

a. Normality Test

The normality test was carried out by the Anderson-Darling test with the help of MINITAB software. The normality test resulted in the P value of the experimental class I of 0.010, the experimental class II of 0.008, and 0.714 to the control class. Based on the results of the normality test for the experimental class I and the experimental class II, the P value was less than the level, it can be concluded that the test data of the students' mathematical problem-solving abilities in the two sample classes were not normally distributed. Whereas for the control class normality test results obtained a P value more than the real level, it can be concluded that the test data of students' mathematical problem solving abilities in the control class are normally distributed. Because the experimental class I and experimental class II were not normally distributed, the hypothesis test used was the Mann-Whitney U test. The complete sample class normality test results can be seen in Appendix 25 on page 267.

b. Hypothesis Test

Hypothesis testing aims to determine whether there are differences in the mathematical problem solving abilities of students who take Group Investigation learning with the mathematical problem solving abilities of students who take Problem Based Learning in class VIII of SMP Negeri 1 Padang, whether the mathematical problem solving abilities of students who take Group learning Investigation is better than the mathematical problem solving abilities of students who take conventional learning in class VIII of SMP Negeri 1 Padang, and whether the mathematical problem solving abilities of students who take Problem

Based Learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII SMP Negeri 1 Padang.

Based on the results of the analysis for the first hypothesis test using the Mann-Whitney U test at the significant level of 0.05, the P value was obtained at 0.9179. Because the P value is greater than the real level, namely $\alpha = 0{,}05$, then accept H_0. Thus, it can be concluded that the mathematical problem solving abilities of students who take Group Investigation learning are not different from the mathematical problem solving abilities of students who take Problem Based Learning in class VIII SMP Negeri 1 Padang in the 2017/2018 academic year.

Based on the results of the analysis for the second hypothesis test using the Mann-Whitney U test at the significant level of 0.05, the P value was obtained at 0.0002. Because the P value is less than the real level, namely$\alpha = 0{,}05$, then reject H_0 . Thus, it can be concluded that the mathematical problem solving abilities of students who take Group Investigation learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII SMP Negeri 1 Padang in the 2017/2018 academic year.

Based on the analysis results for testing the third hypothesis using the Mann-Whitney U test at the significant level of 0.05, the P value is 0.0002. Because the P value is less than the real level, namely $\alpha = 0{,}05$, then reject H_0. Thus, it can be concluded that the mathematical problem solving abilities of students who take Problem Based Learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII

SMP Negeri 1 Padang in the 2017/2018 school year. Sample class hypothesis testing can be seen in Appendix 26 on page 269.

C. Discussion

The mathematical problem solving abilities of students in this study were seen through five indicators, namely (1) organizing data and selecting relevant information in identifying problems, (2) presenting a mathematical problem formulation in various forms, (3) selecting and using approaches and strategies appropriate to solve the problem, (4) solve the problem and (5) interpret the results of the answers obtained to solve the problem.

1. Comparative discussion of the Mathematical Problem Solving Ability of Students in Experiment Class I and Experiment Class II

Based on the results of the description and data analysis, it can be seen that the mathematical problem solving abilities of students in experimental class I are the same as those of experimental class II in class VIII of SMP Negeri 1 Padang in the 2017/2018 school year. Where the average mathematical problem solving ability of students in experimental class I was 70.2, while the average experimental class II was 69.7. In the two sample classes both LKPD and the same amount of time allocation were given, but the only difference was in the learning implementation process. In the experimental class I, the learning carried out is the Group Investigation model, while in the experimental class II, the learning is carried out using the Problem Based Learning model.

The steps of the Group Investigation model that can affect the indicators of students' problem solving abilities are grouping, planning, investigation,

organizing, presenting, and evaluating. When students identify topics, plan tasks to be studied, and carry out investigations, students are trained to organize and select relevant data to solve problems (indicator 1). To prepare the final report requires the ability of students in indicators 2 and 3. While the ability for indicator 4 can be developed at the stage of presenting the final report and for the ability of indicator 5 can be improved at the evaluation stage.

Then for the steps of the Problem Based Learning model that can affect the indicators of students' problem solving abilities are orienting students to problems, organizing students to learn, guiding group investigations, developing and presenting work results, the last phase is analyzing and evaluating the problem solving process. When the phase of orienting students to problems and organizing students to learn, students are trained to organize and select relevant data to solve problems (indicator 1). For the guiding phase of group investigations, the ability of students in indicators 2 and 3. is needed. Meanwhile, the ability for indicator 4 can be developed in the phase of developing and presenting the work and for the ability of indicator 5 can be improved in the phase of analyzing and evaluating the problem solving process.

Students in experimental class I who learn to use the Group Investigation learning model are given the opportunity to become problem solvers. This is in line with the opinion of Bruner (in Permendikbud No.59, 2014: 377) which says that teachers should give their students the opportunity to become a problem solver, a scientist, historian, or mathematician. Students become problem solvers by investigating the problems given through the LKPD in groups, where the group

is arranged by researchers heterogeneously based on the students' abilities from the score of the 2016/2017 academic year Final Examination.

According to Slavin (2009: 215) as part of the investigation of the problem, students seek information from various sources both inside and outside the classroom. Sources such as (various books, institutions, people) offer a series of ideas, opinions, data, solutions, or positions related to the problem being studied. This makes students interested and accustomed to assessing the situation of a problem by gathering information needed to solve the problem. After organizing information related to the problem to be solved, students are guided independently to try to solve the problem. At this stage students can validate the ability to formulate problems mathematically, choose and use the right strategies and approaches in solving problems and the ability to solve problems. Meanwhile, the ability to interpret the results of the answers can be developed by students when presenting the answers on worksheets and presentations in front of the class. Therefore, the Group Investigation learning model which is applied to the experimental class I provides the opportunity for students to find out for themselves and present their ideas when solving a problem. This series of Group Investigation model activities gradually trains students to develop mathematical problem solving skills.

Students in experimental class II who learn to use the Problem Based Learning model are also stimulated by problems, this is in accordance with Boud and Felleti (1997), "Problem Based Learning is an approach to structuring the curriculum involves confronting students with problems from practice with

providing a stimulus from learning ". (Problem Based Learning is an approach to compiling a curriculum that involves students in dealing with problems from practice that provide a stimulus for learning). The Problem Based Learning model requires students to produce or find solutions to the problems they find, this requires students to carry out authentic investigations to find real solutions to the problems presented.

According to Bruner's opinion in Trianto (2012: 19) that trying on his own to find solutions to problems and the knowledge that accompanies them produces knowledge that is truly meaningful. A logical consequence, because trying to find solutions to problems independently will provide concrete experiences, with this experience it can also be used to solve similar problems, because this experience provides its own meaning for students.

From the description, it is explained that the Problem Based Learning model is learning that begins by presenting real problems whose solutions require collaboration between students. This learning helps students to process information that has been finished in their minds and organize their own knowledge to be able to solve problems. The teacher as a facilitator guides every investigation carried out by students starting from analyzing and defining problems, collecting and analyzing information, conducting experiments and formulating conclusions.

However, in principle, the Group Investigation learning model and Problem Based Learning are two learning models that were coined by John Dewey, who during the learning process students solve a problem by conducting an

investigation or investigating, making a final report and presenting the final report at front of the class. Furthermore, when viewed in terms of the division of students into groups in the Group Investigation learning model with Problem Based Learning. In the Group Investigation learning model, the division of students into groups is made heterogeneously according to the academic abilities of students who are viewed based on the 2016/2017 even semester Final Exam scores in the class. This is in accordance with the opinion of Hosnan (2014: 258) which states that in Group Investigation learning, group investigation arrangements are carried out by teachers which are carried out heterogeneously by considering the academic abilities of each student. So that during the learning process in the Group Investigation learning model in this study, of the 6 groups made by researchers in the experimental class I, all groups were active during the Group Investigation learning process, both in submitting the final report, evaluating the final report of other groups or providing feedback to another group.

Meanwhile, in Problem Based Learning, the division of students into groups is not made heterogeneously. This has been done by Gatot (2010: 91) in his research which states that in Problem Based Learning, the division of students into groups is not heterogeneous. In this study, the division of groups in Problem Based Learning by researchers was made based on the location of the seat and only heterogeneous based on gender. This results in Problem Based Learning in this study, there are groups whose members are all smart students and there are also groups that consist of all students who are less intelligent. So that during the learning process in Problem Based Learning in this study, not all groups were

active in Problem Based Learning. Based on the researchers' observations, of the 6 groups that the researcher formed in Problem Based Learning in each class in the experimental class I, only 2 or 3 groups were active in Problem Based Learning and the other groups were not very active and even tended to be just listeners.

Then when viewed in terms of the sub-topic division that will be studied or discussed, in Group Investigation learning after students sit in groups, students are asked by the teacher to take subtopics which they will discuss in groups at the stage of identifying topics, planning tasks to be studied, and at stage of presenting the final report. Furthermore, as part of the investigation, students seek information from various sources both inside and outside the classroomaccording to the subtopic they have chosen. This is in accordance with the opinion of Rusman (2012: 220) which states that in general class organizing planning using the cooperative group investigation model is that each group is free to choose a subtopic from the entire unit of material (subject) to be discussed, and then makes or produces a report. group.

Meanwhile, in Problem Based Learning, students in the first phase directly observe and ask questions about the problem to be investigated. This is in accordance with the opinion of Arends in Warsono and Hariyanto (2012: 151) which states that in the first phase the teacher provides motivation and problems to students so that they pay attention to problem solving activities. Students are not involved in the distribution of the subtopics that they will discuss, but they only accept the subtopic in the phase of presenting the work given by the teacher. So that in the phase of developing the work of the whole group must prepare the

work of the group maximally without knowing which group will present their work in the phase of presenting the work.

In the final test of mathematical problem solving abilities, there are five indicators that are assessed per item. The questions for the final test of mathematical problem solving abilities in the experimental class I and the experimental class II totaled 4 questions. Based on the above discussion of the 5 indicators tested in this study, it turns out that for indicators (1) organizing data and selecting relevant information in identifying problems, (2) presenting a problem mathematically in various forms, (3) choosing and using an approach or strategy appropriate for solving problems, (4) solving problems, and (5) interpreting the results of the answers obtained to solve the problems of students in experimental class I the same as in experimental class II. Thus it can be concluded that the mathematical problem solving abilities of experimental class I students who learn with the learning model are not different from the mathematical problem solving abilities of experimental class II students who learn with Problem Based Learning.

2. Comparative discussion of the Mathematical Problem Solving Ability of Students in Experiment Class I and Control Class

Based on the results of the description and data analysis, it can be seen that the mathematical problem solving abilities of the experimental class I students are better than the control class students' mathematical problem solving abilities in the VII grade of SMP Negeri 1 Padang in the 2017/2018 academic year. Where the

average mathematical problem solving ability of students in the experimental class I was 70.2, while the average control class was 57.1.

Experiment class I used learning with the Group Investigation model, while in the control class who learned using conventional learning, the teacher immediately gave the final concept to students. Then after getting the concept from the teacher, students use the concept in solving the problems given by the teacher. Even though the teacher has tried to lure students to understand the next concept, in reality the students are only able to solve problems that are almost the same as the examples given by the teacher. If given non-routine questions, students will have difficulty solving them because students are not accustomed to analyzing them in stages as found in the Group Investigation model.

In the final test of mathematical problem solving abilities, there are five indicators that are assessed per item. The questions for the final test of mathematical problem solving ability in the experimental class I and the control class consist of 4 questions. The following is explained in more detail regarding the students' mathematical problem solving abilities in achieving each mathematical problem solving indicator used.

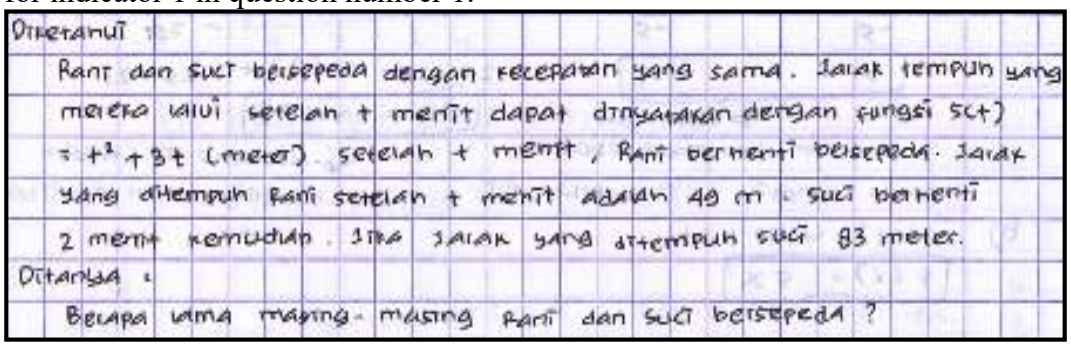
a. Organizing data and selecting relevant information

In the indicators of organizing data and selecting relevant information in identifying problems, it is hoped that students will be able to identify problems in the form of information that is not known and asked by questions. Students must be able to choose between what has been determined, has not been determined and what should be determined from the problems described. This step is a very

important step because a student is able to solve problems well when he is able to organize data and select relevant information well.

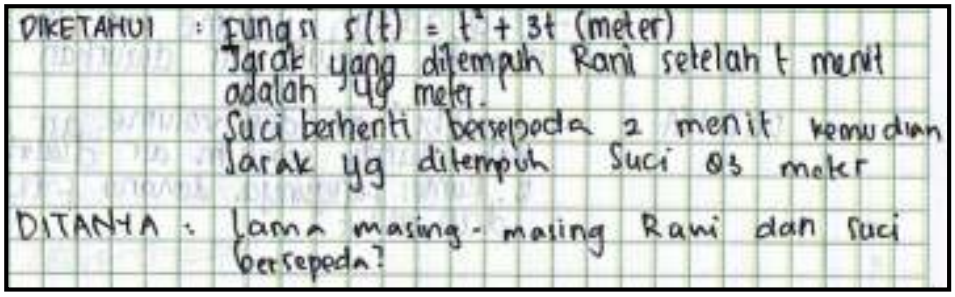
In Table 19, it is known that the highest average percentage score of students in the experimental class I in organizing data and selecting relevant information in identifying problems is greater than students in the control class. The table shows that the highest average score percentage of students in the experimental class I was 82.8% and students in the control class were 36%. The ability of students in selecting information and collecting data can be seen from the answers of students in making it known and asked. The maximum score given if students are able to select information and collect data correctly and completely is 4.

The mathematical problem solving ability test that was tested consisted of 4 questions, where the five questions required the ability of students to organize data and select relevant information in identifying problems. The following is the answer of the experimental class I and control class students who got a score of 4 for indicator 1 in question number 1.


Diketahui :
Rani dan Suci bersepeda dengan kecepatan yang sama. Jarak tempuh yang mereka lalui setelah t menit dapat dinyatakan dengan fungsi s(t) = $t^2 + 3t$ (meter). setelah t menit, Rani berhenti bersepeda. Jarak yang ditempuh Rani setelah t menit adalah 49 m. Suci berhenti 2 menit kemudian. Jika jarak yang ditempuh Suci 83 meter.
Ditanya :
Berapa lama masing-masing Rani dan Suci bersepeda ?

is known : Rani and Suci are cycling at the same speed. the distance they traveled after t minutes can be expressed by $s(t) = t^2 + 3t$ (meters). after t minutes rani stopped cycling. the distance rani traveled after t minutes was 49 meters. Suci stopped cycling 2 minutes laterif the distance traveled by the holy is 83 meters

asked: how long does each rani and saint ride?



is known : $s(t) = t^2 + 3t$ (meters)
the distance rani traveled after t minutes was 49 meters
Suci stopped cycling 2 minutes laterif the distance
traveled by the holy is 83 meters

asked: how long does each rani and saint ride?

Figure 6. Answers of Control Class Students in Organizing Data and Choosing Relevant Information in Identifying Problems

In Figure 5, it can be seen that students in experimental class I have been able to identify and collect the information needed to solve the problem by making it known and being asked completely and according to the information provided in the questions. It can be seen from the answers of students in writing what is known from the questions, students write completely the information obtained from the problem and determine what is asked by the questions. Likewise in Figure 6 shows that control class students are able to identify data well. Students are complete in determining what is known and what is asked in the questions. However, it is known that students write inappropriate language that is not well structured.

The number of students in the experimental class I who got a score of 4 in question number 1 was 29 people. Then for the control class who got a score of 4 only 20 students from the total number of students as a whole. Likewise with questions number 2, 3, and 4 which are presented in more detail in Table 24 below.

Table 24. Number of Students (Percentage) for Indicators of Organizing Data and Choosing Relevant Information in Identifying Problems

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment I	0 (0%)	0 (0%)	1 (3,1%)	2 (6,3%)	29 (90,6%)
	Control	1 (3,1%)	5 (15,6%)	0 (0%)	6 (18,8%)	20 (62,5%)
2a	Experiment I	0 (0%)	0 (0%)	3 (9,37%)	6 (18,75%)	23 (71,88%)
	Control	5 (15,6%)	3 (9,4%)	12 (37,5%)	8 (25%)	4 (12,5%)
3	Experiment I	0 (0%)	1 (3,1%)	2 (6,3%)	3 (9,4%)	26 (81,3%)
	Control	0 (0%)	1 (3,1%)	5 (15,6%)	12 (37,5%)	14 (43,75%)
4a	Experiment I	0 (0%)	0 (0%)	0 (0%)	4 (12,5%)	28 (87,5%)
	Control	1 (3,1%)	15 (46,9%)	1 (3,1%)	7 (21,9%)	8 (25%)

Based on Table 24, it can be seen that the two classes were able to obtain the highest score of 4 for each question tested, but the percentage obtained by the experimental class I was higher than the control class. Then the lowest score obtained by the experimental class I was a score of 1 and the control class was a score of 0. Based on the above explanation, it can be concluded that the experimental class I students were better than the control class in their ability to organize data and select relevant information in solving problems. This is in accordance with the opinion of Oktaviani (2013) which states that students who learn with cooperative learning type Investigation Group are better than students who learn with conventional learning in the ability to organize data and select relevant information in solving problems.

b. Presenting a problem formulation mathematically in various forms

If various information needed to solve the given problem has been obtained, the next step is to present a problem formulation mathematically. The indicators present a mathematical problem formulation in various forms, students are

expected to be able to write down the problems they will solve mathematically. In this indicator, the ability of students will be seen from the ability of students to describe the situation on the problem to be solved. The ability of students to achieve this indicator is influenced by the ability of students to master the indicators of organizing data and selecting relevant information. If students are not able to present information correctly, students will not be able to formulate mathematical problems completely and correctly. The maximum score that can be obtained if students are able to formulate problems mathematically correctly is 4.The following are the answers of the experimental class I and control class students who got a score of 4.

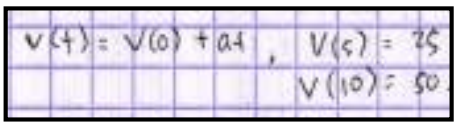


Figure 7. Students' Answers in Experiment Class I in Presenting a Mathematical Problem Formulation in Various Forms

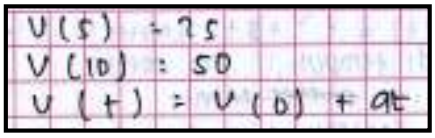


Figure 8. Answers of Control Class Students in Presenting a Mathematical Problem Formulation in Various Forms

Based on Figures 7 and 8, it can be seen that students in the experimental class I and the control class are able to present a mathematical problem formulation in the various forms requested according to the questions given. However, the percentage of students in the experimental class I who got a score of 4 was higher than the control class. Where in table 20, it can be seen that the highest average score percentage of students' mathematical problem solving abilities in experimental class I is 56.3% and the control class is 55.5%. The number of students in the experimental class I who got a score of 4 in question number 2 was 29 people. Then for the control class who got a score of 4 only 22 students from the total number of students as a whole. Likewise for scores 1, 2, and 3. Here is presented in detail the number of students and the percentage who got a score of 0 to 4 for each question.

Table 25. Number of Students (Percentage) for Indicators Presenting a Mathematical Problem Formulation in Various Forms

Question	Class	Number of Students (Percentage				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment I	1 (3,1%)	0 (0%)	2 (6,3%)	3 (9,4%)	26 (81,3%)
	Control	0 (0%)	0 (0%)	0 (0%)	4 (12,5%)	28 (87,5%)
2a	Experiment I	1 (3,1%)	0 (0%)	2 (6,3%)	0 (0%)	29 (90,6%)
	Control	3 (9,4%)	0 (0%)	6 (18,8%)	1 (3,1%)	22 (68,8%)
3	Experiment I	12 (37,5%)	3 (9,4%)	12 (37,5%)	2 (6,3%)	3 (9,4%)
	Control	5 (15,6%)	0 (0%)	15 (46,9%)	1 (3,1%)	11 (34,4%)
4a	Experiment I	0 (0%)	0 (0%)	18 (56,25%)	0 (0%)	14 (43,75%)
	Control	0 (0%)	0 (0%)	22 (68,75%)	0 (0%)	10 (31,25%)

In Table 25, it can be seen that the lowest average score obtained by both classes is 0 and the highest score obtained by both classes is 4. Even so, the percentage of the experimental class I who got a score of 4 was higher than the control class. So it can be concluded that the ability of students in the experimental class I to achieve the indicators of presenting a mathematical problem formulation in various forms is better than the control class students. This is in accordance with the opinion of Oktaviani (2013) which states that students who learn with cooperative learning type Investigation Group are better than students who learn with conventional learning in the ability to present a problem formulation mathematically in various forms.

c. Choosing and using the right approach or strategy to solve the problem

Choosing and using strategies to solve problems is a follow-up after students collect relevant information and formulate problems mathematically. In this indicator, students are expected to be able to develop problem-solving strategies in accordance with the problem. Then the strategy is implemented according to

the procedure. The more students practice solving math problems, the more varied their experiences will be in choosing strategies to solve a problem.

If students are correct in organizing data and presenting the problem formulation appropriately, but students are wrong in choosing and using the right strategy to solve the problem, then for the next step students will experience errors in solving the problem and of course the conclusions obtained are not correct. Based on table 21 it is known that the highest average percentage score of students in the experimental class I in choosing and using approaches or strategies to solve problems is 68.8% and 59.4% of control class students, this means that students in the experimental class I have better mathematical problem solving skills than students in the control class.

A score of 4 will be given to students who are able to choose and use strategies to solve a problem appropriately. From the mathematical problem-solving ability test that was tested, it consisted of 4 questions that demanded the ability of students for this indicator. The following shows the answers of the experimental and control class students who got a score of 4 in question 2a for this indicator.

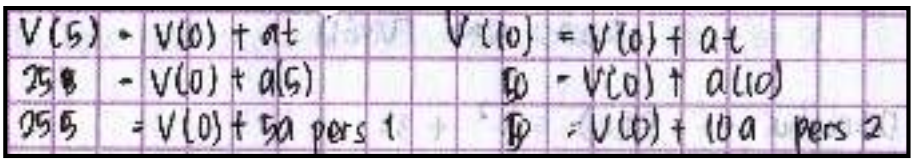


Figure 9. Students' Answers in Experiment Class I in Choosing and Using Strategies to Solve Problems

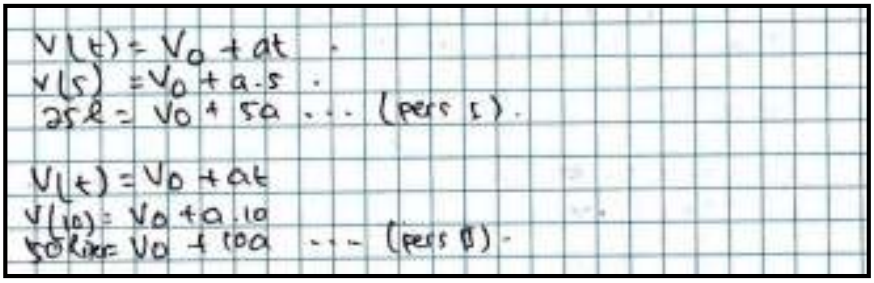


Figure 10. Answers of Control Class Students in Choosing and Using Strategies to Solve Problems

In Figures 9 and 10, it can be seen that students in the experimental class I and the control class have been able to choose the right strategy to find the value

of the water discharge that flows into the bath every minute and the volume of water in the bath before the water is flowed. However, when compared to the answers of students in the two classes, the experimental class I seemed to answer more clearly and systematically than the control class. Then the percentage of the experimental class I students who got a score of 4 was much higher than the control class in answering question number 2. While the lowest score obtained by the experimental class I and the control class was 0. The following is presented in more detail the number of students and the percentage who obtained the score. 0 to 4 for each question.

Table 26. Number of Students (Percentage) for Indicators Choosing and Using the Right Approach and Strategy to Solve Problems

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment I	2 (6,3%)	3 (9,4%)	1 (3,1%)	2 (6,3%)	24 (75%)
	Control	0 (0%)	0 (0%)	2 (6,3%)	6 (18,8%)	24 (75%)
2a	Experiment I	3 (9,4%)	0 (0%)	1 (3,1%)	0 (0%)	28 (87,5%)
	Control	4 (12,5%)	1 (3,1%)	5 (15,6%)	2 (6,3%)	20 (62,5%)
3	Experiment I	15 (46,9%)	0 (0%)	5 (15,6%)	4 (12,5%)	8 (25%)
	Control	4 (12,5%)	2 (6,3%)	2 (6,3%)	3 (9,4%)	21 (65,6%)
4a	Experiment I	1 (3,1%)	0 (0%)	1 (3,1%)	3 (9,4%)	28 (87,5%)
	Control	13 (40,6%)	1 (3,1%)	1 (3,1%)	6 (18,8%)	11 (34,4%)

In Table 26, it can be seen that the lowest average score obtained by both classes is 0 and the highest score obtained by both classes is 4. Even so, the percentage of the experimental class I who got a score of 4 was higher than the control class. So that overall it can be concluded that the ability of experimental class students is better than the ability of the control class for indicators of choosing and using the right approach or strategy to solve problems.

d. Solve problems

In this fourth indicator, students are expected to be able to solve problems as planned before. The ability of students to implement this indicator is influenced by the ability to choose strategies. If students experience errors in choosing strategies, it will affect the calculation when students carry out problem solving. Then mistakes when implementing strategies can occur if students have not been able to organize data and information properly. So it can be said that the ability to solve problems is greatly influenced by the ability of students to achieve the three previous indicators.

Based on Table 22, the average percentage of the problem solving ability indicator score is still low compared to the previous indicators. This is because there are students who only partially answer correctly in choosing and using strategies to solve problems. And in general, many errors occur in solving problems is the calculation procedure that is not precise. However, the percentage of the highest average score of problem solving indicators in the experimental class I was higher than the control class, namely the experimental class I got 47.5% and the control class 40%. This shows that the experimental class I has a better ability to solve problems than the control class. Seen in the control class answer sheet, students generally only answer to formulate problems and some students answer to choose and use strategies and then students experience confusion in solving problems. The following are the answers of experimental class I and control students who got a score of 4 for the indicator of solving the problem in question number 2a.

Eliminate equation 1 and equation 2
V(5) = V(0) + 5A = 25
V(10)= V(0) + 10A = 50 -
-5A = -25
A =-25:-5
A =5

Substitute a = 5 into equation 1
V(5) = v(0) + 5A
25 = V(0) +5(5)
25 = V(0) + 25
V(0) = 25-25
V(0) = 0

Figure 11. Answers of Experiment Class Students in Solving Problems

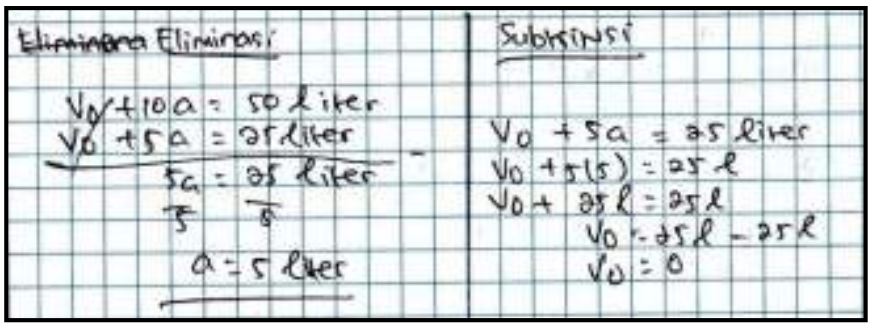


Figure 12. Answers of Control Class Students in Solving Problems

In Figures 11 and 12 it can be seen that the experimental class I and control class students have been able to solve the problem correctly. However, when compared to the answers of students in the two classes, the experimental class I seemed to answer more clearly and systematically than the control class. The percentage of students in the experimental class I who got a score of 4 was higher than the percentage of the control class who got a score of 4 for problem solving indicators. The following is presented in more detail the number and percentage of students who get a score of 0 to 4 for each question.

Table 27. Number of Students (Percentage) for Problem Solving Indicators

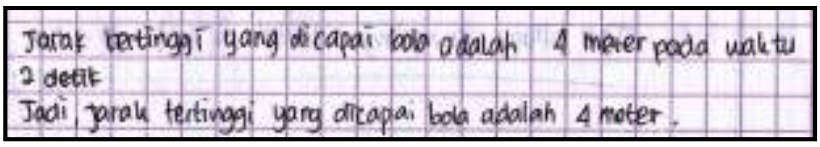
question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment I	6 (18,8%)	3 (9,4%)	1 (3,1%)	0 (0%)	22 (68,8%)
	Control	2 (6,3%)	0 (0%)	2 (6,3%)	1 (3,1%)	27 (84,4%)
2a	Experiment I	1 (3,1%)	1 (3,1%)	2 (6,3%)	0 (0%)	28 (87,5%)
	Control	5 (15,6%)	0 (0%)	3 (9,4%)	5 (15,6%)	19 (59,4%)
2b	Experiment I	0 (0%)	2 (6,3%)	13 (40,6%)	4 (12,5%)	13 (40,6%)
	Control	10 (31,3%)	2 (6,3%)	7 (21,9%)	3 (9,4%)	10 (31,3%)
3	Experiment I	26 (81,3%)	1 (3,1%)	3 (9,4%)	0 (0%)	2 (6,3%)
	Control	6 (18,8%)	7 (21,9%)	7 (21,9%)	4 (12,5%)	8 (25%)
4a	Experiment I	3 (9,4%)	1 (3,1%)	2 (6,3%)	15 (46,9%)	11 (34,4%)
	Control	19 (59,4%)	8 (25%)	2 (6,3%)	3 (9,4%)	0 (0%)

Based on Table 27, it can be seen that there is a difference between the number of students who get a score of 4 in the experimental class I and the control class. So it can be concluded that the ability of students in experimental class I is better than the ability of control class students for indicators of solving problems.

e. Interpret the answers to solve the problem

The final step in the problem-solving process is interpreting the answers obtained from the steps that have been taken previously. Students are expected to be able to make conclusions about what is being asked in the questions. Interpreting the meaning of an answer is also necessary, because if students are able to make conclusions well, it means that these students understand what tasks they want to achieve. So that the solution obtained becomes meaningful.

From Table 23, it is known that this fifth indicator is the lowest percentage, that is, for the highest average score for the experimental class is 26.1% and for the control class is 14.1%. This is because in general, students after solving the problem and obtaining the desired results, students no longer conclude what is actually being asked in the questions. Students assume that if they have succeeded in solving the problems students no longer need to conclude the results of the answers they get. The following shows the answers of the experimental and control class students who got a score of 4 in question number 4b.



The highest distance the ball reaches is 4 meters in 2 seconds, so the highest distance the ball reaches is 4 meters

Figure 13. Students' Answers in Experiment Class I in Concluding the Answer Results for Solving Problems

b) h(2) = 4
so the highest distance the ball reaches is 4 mater

Figure 14. Answers of Control Class Students in Concluding the Results of Answers to Solving Problems

Based on Figure 13 it can be seen that the experimental class students I have been able to interpret the results of the students' answers correctly and also write down the correct reasons. In Figure 14, it can be seen that the control class students have also been able to interpret the results of their answers correctly, but the difference is that the control class has not written the reasons clearly. The following shows the data on the number of students and the percentage of scores obtained for each question.

Table 28. Number of Learners (Percentage) for Indicators Interpreting Answer Results

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment I	11 (34,4%)	3 (9,4%)	0 (0%)	1 (3,1%)	17 (53,1%)
	Control	2 (6,3%)	0 (0%)	5 (15,6%)	4 (12,5%)	21 (65,6%)
2a	Experiment I	1 (3,1%)	1 (3,1%)	5 (15,6%)	18 (56,3%)	7 (21,9%)
	Control	20 (62,5%)	0 (0%)	5 (15,6%)	7 (21,9%)	0 (0%)
2b	Experiment I	2 (6,3%)	6 (18,8%)	10 (31,3%)	3 (9,4%)	11 (34,4%)
	Control	21 (65,6%)	5 (15,6%)	0 (0%)	1 (3,1%)	5 (15,6%)
3	Experiment I	22 (68,8%)	4 (12,5%)	3 (9,4%)	1 (3,1%)	2 (6,3%)
	Control	27 (84,4%)	1 (3,1%)	3 (9,4%)	1 (3,1%)	0 (0%)
4b	Experiment I	2 (6,3%)	5 (15,6%)	1 (3,1%)	14 (43,8%)	10 (31,3%)
	Control	21 (65,6%)	1 (3,1%)	6 (18,8%)	3 (9,4%)	1 (3,1%)
4c	Experiment I	3 (9,4%)	16 (50%)	9 (28,1%)	1 (3,1%)	3 (9,4%)
	Control	26 (81,25%)	6 (18,75%)	0 (0%)	0 (0%)	0 (0%)

Based on Table 28, it can be seen that the highest score that can be obtained by the two classes for each question is 4, but if you pay attention to the percentage that can be obtained by students in the experimental class I is much higher than the control class. Likewise, the lowest score obtained by both classes is 0, where the control class gets a lower percentage for each problem. So it can be concluded that the ability of students in the experimental class I to interpret the results of the answers is better than the ability to interpret the answers of control class students. This is in accordance with the opinion of Oktaviani (2013) which states that students who learn with cooperative learning in the Investigation Group type are

better than students who learn with conventional learning in the ability to interpret the results of the answers.

Based on the above discussion of the 5 indicators tested in this study, it turns out that for indicators (1) organizing data and selecting relevant information in identifying problems, (2) presenting a problem mathematically in various forms, (3) choosing and using an approach or strategy problem solving, (4) solving the problem, and (5) interpreting the results of the answers obtained to solve the problems of the experimental class I students better than the control class. Thus it can be concluded that the mathematical problem solving abilities of experimental class students who learn with the Group Investigation model are better than the mathematical problem solving abilities of control class students who learn using conventional learning.

3. Comparative discussion of the Mathematical Problem Solving Ability of Students in Experiment Class II and Control Class

Based on the results of the description and data analysis, it can be seen that the mathematical problem solving abilities of the experimental class II students are better than the control class students' mathematical problem solving abilities in the VII grade of SMP Negeri 1 Padang in the 2017/2018 academic year. Where the average mathematical problem solving ability of the experimental class II students was 69.7 while the control class average was 57.1.

The experimental class II used the problem-based learning model, while in the control class who learned using conventional learning, the teacher immediately gave the final concept to students. Then after getting the concept from the teacher, students use the concept in solving the problems given by the teacher. Even though the teacher has tried to lure students to understand the next concept, in reality the students are only able to solve problems that are almost the same as the examples given by the teacher. If given non-routine questions, students will have difficulty solving them because students are not accustomed to analyzing them in stages as found in the Problem Based Learning model.

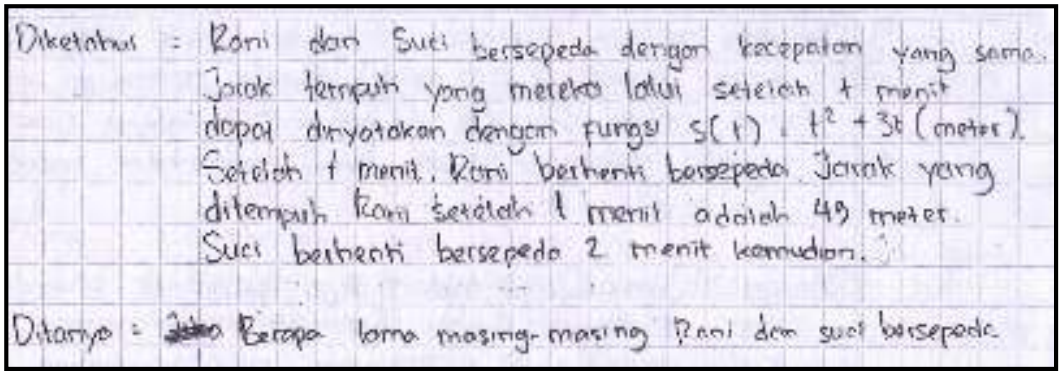
In the final test of mathematical problem solving abilities, there are five indicators that are assessed per item. The questions for the final test of mathematical problem solving ability in the experimental class II and for the control class consist of 4 questions. The following is explained in more detail regarding the students' mathematical problem solving abilities in achieving each mathematical problem solving indicator used.

a. Organizing data and selecting relevant information

In the indicators of organizing data and selecting relevant information in identifying problems, it is hoped that students will be able to identify problems in the form of information that is not known and asked by questions. Students must be able to choose between what has been determined, has not been determined and what should be determined from the problems described. This step is a very important step because a student is able to solve problems well when he is able to organize data and select relevant information well.

In table 19, it is known that the percentage of students in the experimental class II in organizing data and selecting relevant information in identifying problems is greater than students in the control class. In the table, it can be seen that the highest average score percentage of students in the experimental class II is 56.8% and students in the control class are 36%. The ability of students in selecting information and collecting data can be seen from the answers of students in making it known and asked. The maximum score given if students are able to select information and collect data correctly and completely is 4.

The mathematical problem solving ability test that was tested consisted of 4 questions, where the five questions required the ability of students to organize data and select relevant information in identifying problems. The following shows the answers of the experimental class II and control class students who got a score of 4 for indicator 1 in question number 1.



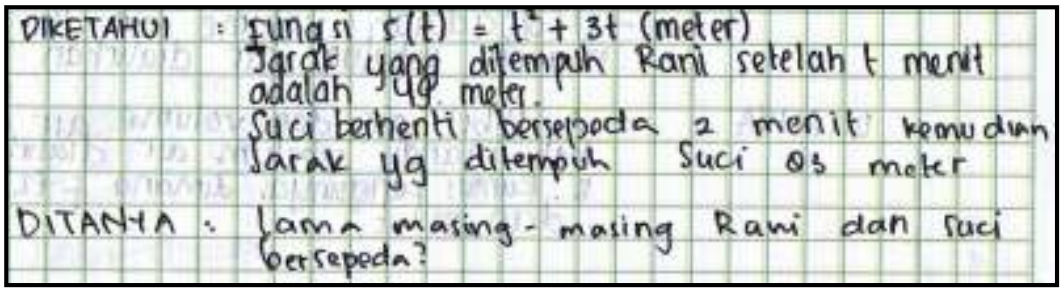
is known:

Rani and Suci are cycling at the same speed. the distance they traveled after t minutes can be expressed by $s(t) = t^2 + 3t$ (meters). after t minutes rani stopped cycling. the distance rani traveled after t minutes was 49 meters. Suci stopped cycling 2 minutes later

asked:

how long does each rani and saint ride?

Figure 15. Students' Answers in Experiment Class II in Organizing Data and Choosing Relevant Information in Identifying Problems



is known : $s(t) = t^2 + 3t$ (meters)
the distance rani traveled after t minutes was 49 meters
Suci stopped cycling 2 minutes laterif the distance traveled by the holy is 83 meters

asked: how long does each rani and saint ride?

Figure 16. Answers of Control Class Students in Organizing Data and Choosing Relevant Information in Identifying Problems

In Figure 15 it can be seen that the experimental class II students have been able to identify and collect the information needed to solve the problem by

making it known and being asked completely and according to the information provided in the questions. It can be seen from the answers of students in writing what is known from the questions, students write completely the information obtained from the problem and determine what is being asked by the questions. Likewise in Figure 16 shows that control class students are able to identify data well. Students are complete in determining what is known and what is asked in the questions. However, it is known that students write inappropriate language that is not well structured.

The number of students in experimental class II who got a score of 4 in question number 1 was 29 people. Then for the control class who got a score of 4 only 20 students from the total number of students as a whole. Likewise with questions number 2, 3, and 4 which are presented in more detail in Table 29 below.

Table 29. Number of Students (Percentage) for Indicators of Organizing Data and Choosing Relevant Information in Identifying Problems

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment II	0 (0%)	0 (0%)	4 (12,9%)	9 (29%)	18 (58,1%)
	Control	1 (3,1%)	5 (15,6%)	0 (0%)	6 (18,8%)	20 (62,5%)
2a	Experiment II	1 (3,2%)	0 (0%)	9 (29%)	11 (35,5%)	10 (32,3%)
	Control	5 (15,6%)	3 (9,4%)	12 (37,5%)	8 (25%)	4 (12,5%)
3	Experiment II	1 (3,2%)	0 (0%)	8 (25,8%)	4 (12,9%)	18 (58,1%)
	Control	0 (0%)	1 (3,1%)	5 (15,6%)	12 (37,5%)	14 (43,75%)
4a	Experiment II	2 (6,5%)	3 (9,7%)	0 (0%)	3 (9,7%)	23 (74,2%)
	Control	1 (3,1%)	15 (46,9%)	1 (3,1%)	7 (21,9%)	8 (25%)

Based on Table 29, it can be seen that the two classes were able to obtain the highest score of 4 for each question tested, where the number of students who

obtained the highest score in the experimental class II was higher than the control class. Then the lowest score obtained by the experimental class II and the control class was a score of 0. However, in question number 3 students in the experimental class who could organize data and select relevant information in solving problems were 4 people, while in the control class were 12 people. This is because 9 people from experimental class II made a mistake in choosing relevant information in solving the problem. Based on the explanation above, it can be concluded that the experimental class II students are better than the control class in the ability to organize data and select relevant information in solving problems.

This is in accordance with the opinion of Gusmiyanti (2015) which states that students who learn with the Problem Based Learning learning model are better than students who learn with conventional learning in the ability to organize data and select relevant information in solving problems.

b. Presenting a problem formulation mathematically in various forms

If various information needed to solve the given problem has been obtained, the next step is to present a problem formulation mathematically. In the indicator presents a problem formulation mathematically in various forms, students are expected to be able to write a problem formulation that they will solve mathematically. In this indicator, the ability of students will be seen from the ability of students to describe the situation on the problem to be solved. The ability of students to achieve this indicator is influenced by the ability of students to master the indicators of organizing data and selecting relevant information. If students are not able to present information correctly, students will not be able to formulate mathematical problems completely and correctly. The maximum score that can be obtained if students are able to formulate problems mathematically correctly is 4.The following are the answers of the experimental class II and control class students who got a score of 4.

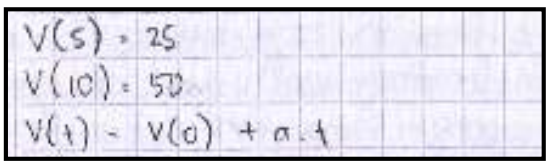


Figure 17. Students' Answers in Experiment Class II in Presenting a Mathematical Problem Formulation in Various Forms

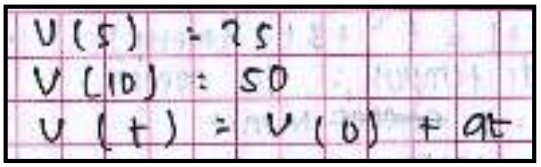


Figure 18. Answers of Control Class Students in Presenting a Mathematical Problem Formulation in Various Forms

Based on Figures 17 and 18, it can be seen that students in the experimental class II and control class are able to present a mathematical problem formulation in various forms requested according to the questions given. However, the percentage of students in the experimental class II who got a score of 4 was lower than the control class. Where in Table 20, it can be seen that the highest average score percentage of students' mathematical problem solving abilities in the experimental class II is 57.3% and the control class is 55.5%. This is because in indicator 2, for the control class students also study problem solving materials related to relations and functions where students are taught how to present a problem formulation mathematically in various forms.

The number of students in experimental class II who got a score of 4 in question number 2 was 27 people. Then for the control class who got a score of 4 only 22 students from the total number of students as a whole. Likewise for questions number 1, 3, and 4. Here is presented in detail the number of students and the percentage who got a score of 0 to 4 for each question.

Table 30. Number of Students (Percentage) for Indicators Presenting a Mathematical Problem Formulation in Various Forms

Question	Class	Number of Students (Percentage)				
		Score0	Score 1	Score 2	Score 3	Score 4
1	Experiment II	3 (9,7%)	1 (3,2%)	1 (3,2%)	6 (19,4%)	20 (64,5%)
	Control	0 (0%)	0 (0%)	0 (0%)	4 (12,5%)	28 (87,5%)
2a	Experiment II	3 (9,7%)	0 (0%)	1 (3,2%)	0 (0%)	27 (87,1%)

	Control	3 (9,4%)	0 (0%)	6 (18,8%)	1 (3,1%)	22 (68,8%)
3	Experiment II	0 (0%)	0 (0%)	26 (83,9 %)	0 (0%)	5 (16,1%)
	Control	5 (15,6%)	0 (0%)	15 (46,9%)	1 (3,1%)	11 (34,4%)
4a	Experiment II	0 (0%)	0 (0%)	12 (38,7%)	0 (0%)	19 (61,3%)
	Control	0 (0%)	0 (0%)	22 (68,75%)	0 (0%)	10 (31,25%)

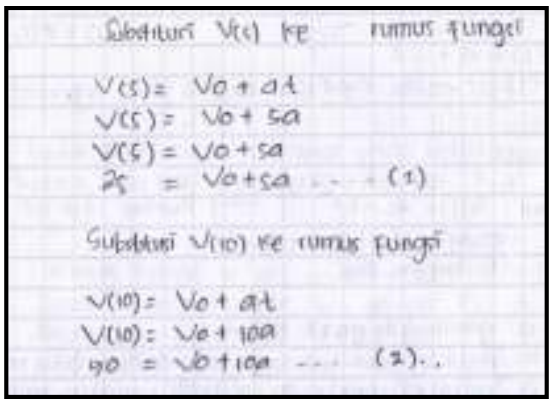
In Table 30, it can be seen that the lowest average score obtained by the two classes is 0 and the highest score obtained by both classes is 4. Even so, the percentage of the experimental class II who got a score of 4 was higher than the control class. However, in question number one and three the percentage of control class students is higher than in experimental class II because at the fourth and fifth meeting the indicators calculate the value of the function, determine the form of the function, and calculate the value of the change in function if the variable changes the number of students learning in the control class. more than in the experimental class II. There were only 22 students in the experimental class II who stayed in the class to take lessons in class. This happened because during the lesson in experimental class II on Wednesday and Tuesday, which happened to be an event that required some students to leave. So that not all students get information on how to present a problem formulation mathematically in various appropriate forms. It can be concluded that the ability of experimental class II students in achieving indicators presents a mathematical problem formulation in various forms better than control class students. This is in accordance with the opinion of Amalia (2014) which states that students who learn with the Problem Based Learning Model are better than students who learn with conventional learning in the ability to present a problem formulation mathematically in various forms.

c. Choosing and using the right approach or strategy to solve the problem

Choosing and using strategies to solve problems is a follow-up after students collect relevant information and formulate problems mathematically. In this indicator, students are expected to be able to develop problem-solving strategies in accordance with the problem. Then the strategy is implemented according to the procedure. The more students practice solving mathematical problems, the more varied their experiences will be in choosing strategies to solve a problem.

If the students are correct in organizing the data and presenting the problem formulation appropriately, but the students are wrong in choosing and using the right strategy to solve the problem, then for the next step students will experience errors in solving the problem and of course the conclusions obtained are not correct. Based on Table 21 it is known that the highest average score percentage of students in the experimental class II in choosing and using approaches or strategies to solve problems is 58.1% and 59.4% of control class students, this means that students in the experimental class II has better mathematical problem solving abilities than students in the control class.

A score of 4 will be given to students who are able to choose and use strategies to solve a problem appropriately. From the mathematical problem-solving ability test that was tested, it consisted of 4 questions that demanded the ability of students for this indicator. The following shows the answers of the experimental class II and control students who got a score of 4 in question 2a for this indicator.



Substitute v (s) for the function formula
V(s) = Vo + at
V(s) = Vo + 5A
25 = Vo + 5a….(1)

Substitute v (s) for the function formula
V(10) = Vo + at
V(10) =Vo + 10a
50 = Vo + 10a….(2)

Figure 19. Answers of Experiment Class II Students in Choosing and Using Strategies to Solve Problems

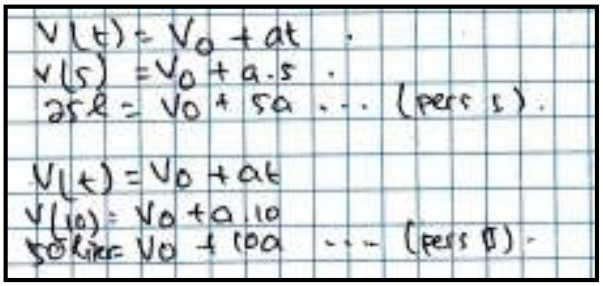


Figure 20. Answers of Control Class Students in Choosing and Using Strategies to Solve Problems

In Figures 19 and 20, it can be seen that the experimental class II and control class students have been able to choose the right strategy to find the value of the water discharge that flows into the bath every minute and the volume of water in the bath before the water is flowed. However, when compared to the answers of students in the two classes, the experimental class II seemed to answer more clearly and systematically than the control class. The following shows in more detail the number of students and the percentage who got a score of 0 to 4 for each question.

Table 31. Number of Students (Percentage) for Indicators Choosing and Using the Right Approach and Strategy to Solve Problems

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment II	3 (9,7%)	1 (3,2%)	1 (3,2%)	4 (12,9%)	22 (71%)
	Control	0 (0%)	0 (0%)	2 (6,3%)	6 (18,8%)	24 (75%)
2a	Experiment II	4 (12,9%)	0 (0%)	2 (6,5%)	0 (0%)	25 (80,7%)
	Control	4 (12,5%)	1 (3,1%)	5 (15,6%)	2 (6,3%)	20 (62,5%)
3	Experiment II	0 (0%)	0 (0%)	0 (0%)	28 (90,3%)	3 (9,7%)
	Control	4 (12,5%)	2 (6,3%)	2 (6,3%)	3 (9,4%)	21 (65,6%)
4a	Experiment II	0	0	0	9	22

		(0%)	(0%)	(0%)	(29%)	(71%)
	Control	13 (40,6%)	1 (3,1%)	1 (3,1%)	6 (18,8%)	11 (34,4%)

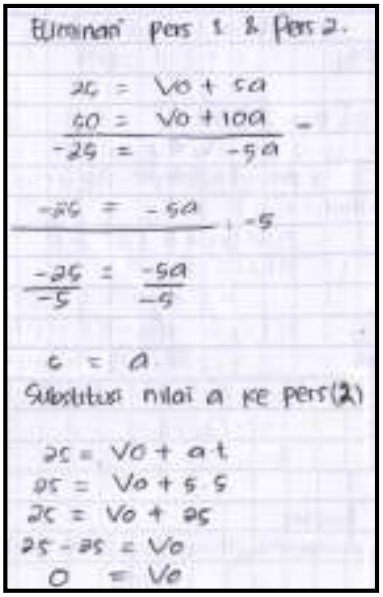
In Table 31, it can be seen that the lowest average score obtained by the two classes is 0 and the highest score obtained by both classes is 4. Even so, the percentage of the experimental class II who got a score of 4 was higher than the control class. However, in question number one and three, the percentage of students' abilities in the indicators of choosing and using the right approach or strategy to solve problems in the control class was higher than in the experimental class II because some students were wrong in the process of determining equation 1 and equation 2 of the problem given, the student is wrong in substituting what is known from the problem to the general formula of the known function in the problem. So that overall it can be concluded that the ability of students in the experimental class II is better than the ability of the control class for indicators of choosing and using the right approach or strategy to solve problems. This is in accordance with the opinion of Gusmiyanti (2015) which states that students who learn with the Problem Based Learning Learning Model are better than students who learn with conventional learning in the ability to choose and use the right approach or strategy to solve problems.

d. Solve problems

In this fourth indicator, students are expected to be able to solve problems as planned before. The ability of students in implementing this indicator is influenced by the ability to choose and use strategies. If students experience errors in choosing strategies, it will affect the calculations when students carry out problem solving. Then mistakes when implementing strategies can occur if students have not been able to organize data and information properly. So it can be said that the ability to solve problems is greatly influenced by the ability of students to achieve the three previous indicators.

Based on Table 22, the percentage of the highest average score of problem solving indicators in the experimental class II was higher than the control class,

namely the experimental class II got 40.6% and the control class 40%. This shows that the experimental class II has a better ability to solve problems than the control class. Seen in the control class answer sheet, students generally only answer to formulate problems and some students answer to choose and use strategies and then students experience confusion in solving problems. The following are the answers of the experimental class II and control students who got a score of 4 for the indicator of solving the problem in question number 2a.



Eliminate equation 1 and equation 2

V(5) = V(0) + 5A = 25
V(10)= V(0) + 10A = 50 -
-5A = -25
A =-25:-5
A =5

Substitute a = 5 into equation 1

V(5) = v(0) + 5A
25 = V(0) +5(5)
25 = V(0) + 25
V(0) = 25-25
V(0) = 0

Figure 21. Students' Answers in Experiment Class II in Solving Problems

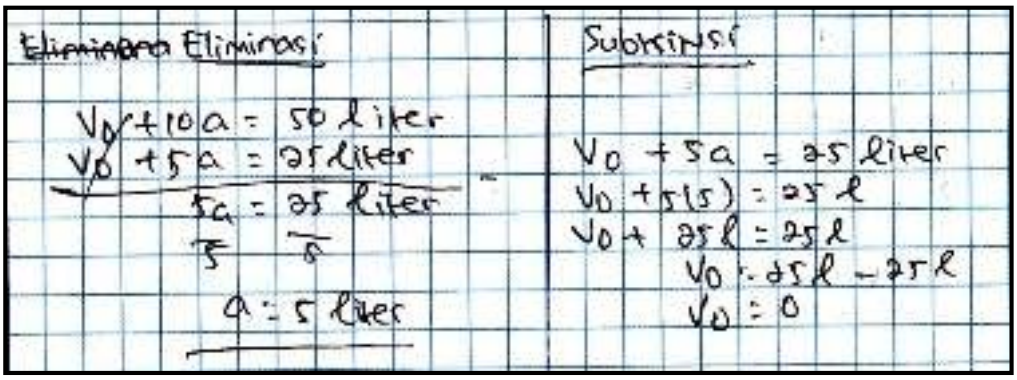


Figure 22. Answers of Control Class Students in Solving Problems

Figures 21 and 22 show that the experimental class II and control students have been able to solve the problem correctly. However, when compared to the answers of students in the two classes, the experimental class II seemed to answer more clearly and systematically than the control class. The percentage of students

in the experimental class II who got a score of 4 was higher than the percentage of the control class who got a score of 4 for indicators of solving problems. The following shows in more detail the number and percentage of students who get a score of 0 to 4 for each question

Table 32. Number of Students (Percentage) for Problem Solving Indicators

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment II	5 (16,1%)	2 (6,5%)	1 (3,2%)	2 (6,5%)	21 (67,7%)
	Control	2 (6,3%)	0 (0%)	2 (6,3%)	1 (3,1%)	27 (84,4%)
2a	Experiment II	2 (6,5%)	2 (6,5%)	4 (12,9%)	14 (45,1%)	9 (29%)
	Control	5 (15,6%)	0 (0%)	3 (9,4%)	5 (15,6%)	19 (59,4%)
2b	Experiment II	2 (6,5%)	3 (9,7%)	4 (12,9%)	7 (22,6%)	15 (48,4%)
	Control	10 (31,3%)	2 (6,3%)	7 (21,9%)	3 (9,4%)	10 (31,3%)
3	Experiment II	6 (19,4%)	1 (3,2%)	2 (6,5%)	8 (25,8%)	14 (45,2%)
	Control	6 (18,8%)	7 (21,9%)	7 (21,9%)	4 (12,5%)	8 (25%)
4a	Experiment II	5 (16,1%)	3 (9,7%)	7 (22,6%)	12 (38,7%)	4 (12,9%)
	Control	19 (59,4%)	8 (25%)	2 (6,3%)	3 (9,4%)	0 (0%)

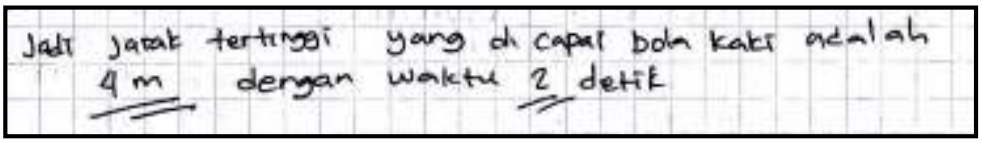
Based on Table 32, it can be seen that there is a difference between the number of students who get a score of 4 in the experimental class II and the control class. However, in question number one and two, the percentage of students' ability in the indicators of solving problems in the control class was higher than in the experimental class II. This is because there are students who only partially answer correctly in choosing and using strategies to solve problems. And in general, many mistakes occur in solving the problem is the calculation procedure that is less accurate. Then it causes students to be less precise in solving problems inappropriately. However, overall it can be concluded that the ability of

the experimental class II students is better than the control class students' ability to solve problems. This is in accordance with the opinion of Amalia (2014) which states that students who learn with the Problem Based Learning Model are better than students who learn with conventional learning in the ability to solve problems.

e. Interpret the answers to solve the problem

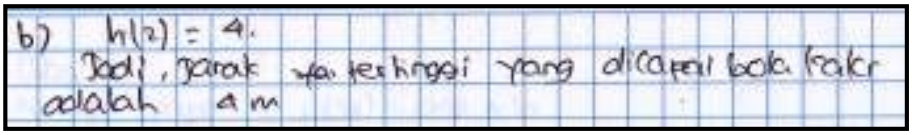
The final step in the problem-solving process is interpreting the answers obtained from the steps that have been taken previously. Students are expected to be able to make conclusions about what is being asked in the questions. Interpreting the meaning of an answer is also necessary, because if students are able to make conclusions well, it means that these students understand what tasks they want to achieve. So that the solution obtained becomes meaningful.

From Table 23, it is known that this fifth indicator is with the lowest percentage, namely the highest average score for the experimental class II is 23.1% and for the control class is 14.1%. This is because in general, students after solving the problem and obtaining the desired results, students no longer conclude what is actually being asked in the questions. Students assume that if they have succeeded in solving the problems students no longer need to conclude the results of the answers they get. The following shows the answers of the experimental class II and control class students who got a score of 4 in question no 4b.



So the highest distance that the ball reaches is 4 meters in 2 minutes

Figure 23. Students' Answers in Experiment Class II in Concluding the Answer Results for Solving Problems



b) h(2) = 4
so the highest distance that the ball of the foot reaches is 4 meters

Figure 24. Answers of Control Class Students in Concluding the Results of Answers to Solving Problems

Based on Figure 23, it can be seen that the experimental class II students have been able to interpret the results of the students' answers correctly and also write down the correct reasons. In Figure 24, it can be seen that the control class students have also been able to interpret the results of their answers correctly, but the difference is that the control class has not written the reasons clearly. The following shows the data on the number of students and the percentage of scores obtained for each question.

Table 33. Number of Students (Percentage) for Indicators Interpreting the Answer Results

Question	Class	Number of Students (Percentage)				
		Score 0	Score 1	Score 2	Score 3	Score 4
1	Experiment II	7 (22,6%)	1 (3,2%)	3 (9,7%)	0 (0%)	20 (64,5%)
	Control	2 (6,3%)	0 (0%)	5 (15,6%)	4 (12,5%)	21 (65,6%)
2a	Experiment II	1 (3,2%)	7 (22,6%)	3 (9,7%)	19 (61,3%)	1 (3,2%)
	Control	20 (62,5%)	0 (0%)	5 (15,6%)	7 (21,9%)	0 (0%)
2b	Experiment II	5 (16,1%)	15 (48,4%)	0 (0%)	6 (19,4%)	5 (16,1%)
	Control	21 (65,6%)	5 (15,6%)	0 (0%)	1 (3,1%)	5 (15,6%)
3	Experiment II	7 (22,6%)	2 (6,5%)	4 (12,9%)	10 (32,3%)	8 (25,8%)
	Control	27 (84,4%)	1 (3,1%)	3 (9,4%)	1 (3,1%)	0 (0%)
4b	Experiment II	8 (25,8%)	5 (16,1%)	4 (12,9%)	9 (29%)	5 (16,1%)
	Control	21	1	6	3	1

Question	Class	Number of Students (Percentage)				
		Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**
		(65,6%)	(3,1%)	(18,8%)	(9,4%)	(3,1%)
4c	Experiment II	14 (45,2%)	10 (32,3%)	0 (0%)	3 (9,7%)	4 (12,9%)
	Control	26 (81,25%)	6 (18,75%)	0 (0%)	0 (0%)	0 (0%)

Based on Table 33, it can be seen that the highest score that can be obtained by both classes for each question is 4, if you pay attention to the percentage that can be obtained by students of experimental class II is much higher than the control class. Likewise, the lowest score obtained by both classes is 0, where the control class gets a lower percentage for each problem. However, in question number one, the percentage of students' ability in solving problems in the control class was higher than the experimental class II. This is because in the experimental class II after students solved the problem in number 1, there were some students who did not make the process of interpreting the results of their answers, even though during the learning process the researcher had emphasized the students to make the process of interpreting the results of the answers they had obtained, so that some participants The student gets a score of 0 for this fifth indicator. However, overall it can be concluded that the ability of experimental class II students on the indicators of interpreting the results of the answers is better than the ability to interpret the answers of control class students.

Based on the above discussion of the 5 indicators tested in this study, it turns out that for indicators (1) organizing data and selecting relevant information in identifying problems, (2) presenting a problem mathematically in various forms, (3) choosing and using an approach or strategy appropriate to solve the problem, (4) solve the problem, and (5) interpret the results of the answers obtained to solve the problems of the experimental class II students better than the control class. Thus it can be concluded that the mathematical problem solving abilities of experimental class II students who learn with the Problem Based Learning model are better than the mathematical problem solving abilities of control class students who learn using conventional learning.

D. Research Constraints

During the research, several obstacles were found, namely:

1. Students are less interested in reading the problem narratives listed in the LKPD. Students are more interested in being given formulas immediately and immediately discussing sample questions. This obstacle can be overcome by telling students that students need to know where the formulas they will use come from, for that students need to understand the problems contained in the LKPD, and understand each step of the solution. So that students don't just get the concept, every step of the way. So that students do not only get the concept, at each stage of concept discovery, students can practice previous knowledge.
2. In the study, students were divided into several small groups, there were some students who did not like the division of the group. They want that they will divide the group by themselves. This is overcome by providing understanding to all students that the predetermined group division is for the common good, so that students can fully understand the material being studied.
3. In presenting the results of group work, there are groups of students who have been assigned by the teacher to present the results of group work who do not want to display the results of their discussions, the reason is that they are not ready. So that the group that has appeared again displays the results of their answers. This is overcome by first at the beginning of the lesson the name of the group of students who will appear to present the results of their group discussions so that they can complete their work on time.

CHAPTER V
CLOSING

A. Conclusion

The conclusions of this study are as follows.

1. The mathematical problem solving abilities of students who take Group Investigation learning are the same as the mathematical problem solving abilities of students who take Problem Based Learning in class VIII SMP Negeri 1 Padang in the 2017/2018 school year.
2. The mathematical problem solving abilities of students who take Group Investigation learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII of SMP Negeri 1 Padang in the 2017/2018 academic year
3. The mathematical problem solving abilities of students who take Problem Based Learning are better than the mathematical problem solving abilities of students who take conventional learning in class VIII of SMP Negeri 1 Padang in the 2017/2018 academic year

B. Advice

The suggestions that can be raised from this research are as follows.

1. Teachers are expected to often apply the Group Investigation and Problem Based Learning learning models as variations in mathematics learning to improve learning activities and students' ability to understand mathematical concepts.
2. Students are expected to get used to being actively involved in learning, both individually and in groups. Students are also expected to often carry out Group Investigation and Problem Based Learning model activities in learning mathematics.
3. For researchers who are interested in continuing this research, they are expected to carry out different materials. The allocation of time used for the implementation of the Group Investigation and Problem Based Learning learning models must be

designed as well as possible, because this model requires a lot of time in the process of Group Investigation and Problem Based Learning models.

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ATTACHMENT

Attachment 1

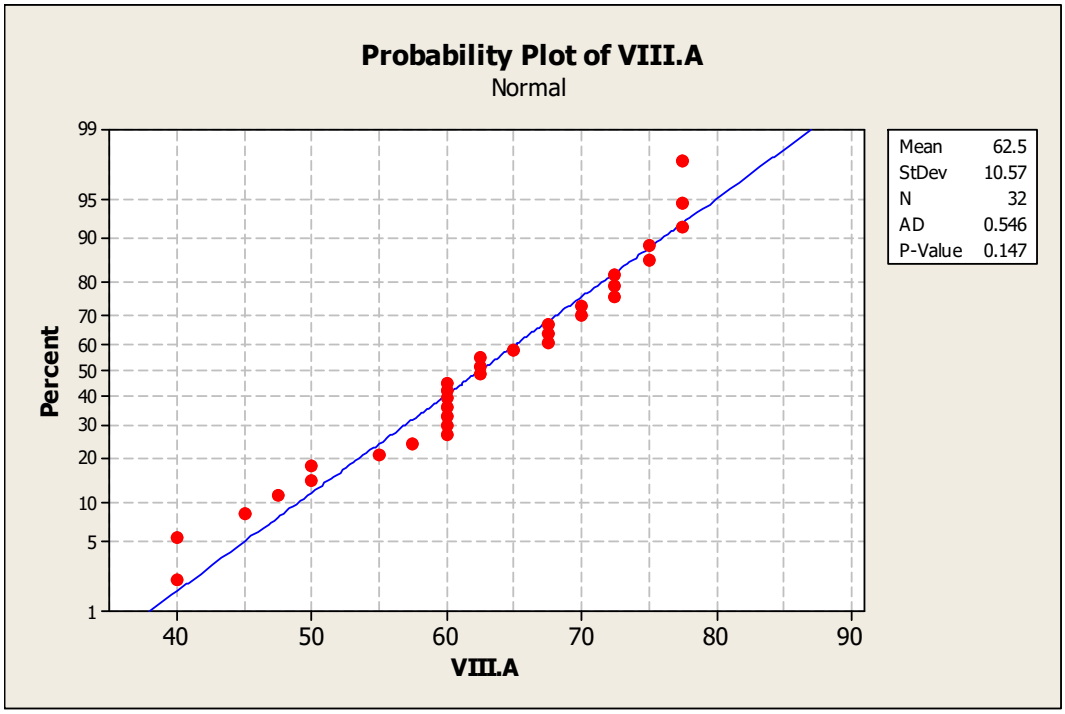
List of Grade VII Mathematics Even Semester Final Exam Values

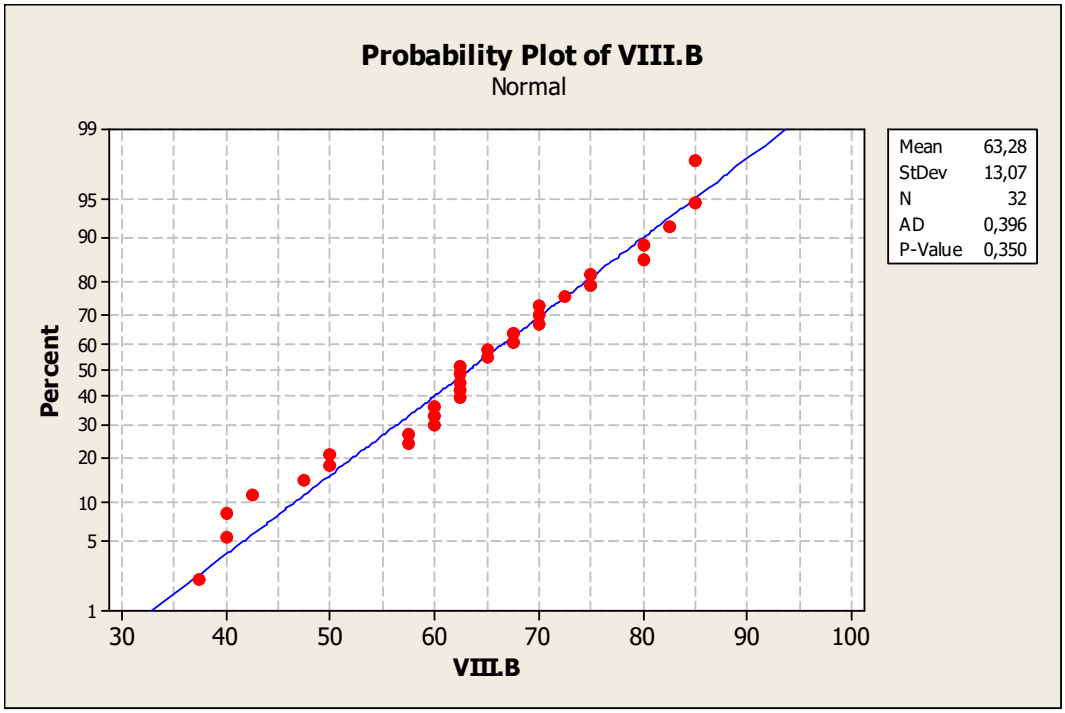
SMP Negeri 1 Padang Academic Year 2016/2017

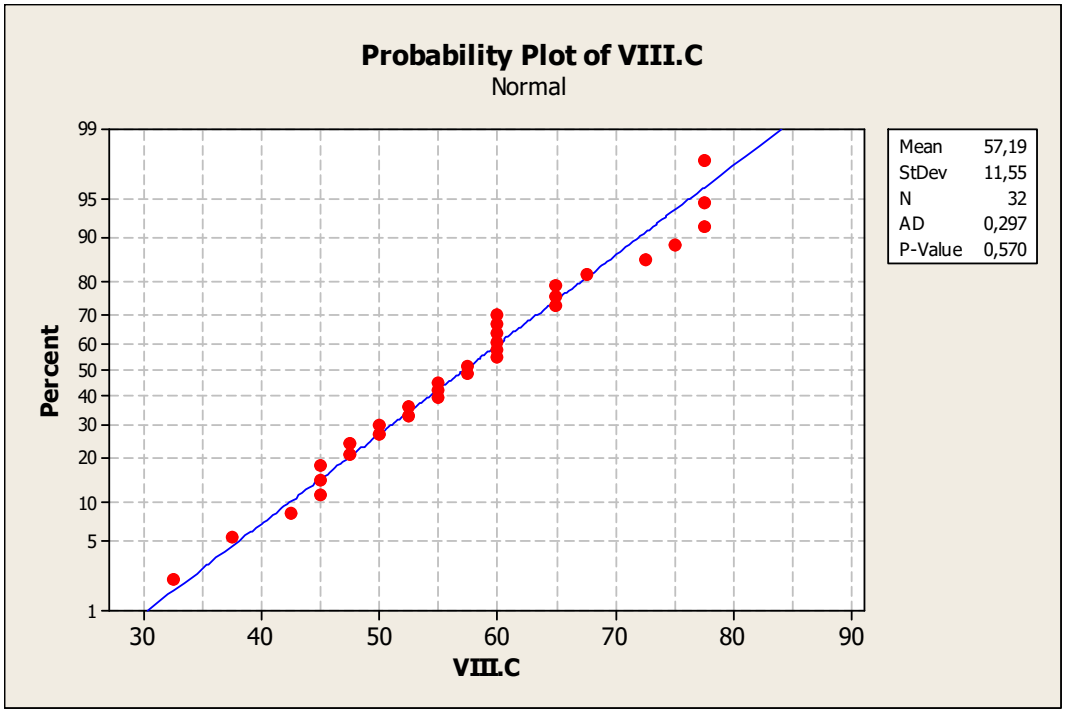
NO	Class							
	VIII. A	VIII. B	VIII. C	VIII. D	VIII. E	VIII. F	VIII. H	VIII. I
1	62,5	62,5	77,5	45,0	65,0	65,0	47,5	52,5
2	72,5	72,5	45,0	82,5	60,0	50,0	32,5	62,5
3	60,0	60,0	55,0	57,5	65,0	67,5	37,5	57,5
4	77,5	42,5	42,5	77,5	55,0	45,0	67,5	67,5
5	60,0	37,5	47,5	35,0	62,5	45,0	30,0	50,0
6	72,5	57,5	60,0	37,5	55,0	65,0	52,5	72,5
7	70,0	67,5	55,0	72,5	52,5	45,0	57,5	77,5
8	77,5	62,5	67,5	72,5	52,5	40,0	62,5	62,5
9	60,0	75,0	60,0	62,5	67,5	60,0	72,5	60,0
10	77,5	82,5	50,0	70,0	55,0	45,0	60,0	60,0
11	47,5	62,5	45,0	70,0	55,0	60,0	27,5	27,5
12	67,5	65,0	55,0	55,0	55,0	80,0	47,5	45,0
13	57,5	57,5	32,5	70,0	77,5	55,0	47,5	47,5
14	62,5	40,0	77,5	50,0	70,0	65,0	57,5	62,5
15	60,0	60,0	52,5	57,5	80,0	45,0	60,0	30,0
16	50,0	60,0	60,0	65,0	42,5	67,5	77,5	60,0
17	75,0	62,5	72,5	35,0	52,5	77,5	40,0	82,5
18	40,0	40,0	60,0	57,5	57,5	62,5	62,5	32,5
19	75,0	70,0	75,0	67,5	40,0	42,5	60,0	60,0
20	65,0	80,0	52,5	80,0	62,5	70,0	40,0	62,5
21	60,0	80,0	60,0	62,5	55,0	57,5	55,0	52,5
22	45,0	75,0	57,5	42,5	65,0	72,5	40,0	52,5
23	50,0	50,0	50,0	70,0	57,5	62,5	45,0	42,5
24	62,5	62,5	65,0	70,0	70,0	55,0	62,5	62,5
25	60,0	50,0	57,5	75,0	47,5	60,0	67,5	40,0
26	55,0	85,0	77,5	87,5	57,5	30,0	85,0	67,5
27	72,5	65,0	47,5	45,0	22,5	60,0	67,5	57,5
28	67,5	47,5	65,0	40,0	47,5	47,5	75,0	52,5
29	70,0	70,0	45,0	80,0	65,0	60,0	67,5	37,5
30	67,5	67,5	37,5	37,5	25,0	85,0	62,5	42,5
31	40,0	70,0	65,0	60,0	57,5	27,5	85,0	70,0
32	60,0	85,0	60,0	67,5	47,5	62,5		55,0
Total	**2000**	**2025**	**1830**	**1957,5**	**1800**	**1832, 5**	**1752,5**	**1765**
Average	**62,50**	**63,28**	**57,19**	**61,17**	**56,25**	**57,27**	**56,53**	**55,16**

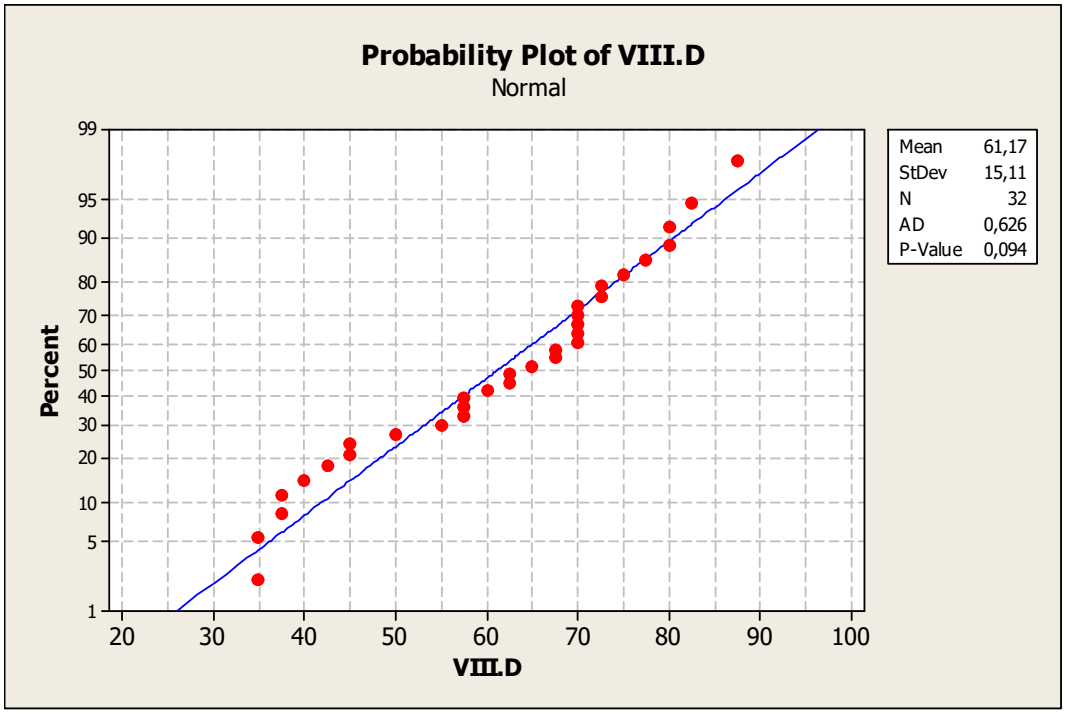
Attachment 2

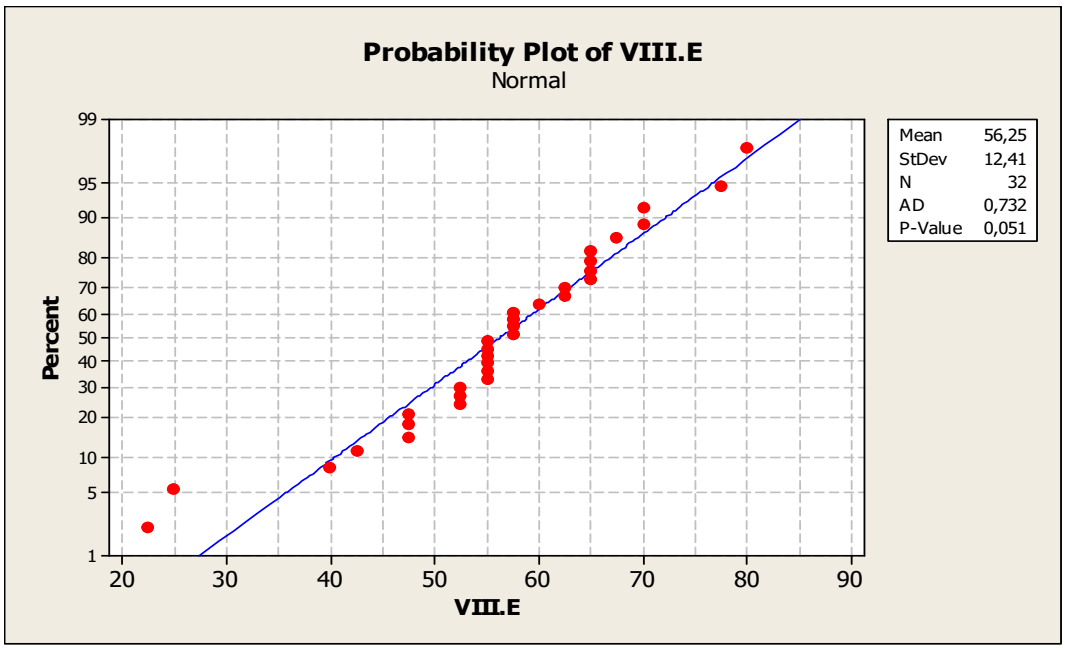
Population Normality Test

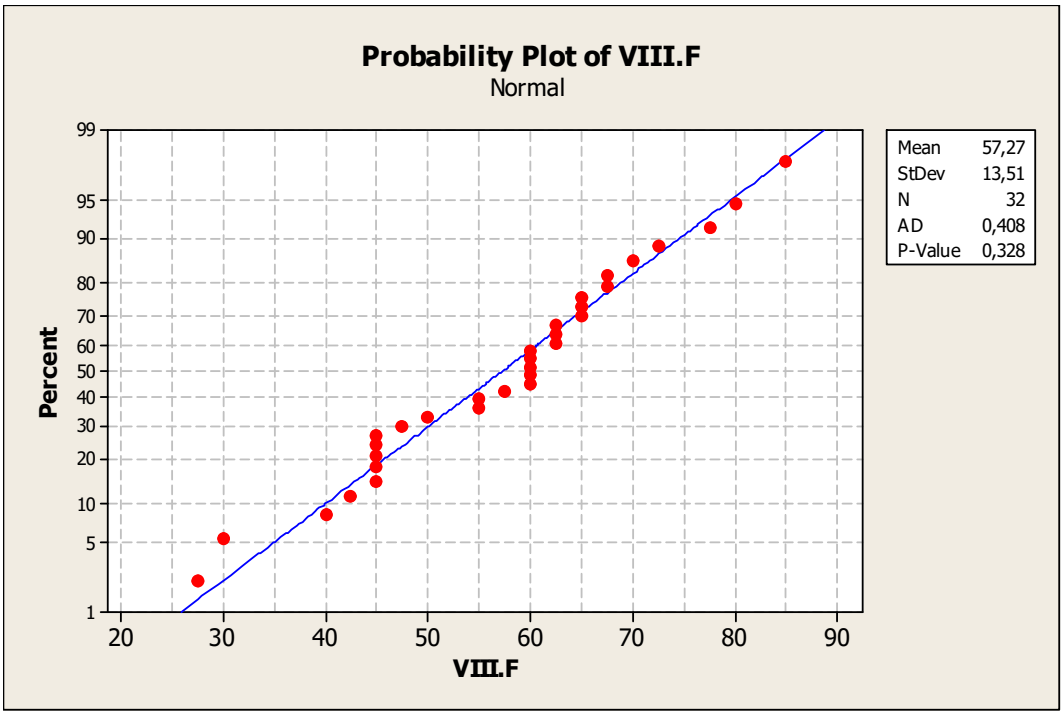


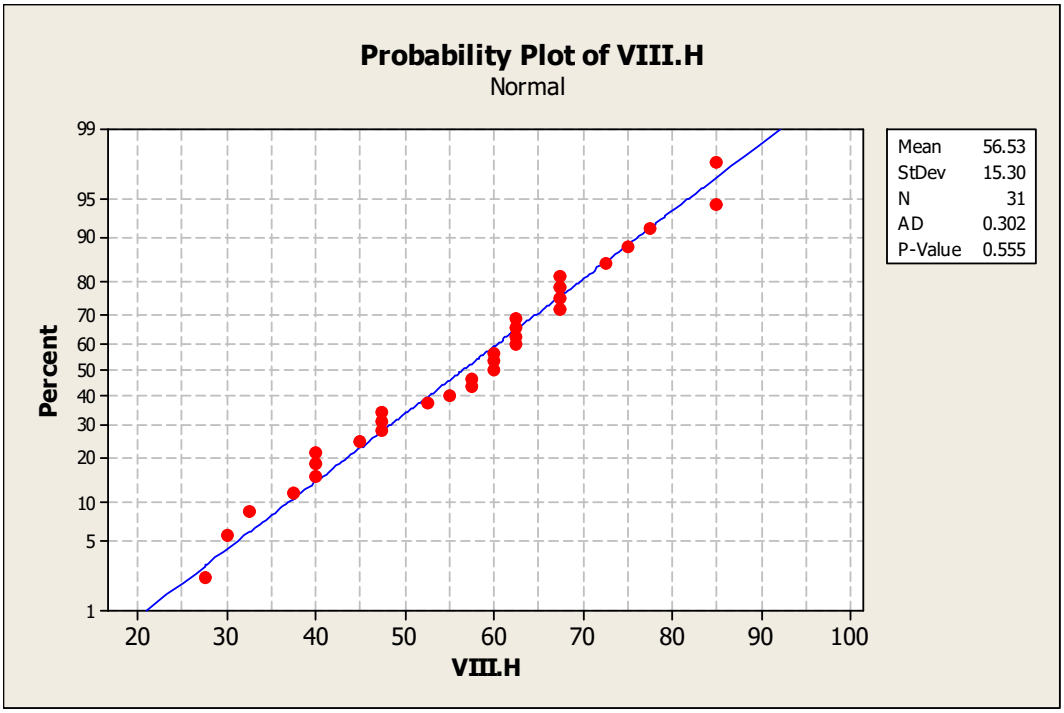


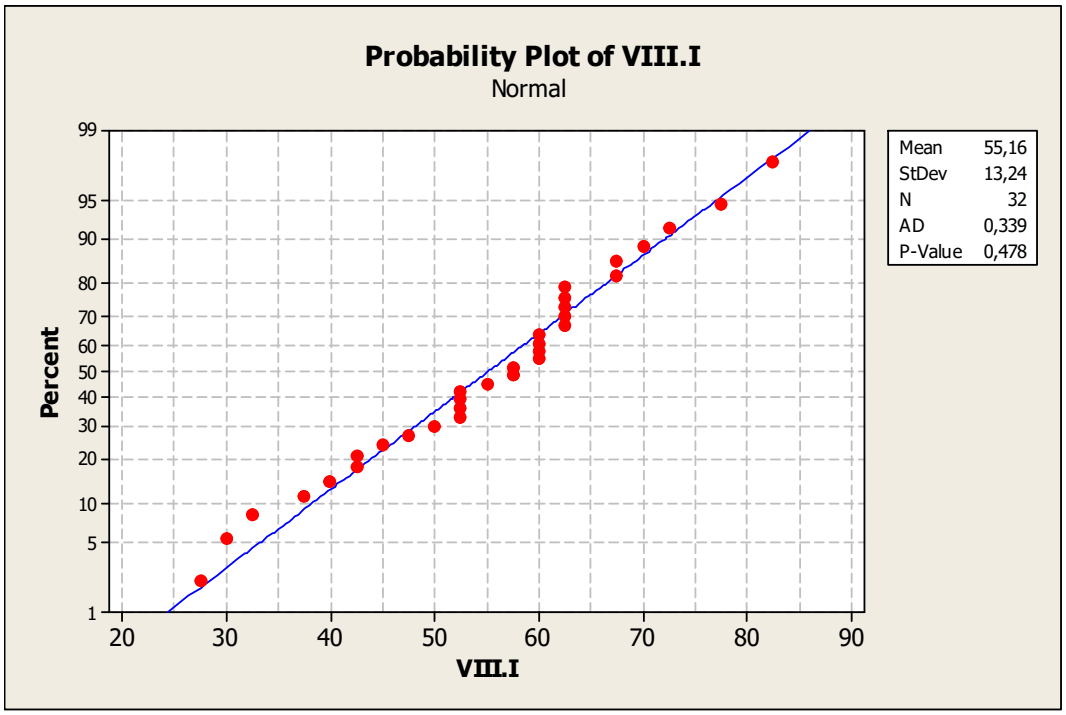

Probability Plot of VIII.C
Normal
Percent
VIII.C
Mean 57,19
StDev 11,55
N 32
AD 0,297
P-Value 0,570


Probability Plot of VIII.D
Normal
Percent
VIII.D
Mean 61,17
StDev 15,11
N 32
AD 0,626
P-Value 0,094


Probability Plot of VIII.E
Normal
Percent
VIII.E
Mean 56,25
StDev 12,41
N 32
AD 0,732
P-Value 0,051

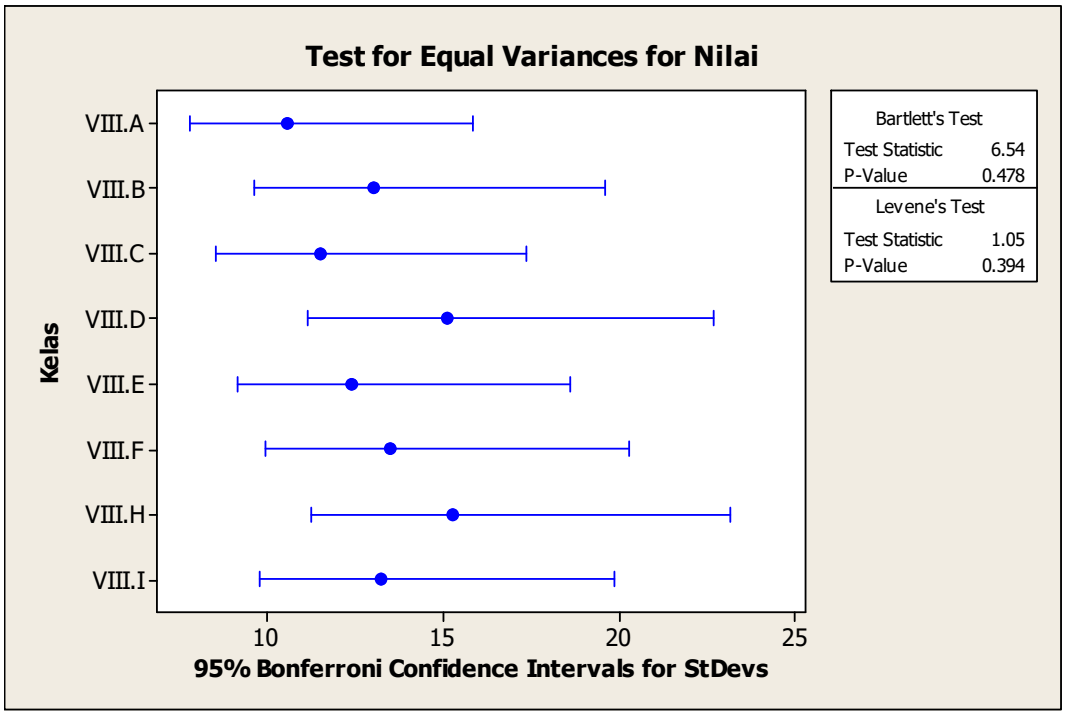

Probability Plot of VIII.F
Normal
Percent
VIII.F
Mean 57,27
StDev 13,51
N 32
AD 0,408
P-Value 0,328


Probability Plot of VIII.H
Normal
Percent
VIII.H
Mean 56.53
StDev 15.30
N 31
AD 0.302
P-Value 0.555


Probability Plot of VIII.I
Normal
Percent
VIII.I
Mean 55,16
StDev 13,24
N 32
AD 0,339
P-Value 0,478

Attachment 3

Homogeneity Test of Variance



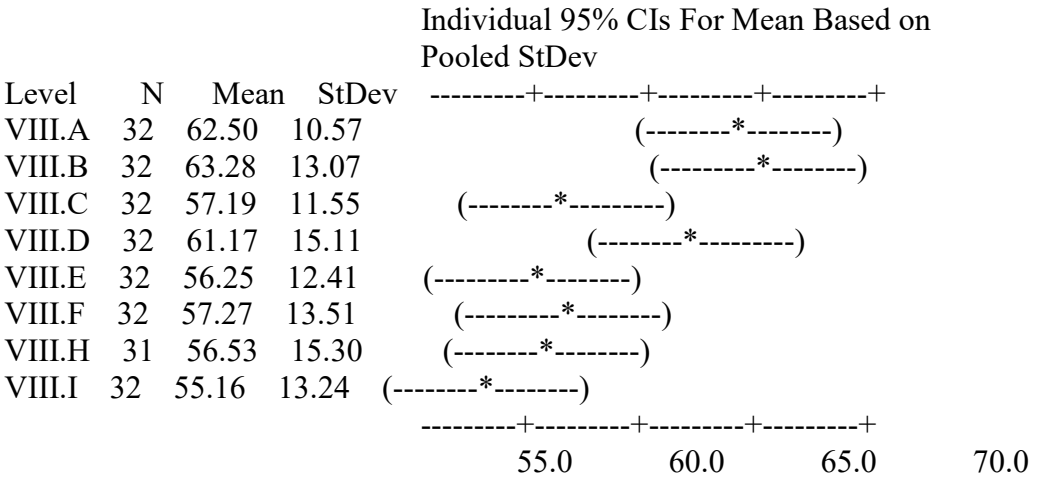
Attachment 4

Population Class Mean Similarity Test

One-way ANOVA: Nilai versus Kelas

Source	DF	SS	MS	F	P
Kelas	7	2208	315	1.82	0.084
Error	247	42852	173		
Total	254	45060			

S = 13.17 R-Sq = 4.90% R-Sq(adj) = 2.20%



Pooled StDev = 13.17

Attachment 5

LESSON PLAN

(RPP)

School Name : SMP Negeri 1 Padang

Subjects : Mathematics

Class / Semester: VIII / 1

Academic Year : 2017/2018

Main Material : Relations and Functions

Time allocation : 6 meetings = 3 x (2 + 3) jp x 40 minutes

A. Basic competencies

KD on KI 3	KD on KI 4
3.3 Describe and state relations and functions using various representations (words, tables, graphs, diagrams, and equations.	4.3 Solve problems related to relations and functions by using various representations.

B. Competency Achievement Indicators and Learning Objectives

(2 x 40 minutes)	
Indicators of Competence Achievement	**Learning objectives**
3.3.1 State the meaning of the relationship	1. Through question and answer students can mention examples of relationships related to everyday life. 2. Students can mention examples of relations related to numbers in mathematics through group discussions. 3. Through group discussions students can mention the meaning of relationships.
3.3.1 Present relations in the form of arrows, Cartesian diagrams, and consecutive sets of pairs.	1. Students can present relationships in the form of arrow diagrams through discussions and assignments in the form of exercises regarding questions related to relations. 2. Students can present a relationship in the form of a set of consecutive pairs

	through discussion and giving assignments in the form of exercises regarding questions related to relations. 3. Students can present relationships in the form of a Cartesian diagram through discussions and assignments in the form of exercises regarding questions related to relations

C. Learning Materials

Material: Relationships and Functions

(2x 40 minutes)

Definition of Relationships, Examples of Relationships, Presenting Relationships

1. Definition of Relationships

The relation from set A to set B is a rule that pairs the members of set A with members of set B.

2. Examples of Relationships

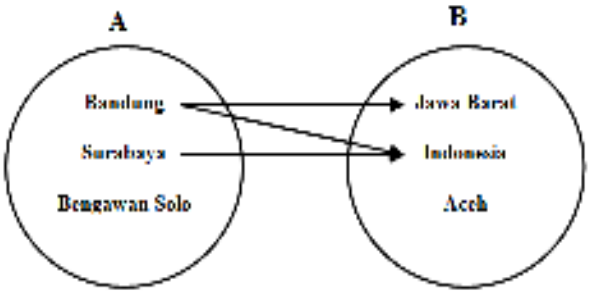
For example the relation "is a city in" pairs members of set A = {Bandung, Surabaya, Bengawan Solo} to members of association B = {West Java, Indonesia, Aceh} in the following manner:

- Bandung is paired with West Java and Indonesia, because Bandung is “a city” in West Java and also “is a city” in Indonesia.
- Surabaya is paired with Indonesia, because Surabaya is “a city” in Indonesia.

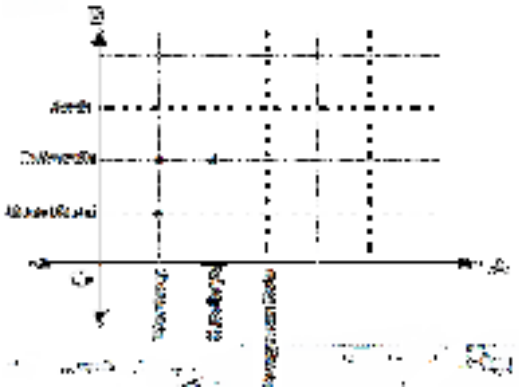
3. Presenting Relationships

A relation from one set to another can be expressed in three ways, namely:

a. Arrow diagram



b. Cartesian diagram



c. Consecutive Pair Association

The ordered pair set of set A and set B is =

{(Bandung, West Java), (Bandung, Indonesia), (Surabaya, Indonesia)}.

From the description above, what includes facts, concepts, principles and procedures are:

1. Facts

$n(A)$: Many members of the set A.

$n(B)$: Many members of the association B.

$f: x \to y$, read: function maps to.

$f: x \to f(x)$, if the member of origin is A, then the image of by x the function f is represented by $f(x)$, reads the function from x..

2. Concept

a. Definition of relation.

b. Definition of function.

c. Definition of domain, codomain, and range.

d. Definition of one-on-one correspondence.

3. Principles

The number of mappings from set A to set B is $n(B)^{n(A)}$.

The number of mappings from set B to set A are $n(A)^{n(B)}$.

4. Procedures

The relation between two defined sets can be expressed in the following ways:

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

Mapping can be expressed in the following three ways.

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

D. Learning Methods

Learning Methods: Methods of discussion, demonstration, question and answer, and assignments.

Scientific approach (observing, asking questions, collecting information associating, communicating)

Learning Model: Group Investigation

Group Investigation Model Phase and Scientific Approach

Group Investigation Model Phase	**Activity scientific approach**
Stage-1. Grouping 1. The teacher starts the lesson by presenting a problem in front of the class.	
Stage -2. Planning 2. Students plan together regarding: ● What did we learn? ● How do we learn? ● Who did what (division of tasks)? ● For what purposes and interests are we investigating this topic? 2. The teacher starts the lesson by presenting a problem in front of the class.	Asking, Observing

Group Investigation Model Phase	Activity scientific approach
Stage -3. Investigation 3. Students and their group friends try to complete the guidelines at the LKPD. 4. Students discuss with their group friends to answer questions in the LKPD, students share answers and opinions to formulate conclusions. 5. The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in the LKPD.	Gathering Information, Asking
Stage -4. Organizing 6. Students plan and prepare appropriate work such as reports and conclusions 7. Students plan the division of tasks with their friends.	Associate
Stage -5. Presenting 9. The teacher asks the group that gets topics about relations, examples of relations, and presents the relations in the form of arrow diagrams, sequential sets of pairs, and cartesian diagrams to come to the front of the class presenting the results of their group discussions. 10. The selected groups present the results of their group discussions in front of the class	Observing, Asking, Gathering Information, Communicating
Stage -6 Evaluating 11. Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers	Observing, Asking, Gathering Information, Communicating

E. Learning Media

Media: Student Worksheet (LKPD)

F. Learning steps

(2 x 40 minutes)

Learning Activity Steps	**Time**
Preliminary activities	
1. The teacher says hello. 2. The teacher begins the lesson by inviting students to read basmalah and pray first according to their respective beliefs. 3. The teacher delivers the learning model that will be applied, namely Group Investigation and the tasks that must be done in groups using LKPD 1. Each group consists of 5-6 heterogeneous people and one chairperson is appointed to lead the discussion. 4. Apperception: The teacher reminds students about the set material, linear equations, and algebraic operations that have been studied previously in class VII. 5.Motivation: Students find the benefits of learning relationships in everyday life through the examples given. Look at the following picture:  The image is a picture of the animal and its food. The relationship between animals and their food is one example of the application of relationships in everyday life. 6. The teacher delivered the material that will be discussed today, namely about relations, examples of relations, and presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian	10 minutes

<table>
<tr><td>diagrams.
7. The teacher communicates the learning objectives and learning outcomes that students are expected to achieve.
Stage-1. Grouping
8. Students are asked to sit with their respective group friends.</td><td></td></tr>
<tr><td>Core activities</td><td></td></tr>
<tr><td>Stage -2. Planning
9. Students plan together regarding:
● □ What did we learn?
● □ How do we learn?
● □ Who did what (division of tasks)?
● □ For what purposes and interests are we investigating this topic? (ask)

10. The teacher begins learning by presenting a problem in front of the class, namely: (observing)
“A stationery shop sells notebooks, pens, pencils, rulers, and so on. Each item has its own price as follows:
1 notebook for Rp. 3,000.00
1 Balpoin at a price of IDR 4,000.00
1 pencil for Rp. 2,000.00
1 ruler at a price of Rp. 6,000.00
Every item has a relationship with a price. "

To make it easier to find out each price of writing equipment, each student is asked to make a table of stationery names and prices. (Observing)</td><td>5 minutes</td></tr>
<tr><td>Stage -3. Investigation
11. The teacher distributes LKPD 1 to each group, students sit in groups to work on and solve problems given in LKPD 1. (associate)
12. Students and their group friends try to complete the guidelines in LKPD 1 and fill in the tables for Himpunan A and Himpunan B. (gathering information)
<table>
<tr><td>No</td><td>Set A</td><td>Set B</td></tr>
<tr><td>1</td><td>1 notebook</td><td>Rp 3.000,00</td></tr>
<tr><td>2</td><td>1 pen</td><td>Rp 4.000,00</td></tr>
<tr><td>3</td><td>1 pencil</td><td>Rp 2.000,00</td></tr>
<tr><td>4</td><td>1 ruler</td><td>Rp 6.000,00</td></tr>
</table>
Based on the table above, students are asked to make a relationship between set A and set B where the expected answer is price. (Associate)
13. Students discuss answering questions in LKPD 1, students share</td><td>25,minutes</td></tr>
</table>

answers and opinions to formulate conclusions. The question is if the relation between set A and set B is a relation, what do you think that relation is? The expected answer is the relation of set A and set B is a rule that pairs the members of set A with members of set B (communicates) 14. The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in LKPD 1. (ask) 15. After students solve the problems in Activity 1, students and their groups continue to discuss for activity 2, namely presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams. (Gathering information) 16. Students are asked to pay attention to problems such as the following. Pay attention to the problems below. Budi, Wahyu, Mukti, and Anton are fruit traders who sell products in the market. Budi sells melons, Wahyu sells apples, Mukti sells oranges, and Anton sells mangoes. If A = $\{Budi, Wahyu, Mukti, Anton\}$ and B =$\{melon, apel, jeruk, mangga\}$ then a relationship can be formed between members of set A and members of set B.	
Stage -4. Organizing 17. Students plan and prepare appropriate work such as reports and conclusions. (associate) 18. Students plan the division of tasks with their friends.	10 minutes
Stage -5. Presenting 19. The teacher asks the group that gets topics about relations, examples of relations, and presents the relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams to come to the front of the class presenting the results of their group discussions. 20. The selected group presents the results of their group discussion in front of the class (communicating, asking questions, observing, gathering information)	10 minutes
Stage -6 Evaluating 21. Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. (Ask, observe, collect information)	10 minutes
Closing Activities	
22. The teacher with students concludes the material that has been studied. The teacher reflects by asking the students "What did you	10 minutes

get today?" and designate several students to answer. If the designated students cannot answer, the teacher will give guiding questions to answer them. 23. The teacher provides homework. (PR) 24. The teacher ends the lesson by inviting students to say hamdalah.	

G. Assessment

A. Spiritual Attitude

Assessment Technique: Observation

Instrument of Spiritual Attitude

No	Observational Aspects	Score			
		1	2	3	4
1	Pray before and after doing something				
2	Give thanks for God's gift				
3	Greeting before and after giving opinions / presentations				
Total score					

B. Social Attitude

a. Assessment Technique: Observation

b. Instrument Shape: observation sheet (Curiosity)

No	Observational Aspects	Score			
		1	2	3	4
1.	Likes to ask questions during the learning process				
2.	Likes to observe things related to squares and rectangles				
total score=					

c. .Disciplinary instruments:

No	Observational Aspects	Score			
		1	2	3	4
1.	Work actively and on time during the learning process				
2.	Able to work on problems in LKPD well				
total score =					

d. Instruments Respect the opinion of friends or value diversity:

No	Observational Aspects	Score			
		1	2	3	4
1.	Listen during the presentation of the discussion results				
2.	Listening and giving opinions during group discussions				
	Jumlah Skor =				

C. Knowledge

Assessment technique: written test (LKPD)

Instrument form: Description

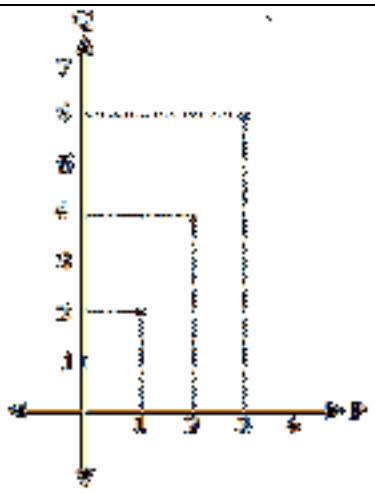
Assessment of learning outcomes as follows:

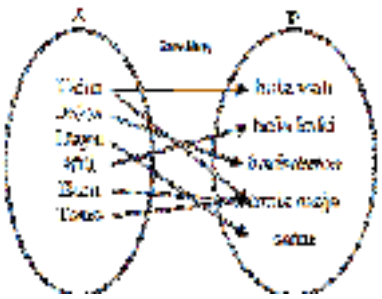
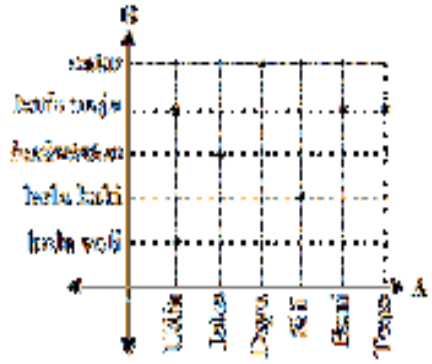
Indicators of Competence Achievement:

1. Mention the meaning of a relationship

2. Present relations in the form of arrow diagrams, Cartesian diagrams, and sets of consecutive pairs.

Question	Answer	Score
1. Given that the set P = {1, 2, 3, 4} and the set Q = {1, 2, 3, 4, 5, 6, 7}. If from set P to set Q are connected by a relation "half of", define the relation in the form: a. Arrow diagram b. Cartesian diagram c. The set of consecutive pairs	Given: set P = {1, 2, 3, 4} set Q = {1, 2, 3, 4, 5, 6, 7} relation = "half of" Wanted: a. arrow diagram b. cartesius diagram c. set of consecutive pairs Answer: a.Arrow Diagram  a. Cartesian diagram	4

	 b. Set of consecutive pairs = $\{(1,2),(2,4),(3,6)\}$	
2. A relation between two sets is represented by: 4,2), (6,3), (8,4), (10,5), (12,6)). a. Write the first set and the second set! b. Express in words the rule of relations from the first set to the second set	It is known that: 4,2), (6,3), (8,4), (10,5), (12,6)) Wanted: a. the first set and the second set b. relational rules from the first set to the second set Answer: a. The first set $=\{4,6,8,10,12\}$ The second set $=\{2,3,4,5,6\}$ a. The rule of relations from the first set to the second setadalah "kelipatan dari"	4
3. Pay attention to the following problems! In commemoration of the 68th Indonesian Independence Day in Sorong Regency, SMP Negeri 1 Sorong will send its students to participate in competitions between junior high school students in tennis, volleyball, football, badminton, table tennis and chess competitions. There are 6 students (Udin, Joko, Dayu, Siti, Beni, and Tono) who will take part in the competition. The school makes two alternative choices in determining the	Is known: Set:$A = \{Udin, Joko, Dayu, Siti, Beni, dan\ Tono\}$ Set$B$: *{tennis court, volleyball, football, badminton, table tennis and chess}* Udin participated in tennis and volleyball matches, Joko participated in badminton matches, Dayu participated in chess, Siti participated in volleyball matches, Beni participated in table tennis matches, and Tono participated in table tennis matches. Wanted: a. Arrow diagram b. The set of ordered pairs c. Cartesian diagram Answer: a. Arrowdiagram	4

competition that the six students will participate in. The two choices were: 1) Udin participated in a tennis and volleyball match, Joko participated in a badminton match, Dayu participated in a chess match, Siti participated in a volleyball match, Beni participated in a table tennis match, and Tono participated in a table tennis match. 2) Dayu and Siti participate in a volleyball match, Joko and Udin participate in a football match, Tono participate in a table tennis match, and Beni participate in a chess match. If the school choice is item (1), match students with the type of competition to be followed using the arrow diagram, ordered pairs, and the Cartesian diagram.	 a. Ordered pair set:$\{(Udin, tenis\ \ count), (Udin, chess), (Joko, badminton), (Dayu, chess), (Siti, vollyball), (Beni, table\ \ tennis), (Tono, table\ \ tennis)\}$ b. Cartesiandiagram 	

$$\text{Score} = \frac{acquisition\ \ score}{total\ \ score\ \ (max)} \times 100$$

For the assessment of knowledge using qualitative values as follows

Score	Conversion
≥ 85	A
75 – 84	B
65 - 74	C
64 - 40	D
≤ 39	E

H. Learning Resources

- Kemendikbud. 2017. SMP / MTs Mathematics Class VIII. Jakarta: Ministry of Education and Culture

- M. Cholik Adinawan and Sugijono. 2007. Mathematics 2A. Jakarta: Erlangga
- Salamah, Umi. 2017. Logic with Mathematics 2 For SMP and MTS Class VIII. Solo: PT Tiga Serangkai Pustaka Mandiri.

LESSON PLAN

(RPP)

School Name : SMP Negeri 1 Padang

Subjects : Mathematics

Class / Semester : VIII / 1

Academic Year : 2017/2018

Main Material : Relations and Functions

Time allocation : 6 meetings = 3 x (2 + 3) jp x 40 minutes

A. Basic Competence

KD on KI 3	KD on KI 4
3.3 Describe and state relations and functions using various representations (words, tables, graphs, diagrams, and equations.	4.3 Solve problems related to relations and functions by using various representations.

B. Competency Achievement Indicators and Learning Objectives

(2 x 40 minutes)	
Indicators of Competence Achievement	**Learning objectives**
3.3.2 Mention the meaning of the relations	1. Through question and answer students can mention examples of relationships related to everyday life. 2. Students can mention examples of relations related to numbers in mathematics through group discussions. 3. Through group discussions students can mention the meaning of relationships.
3.3.3 Present relations in the form of arrows, Cartesian diagrams, and consecutive sets of pairs.	4. Students can present relationships in the form of arrow diagrams through discussions and assignments in the form of exercises regarding questions related to relations. 5. Students can present a relationship in the form of a set of consecutive pairs through discussion and giving assignments in the form of exercises regarding questions related to relations. Students can present relationships in the

	form of a Cartesian diagram through discussions and giving assignments in the form of exercises on questions related to relations..

C. Learning Materials

Material: Relationships and Functions

(2x 40minute)

Definition of Relationships, Examples of Relationships, Presenting Relationships

1. Definition of Relationships

The relation from set A to set B is a rule that pairs the members of set A with members of set B.

2. Examples of Relationships

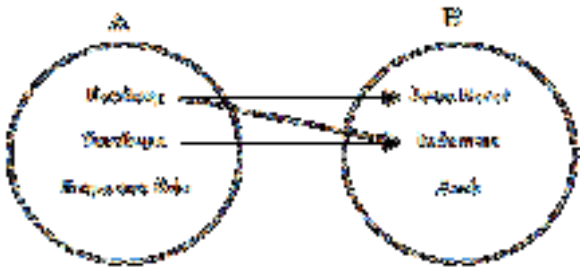
For example the relation "is a city in" pairs members of set A = {Bandung, Surabaya, Bengawan Solo} to members of association B = {West Java, Indonesia, Aceh} in the following manner:

- Bandung is paired with West Java and Indonesia, because Bandung is “a city” in West Java and also “is a city” in Indonesia.
- Surabaya is paired with Indonesia, because Surabaya "is a city" in Indonesia.

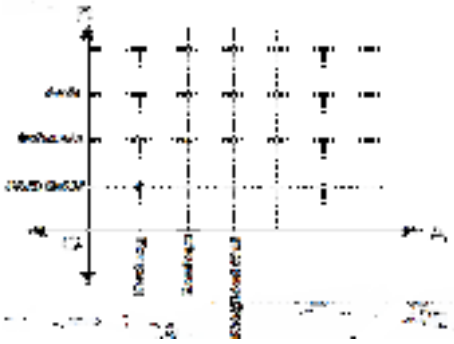
3. Presenting Relationships

A relation from one set to another can be expressed in three ways, namely:

a. Arrow diagram



b. Diagram Cartesius



c. Consecutive Pair Association

The ordered pair set of set A and set B is =

{(Bandung, West Java), (Bandung, Indonesia), (Surabaya, Indonesia)}.

From the description above, what includes facts, concepts, principles and procedures are:

1. Facts

$n(A)$: Many members of the set A.

$n(B)$: Many members of the association B.

$f: x \to y$, read: function f maps x to y..

$f: x \to f(x)$, if the member of origin is A, then the image of x by the function f is represented by $f(x)$,, reads the function from x..

2. Concept

a) Definition of relation.

b. Definition of function.

c. Definition of domain, codomain, and range.

d. Definition of one-on-one correspondence.

3. Principles

The number of mappings from set A to set B is $n(B)^{n(A)}$.

The many mappings from set B to set A are $n(A)^{n(B)}$.

4. Procedures

The relation between two defined sets can be expressed in the following ways:

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

Mapping can be expressed in the following three ways.

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

D. Learning Methods

Learning Methods: Methods of discussion, demonstration, question and answer, and assignments.

Scientific approach (observing, asking questions, collecting information associating, communicating)

Learning Model: Problem Based Learning

D.Learning Methods

Learning Methods: Methods of discussion, demonstration, question and answer, and assignments.

Scientific approach (observing, asking questions, collecting information associating, communicating)

Learning Model: Problem Based Learning.

Phase Model Problem Based Learning and Scientific Approach

Model Phase *Problem Based Learning*	**Activity scientific approach**
Phase I: Orientation of students to problems 1. The teacher starts learning by presenting a problem in front of the class.	Observing, Asking

Phase II: Organizing students 2. The teacher distributes LKPD to each group, students sit in groups to work on and solve problems given in the LKPD.	
Phase III: Guiding individual and group investigations 3. Students and their group friends try to complete the guidance on the LKPD. 4. Students with their group friends discuss answering questions in the LKPD, students share answers and opinions to formulate conclusions. 5. The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in the LKPD.	Gathering Information, Asking Questions
Phase IV: Developing and presenting the work 6. The teacher asks one of the groups to come to the front of the class to present the results of the group discussion. 7. The selected groups present the results of their group discussions in front of the class. 8. Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers.	Observing, Asking, Associating, Communicating

Phase V: Analyzing and evaluating the problem-solving process 9. Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. 10. Students with the help of the teacher draw conclusions based on the results of the discussion.	Observe, ask, associate, communicate

E. Learning Media

Media: Student Worksheet (LKPD)

F. Learning steps

(2 x 40 minutes)

Learning Activity Steps	**Time**
Preliminary activities	
1. The teacher says hello. 2. The teacher begins the lesson by inviting students to read basmalah and pray first according to their respective beliefs. 3. The teacher delivers the learning model that will be applied, namely Group Investigation and the tasks that must be done in groups using LKPD 1. Each group consists of 5-6 heterogeneous people and one chairperson is appointed to lead the discussion. 4. Apperception: The teacher reminds students about the set material, linear equations, and algebraic operations that have been studied previously in class VII. 5.Motivation: Students find the benefits of learning relationships in everyday life through the examples given. Look at the following picture:	10 minutes

   The image is a picture of the animal and its food. The relationship between animals and their food is one example of the application of relationships in everyday life. 6. The teacher delivered the material that will be discussed today, namely about relations, examples of relations, and presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams. 7. The teacher communicates the learning objectives and learning outcomes that students are expected to achieve. Stage-1. Grouping 8.Students are asked to sit with their respective group friends.	
Core activities	
Stage -2. Planning 9. Students plan together regarding: ● □ What did we learn? ● □ How do we learn? ● □ Who did what (division of tasks)? ● □ For what purposes and interests are we investigating this topic? (ask) 10. The teacher begins learning by presenting a problem in front of the class, namely: (observing) "A stationery shop sells notebooks, pens, pencils, rulers, and so on. Each item has its own price as follows: 1 notebook for Rp. 3,000.00 1 Balpoin at a price of IDR 4,000.00 1 pencil for Rp. 2,000.00 1 ruler at a price of Rp. 6,000.00 Every item has a relationship with a price. " To make it easier to find out each price of writing equipment, each student is asked to make a table of stationery names and	5 minutes

prices. (Observing)

Stage -3. Investigation

11. The teacher distributes LKPD 1 to each group, students sit in groups to work on and solve problems given in LKPD 1. (associate)
12. Students and their group friends try to complete the guidelines in LKPD 1 and fill in the tables for Himpunan A and Himpunan B. (gathering information)

No	Set A	Set B
1	1 notebook	Rp 3.000,00
2	1 pen	Rp 4.000,00
3	1 pencil	Rp 2.000,00
4	1 ruler	Rp 6.000,00

Based on the table above, students are asked to make a relationship between set A and set B where the expected answer is price. (Associate)

13. Students discuss answering questions in LKPD 1, students share answers and opinions to formulate conclusions.

The question is if the relation between set A and set B is a relation, what do you think that relation is?

The expected answer is the relation of set A and set B is a rule that pairs the members of set A with members of set B (communicates)

14. The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in LKPD 1. (ask)
15. After students solve the problems in Activity 1, students and their groups continue to discuss for activity 2, namely presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams. (Gathering information)
16. Students are asked to pay attention to problems such as the following.

Pay attention to the problems below.

Budi, Wahyu, Mukti, and Anton are fruit traders who sell products in the market. Budi sells melons, Wahyu sells apples, Mukti sells oranges, and Anton sells mangoes.

If A = $\{Budi, Wahyu, Mukti, Anton\}$ and
B =$\{melon, apel, jeruk, mangga\}$
then a relationship can be formed between members of set A and members of set B.

25,minutes

Stage -4. Organizing 17. Students plan and prepare appropriate work such as reports and conclusions. (associate) 18. Students plan the division of tasks with their friends.	10 minutes
Stage -5. Presenting 19. The teacher asks the group that gets topics about relations, examples of relations, and presents the relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams to come to the front of the class presenting the results of their group discussions. 20. The selected group presents the results of their group discussion in front of the class (communicating, asking questions, observing, gathering information)	10 minutes
Stage -6 Evaluating 21. Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. (Ask, observe, collect information)	10 minutes
Closing Activities	
22. The teacher with students concludes the material that has been studied. The teacher reflects by asking the students "What did you get today?" and designate several students to answer. If the designated students cannot answer, the teacher will give guiding questions to answer them. 23. The teacher provides homework. (PR) 24. The teacher ends the lesson by inviting students to say hamdalah.	10 minutes

G. Assessment

A. Spiritual Attitude

Assessment Technique: Observation

Instrument of Spiritual Attitude

No	Observational Aspects	Score			
		1	2	3	4
1	Pray before and after doing something				
2	Give thanks for God's gift				

3	Greeting before and after giving opinions / presentations				
Total score					

B. Social Attitude

a. Assessment Technique: Observation

b. Instrument Shape: observation sheet (Curiosity)

No	Observational Aspects	Score			
		1	2	3	4
1.	Likes to ask questions during the learning process				
2.	Likes to observe things related to squares and rectangles				
total score=					

c. Disciplinary instruments:

No	Observational Aspects	Score			
		1	2	3	4
1.	Work actively and on time during the learning process				
2.	Able to work on problems in LKPD well				
total score =					

d. Instruments Respect the opinion of friends or value diversity:

No	Observational Aspects	Score			
		1	2	3	4
1.	Listen during the presentation of the discussion results				
2.	Listening and giving opinions during group discussions				
Jumlah Skor =					

C. Knowledge

Assessment technique: written test (LKPD)

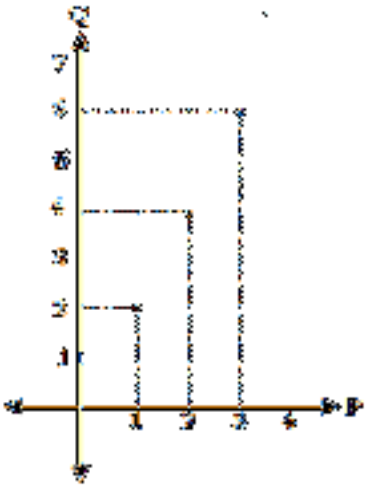
Instrument form: Description

Assessment of learning outcomes as follows:

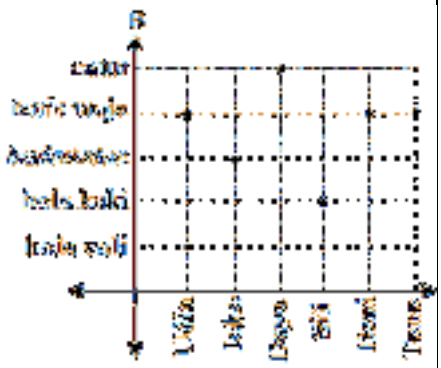
Indicators of Competence Achievement:

1. Mention the meaning of a relationship

2. Present relations in the form of arrow diagrams, Cartesian diagrams, and sets of consecutive pairs.

Question	Answer	Score
1. Given that the set P = {1, 2, 3, 4} and the set Q = {1, 2, 3, 4, 5, 6, 7}. If from set P to set Q are connected by a relation "half of", define the relation in the form: a. Arrow diagram b. Cartesian diagram c. The set of consecutive pairs	Given: set P = {1, 2, 3, 4} set Q = {1, 2, 3, 4, 5, 6, 7} relation = "half of" Wanted: a. arrow diagram b. cartesius diagram c. set of consecutive pairs Answer: a.Arrow Diagram  c. Cartesian diagram 	4

	d. Set of consecutive pairs = $\{(1,2),(2,4),(3,6)\}$	
2. A relation between two sets is represented by: 4,2), (6,3), (8,4), (10,5), (12,6)). a. Write the first set and the second set! b. Express in words the rule of relations from the first set to the second set	It is known that: 4,2), (6,3), (8,4), (10,5), (12,6)) Wanted: a. the first set and the second set b. relational rules from the first set to the second set Answer: a. The first set $=\{4,6,8,10,12\}$ The second set $=\{2,3,4,5,6\}$ b. The rule of relations from the first set to the second setadalah "kelipatan dari"	4
3, Pay attention to the following problems! In commemoration of the 68th Indonesian Independence Day in Sorong Regency, SMP Negeri 1 Sorong will send its students to participate in competitions between junior high school students in tennis, volleyball, football, badminton, table tennis and chess competitions. There are 6 students (Udin, Joko, Dayu, Siti,	Is known: Set:$A = \{Udin, Joko, Dayu, Siti, Beni, dan\ Tono\}$ Set$B$: *{tennis court, volleyball, football, badminton, table tennis and chess}* Udin participated in tennis and volleyball matches, Joko participated in badminton matches, Dayu participated in chess, Siti participated in volleyball matches, Beni participated in table tennis matches, and Tono participated in table tennis matches. Wanted: a. Arrow diagram b. The set of ordered pairs c. Cartesian diagram Answer:	4

Beni, and Tono) who will take part in the competition. The school makes two alternative choices in determining the competition that the six students will participate in. The two choices were: 1) Udin participated in a tennis and volleyball match, Joko participated in a badminton match, Dayu participated in a chess match, Siti participated in a volleyball match, Beni participated in a table tennis match, and Tono participated in a table tennis match. 2) Dayu and Siti participate in a volleyball match, Joko and Udin participate in a football match, Tono participate in a table tennis match, and Beni participate in a chess match. If the school choice is item (1), match students with the type of competition to be followed using the arrow	b. Arrowdiagram  c. Ordered pair set:$\{(Udin, tenis\ \ count), (Udin, chess), (Joko, badminton), (Dayu, chess), (Siti, vollyball), (Beni, table\ \ tennis), (Tono, table\ \ tennis)\}$ d. Cartesiandiagram 	

diagram, ordered pairs, and the Cartesian diagram.		

$$\text{Score} = \frac{acquisition\ \ score}{total\ \ score\ \ (max)} \times 100$$

For the assessment of knowledge using qualitative values as follows

Score	Conversion
≥ 85	A
75 – 84	B
65 - 74	C
64 - 40	D
≤ 39	E

H. Learning Resources

- Kemendikbud. 2017. SMP / MTs Mathematics Class VIII. Jakarta: Ministry of Education and Culture
- M. Cholik Adinawan and Sugijono. 2007. Mathematics 2A. Jakarta: Erlangga
- Salamah, Umi. 2017. Logic with Mathematics 2 For SMP and MTS Class VIII. Solo: PT Tiga Serangkai Pustaka Mandiri.

LESSON PLAN

(RPP)

School Name : SMP Negeri 1 Padang

Subjects : Mathematics

Class / Semester : VIII / 1

Academic Year : 2017/2018

Main Material : Relations and Functions

Time allocation : 6 meetings = 3 x (2 + 3) jp x 40 minutes

A. Basic Competence

KD on KI 3	KD on KI 4
3.3 Describe and state relations and functions using various representations (words, tables, graphs, diagrams, and equations.	4.3 Solve problems related to relations and functions by using various representations.

B. Competency Achievement Indicators and Learning Objectives

(2 x 40 minutes)	
Competency Achievement Indicators	**Learning Objectives**
3.3.1 State the meaning of the relationship	1. Through question and answer students can mention examples of relationships related to everyday life. 2. Students can mention examples of relations related to numbers in mathematics through group discussions. 3. Through group discussions students can mention the meaning of relationships.

3.3.2 Presenting relations in the form of arrow diagrams, Cartesian diagrams, and consecutive sets of pairs.	4. Students can present relationships in the form of arrow diagrams through discussions and assignments in the form of exercises regarding questions related to relationships. 5. Students can present a relationship in the form of a set of consecutive pairs through discussion and giving assignments in the form of exercises regarding questions related to relationships. 6. Students can present relationships in the form of a Cartesian diagram through discussions and assignments in the form of exercises regarding questions related to relations.

C. Learning Materials

Material: Relationships and Functions minute

Definition of Relationships, Examples of Relationships, Presenting Relationships

1. Definition of Relationships

The relation from set A to set B is a rule that pairs the members of set A with members of set B.

2. Examples of Relationships

For example the relation "is a city in" pairs members of set A = {Bandung, Surabaya, Bengawan Solo} to members of association B = {West Java, Indonesia, Aceh} in the following manner:

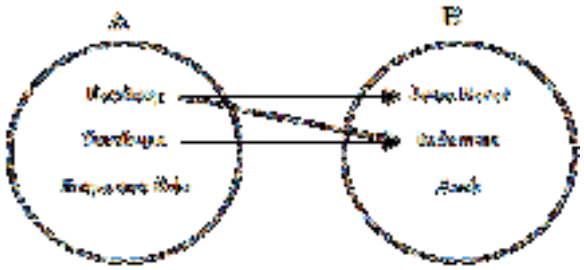
- Bandung is paired with West Java and Indonesia, because Bandung is “a city” in West Java and also “is a city” in Indonesia.

- Surabaya is paired with Indonesia, because Surabaya is “a city” in Indonesia.

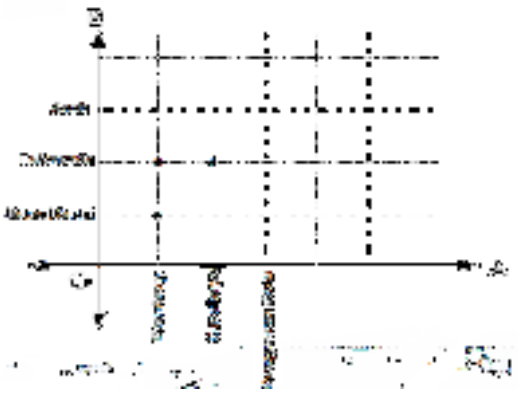
3. Presenting Relationships

A relation from one set to another can be expressed in three ways, namely:

a. Arrow diagram



b. Cartesian diagram



c. Consecutive Pair Association

The ordered pair set of set A and set B is =

{(Bandung, West Java), (Bandung, Indonesia), (Surabaya, Indonesia)}.

From the description above, what includes facts, concepts, principles and procedures are:

1. Facts

$n(A)$: Many members of the set A.

$n(B)$: Many members of the association B.

$f: x \rightarrow y$, read: function f maps x to y..

$f: x \rightarrow f(x)$, if the member of origin is A, then the image of x by the function f is represented by $f(x)$,, reads the function from x..

2. Concept

a) Definition of relation.

b. Definition of function.

c. Definition of domain, codomain, and range.

d. Definition of one-on-one correspondence.

3. Principles

The number of mappings from set A to set B is $n(B)^{n(A)}$.

The many mappings from set B to set A are $n(A)^{n(B)}$.

4. Procedures

The relation between two defined sets can be expressed in the following ways:

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

Mapping can be expressed in the following three ways.

a. arrow diagram,

b. The set of consecutive pairs,

c. Cartesian diagram.

D. Learning Methods

Learning Methods: Methods of discussion, demonstration, question and answer, and assignments.

Scientific approach (observing, asking questions, collecting information associating, communicating)

E. Learning Media

Media: LKS

F. Learning steps

Meeting I (2 x 40 minutes)

Learning Activity Steps	Time
Preliminary activities	
1. The teacher says hello. 2. The teacher begins the lesson by inviting students to read basmalah and pray first according to their respective beliefs. 3. The teacher delivers the learning model that will be applied, namely Group Investigation and the tasks that must be done in groups using LKPD 1. Each group consists of 5-6 heterogeneous people and one chairperson is appointed to lead the discussion. 4. Apperception: The teacher reminds students about the set material, linear equations, and algebraic operations that have been studied previously in class VII. 5.Motivation: Students find the benefits of learning relationships in everyday life through the examples given. Look at the following picture:  The image is a picture of the animal and its food. The relationship between animals and their food is one example of the application of relationships in everyday life. 6. The teacher delivered the material that will be discussed today, namely about relations, examples of relations, and presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams. 7. The teacher communicates the learning objectives and learning outcomes that students are expected to achieve.	10 minutes

Stage-1. Grouping 8.Students are asked to sit with their respective group friends.	
Core activities	
Stage -2. Planning 9. Students plan together regarding: ● □ What did we learn? ● □ How do we learn? ● □ Who did what (division of tasks)? ● □ For what purposes and interests are we investigating this topic? (ask) 10.The teacher begins learning by presenting a problem in front of the class, namely: (observing) "A stationery shop sells notebooks, pens, pencils, rulers, and so on. Each item has its own price as follows: 1 notebook for Rp. 3,000.00 1 Balpoin at a price of IDR 4,000.00 1 pencil for Rp. 2,000.00 1 ruler at a price of Rp. 6,000.00 Every item has a relationship with a price. " To make it easier to find out each price of writing equipment, each student is asked to make a table of stationery names and prices. (Observing)	5 minutes
Stage -3. Investigation ***11.*** The teacher distributes LKPD 1 to each group, students sit in groups to work on and solve problems given in LKPD 1. (associate) 12. Students and their group friends try to complete the guidelines in LKPD 1 and fill in the tables for Himpunan A and Himpunan B. (gathering information)	25,minutes

No	Set A	Set B
1	1 notebook	Rp 3.000,00
2	1 pen	Rp 4.000,00
3	1 pencil	Rp 2.000,00
4	1 ruler	Rp 6.000,00

Based on the table above, students are asked to make a relationship between set A and set B where the expected answer is price. (Associate)

13.Students discuss answering questions in LKPD 1, students share answers and opinions to formulate conclusions.

The question is if the relation between set A and set B is a relation, what do you think that relation is?

The expected answer is the relation of set A and set B is a rule that pairs the members of set A with members of set B (communicates)

14.The teacher walks and controls the course of the discussion, students are allowed to ask questions if something is not understood in LKPD 1. (ask)

15. After students solve the problems in Activity 1, students and their groups continue to discuss for activity 2, namely presenting relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams. (Gathering information)

16. Students are asked to pay attention to problems such as the following.

Pay attention to the problems below.

Budi, Wahyu, Mukti, and Anton are fruit traders who sell products in the market. Budi sells melons, Wahyu sells apples, Mukti sells oranges, and Anton sells mangoes.

If A = $\{Budi, Wahyu, Mukti, Anton\}$ and

B =$\{melon, apel, jeruk, mangga\}$

then a relationship can be formed between members of set A and

members of set B.	
Stage -4. Organizing 17. Students plan and prepare appropriate work such as reports and conclusions. (associate) 18. Students plan the division of tasks with their friends.	10 minutes
Stage -5. Presenting 19.The teacher asks the group that gets topics about relations, examples of relations, and presents the relations in the form of arrow diagrams, sequential sets of pairs, and Cartesian diagrams to come to the front of the class presenting the results of their group discussions. 20.The selected group presents the results of their group discussion in front of the class (communicating, asking questions, observing, gathering information)	10 minutes
Stage -6 Evaluating 21.Students together with the teacher discuss the answers displayed by the group, other groups are welcome if anyone wants to convey different suggestions or answers. (Ask, observe, collect information)	10 minutes
Closing Activities	
22.The teacher with students concludes the material that has been studied. The teacher reflects by asking the students "What did you get today?" and designate several students to answer. If the designated students cannot answer, the teacher will give guiding questions to answer them. 23.The teacher provides homework. (PR) 24.The teacher ends the lesson by inviting students to say hamdalah.	10 minutes

G. Assessment

A. Spiritual Attitude

Assessment Technique: Observation

Instrument of Spiritual Attitude

No	Observational Aspects	Score			
		1	2	3	4
1	Pray before and after doing something				
2	Give thanks for God's gift				
3	Greeting before and after giving opinions / presentations				
Total score					

B. Social Attitude

a. Assessment Technique: Observation

b. Instrument Shape: observation sheet (Curiosity)

No	Observational Aspects	Score			
		1	2	3	4
1.	Likes to ask questions during the learning process				
2.	Likes to observe things related to squares and rectangles				
total score=					

c. Disciplinary instruments:

No	Observational Aspects	Score			
		1	2	3	4
1.	Work actively and on time during the learning process				
2.	Able to work on problems in LKPD well				
total score =					

d. Instruments Respect the opinion of friends or value diversity:

No	Observational Aspects	Score			
		1	2	3	4
1.	Listen during the presentation of the discussion results				
2.	Listening and giving opinions during				

	group discussions				
Jumlah Skor =					

C. Knowledge

Assessment technique: Written test (Practice)

Instrument form: Description

H. Learning Resources

- Kemendikbud. 2017. SMP / MTs Mathematics Class VIII. Jakarta: Ministry of Education and Culture
- M. Cholik Adinawan and Sugijono. 2007. Mathematics 2A. Jakarta: Erlangga
- Salamah, Umi. 2017. Logic with Mathematics 2 For SMP and MTS Class VIII. Solo: PT Tiga Serangkai Pustaka Mandiri.

Attachment 6

LEARNING IMPLEMENTATION PLAN (RPP) VALIDATION SHEET

Education Unit : SMP Negeri 1 Padang

Subjects : Mathematics

Class / Semester : VIII / 1

Put a check mark (√) in the answer column below with the assessment criteria as follows:

Answer column 1: Disagree

Answer column 2: Disagree

Answer column 3: Agree

Answer column 4: Strongly Agree

No	Components / Indicators	Assessment				Note
		1	2	3	4	
I. General						
A	Arranged for each KD which can be implemented in one or more meetings.					

No	Components / Indicators		Assessment				Note
			1	2	3	4	
B	RPP components: subject identity, basic competency, competency achievement indicators, learning objectives, teaching materials, time allocation, learning methods, learning activities (introduction, core, cover), assessment of learning outcomes and learning resources						
II. Explanation of RPP Components							
A	**RPP identity**						
	Includes educational units, classes, semesters, programs, subjects, number of meetings.						
B	**Indicator**						
	1	Indicators are developed in accordance with the characteristics of students, subjects, and educational units					
	2	Indicators are formulated using measurable and observable operational verbs that include knowledge, skills and attitudes.					
	4	Indicators are used as a basis for developing assessment tools.					
	5	Each KD is developed into several indicators (at least one KD has two indicators)					
	6	Operational Verbs (KKO) on achievement indicators do not exceed the KKO level of thinking in KD					
C	**Learning objectives**						
	Describe the process and learning outcomes that are expected to be achieved by students in accordance with basic competencies						
D	**Teaching Materials**						
	1	Contains relevant facts, concepts, principles and procedures					

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No	Components / Indicators		Assessment				Note
			1	2	3	4	
	2	The material coverage is in accordance with the competencies to be achieved.					
E	**Time Allocation**						
	1	In accordance with the needs for achieving basic competency and learning load					
F	**Learning Activities**						
	1	**preliminary** Initial activities to generate motivation and focus the attention of students to actively participate in the learning process					
	2	**Core activities**					
		It is a learning process to achieve learning objectives with a problem-based learning model and a Group Investigation model.					
		Performed interactively, inspiring, fun, challenging, motivating students to participate actively and providing sufficient space for initiative, creativity, and independence according to the talents, interests, and physical and psychological development of students.					
	3	**Closing**					
		Reflect on activities to end learning activities.					
		Make a summary or conclusion and judgment.					
		Provide feedback and follow up.					
G	Assessment of Learning Outcomes						
	1	The procedures and instruments for assessing the process and learning outcomes are adjusted to the indicators of competency achievement.					
	2	Refers to assessment standards					

No	Components / Indicators		Assessment				Note
			1	2	3	4	
	3	There is a question attachment according to the achievement indicators					
H	**Learning Resources**						
	Determination of learning resources is based on basic competency, teaching materials, learning activities, and indicators of competency achievement.						

General Assessment
RPP can be used without revision.
RPP can be used with a few revisions.
RPP can be used with many revisions.
RPP can not be used (still requires consultation).
Validator Recommendations for RPP:

……...……
……
……
……
……...
……...

Padang, July 2017
Validator,

(.....)

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Attachment 7

LKPD

RELATIONS AND FUNCTIONS

Basic competencies:

3. 3 Describe and state relations and functions using various representations (words, tables, graphs, diagrams, and equations).
4. 3 Solve problems related to relations and functions by using various representations

Learning objectives :

1. Through question and answer students can mention examples of relationships related to everyday life.
2. Students can mention examples of relations related to numbers in mathematics through group discussions.
3. Through group discussions students can mention the meaning of relationships.
4. Students can present relationships in the form of arrow diagrams through giving assignments in the form of exercises regarding questions related to relations.
5. Students can present relationships in the form of a Cartesian diagram by giving assignments in the form of exercises regarding questions related to relations.
6. Students can present a relationship in the form of a set of consecutive pairs through giving assignments in the form of exercises regarding questions related to relations.

Group name :

Members:

1. 4.
2. 5.
3. 6.

INSTRUCTIONS!

1. Complete the empty parts of this LKPD properly and correctly
2. Complete the empty parts of this LKPD properly and correctly.
3. Each member of the group is expected to actively

1 Relationship

Problem

Activity 1

Take a look at the issues below.

"*A stationery store sells notebooks, balpoin, pencils, mistar, and so on. Each item has its own price as follows:*

1 notebook at a price *Rp 3.000,00*

1 Balpoin with price *Rp 4.000,00*

1 pencil at the price *Rp 2.000,00*

1 mistar with price *Rp 6.000,00*

Every item has a connection with a price."

To make it easier to know the price of stationery, a table of orders for each student is created. Complete the table below to order the students.

No	Set A	Set B
1	1 notebook	Rp 3.000,00
2		
3		
4		

Question:

Before knowing what a relationship is, first answer the following questions.

1. Set A is a list of names?
Answer:

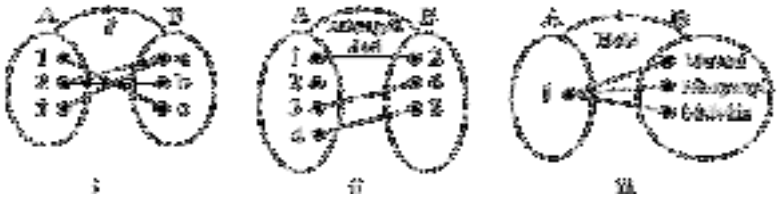
2. What set B is a list of names?
Answer:

3. What is the relationship between set A and set B?
Answer :

Note that in the relation set A to set B, each member of set A can be paired with one or more members of set B, there can even be members of A who have no partner with members of set B.

If the relationship between set A and set B is a relationship, what do you think it is?
Answer:

Here are some examples of relationships



Activity 2

Relation between two sets can be expressed in the following way:
1. Arrow diagram
2. Consecutive set of pairs
3.Cartesian diagram

Problem

Consider the problem below.

Budi, Wahyu, Mukti, and Anton are fruit traders who sell products in the market. Budi sells melons, Wahyu sells apples, Mukti sells oranges, and Anton sells mangoes.

If A = {Budi, Wahyu, Mukti, Anton} and
B = {Melon, Apple, Orange, Mangoes}
then a relationship can be formed between members of set A and members of set B.

Question:

1. State the relationship between the two sets A and set B with the relation "sell" in Activity 2 in the arrow diagram

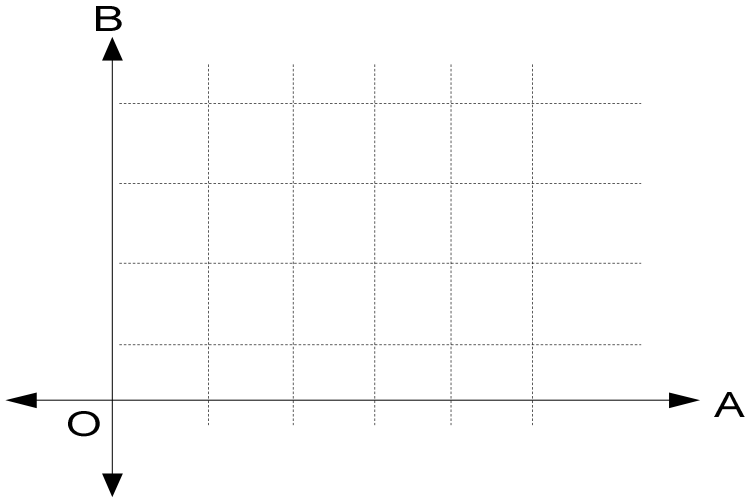
Answer:

2. State the relationship between the two sets A and set B with the relation "sell" in activity 2 in the consecutive set of pairs. Answer: ((,),

{ _____

_____ }

3. State the relationship between the two sets A and set B with the relation "sell" in activity 2 in the consecutive set of pairs.
Answer:



CONCLUSION::

Exercise Problem

1. Given that the set P = {1, 2, 3, 4} and the set Q = {1, 2, 3, 4, 5, 6, 7}. If from set P to set Q are connected by a relation "half of", state the relation in the form:
a. Arrow diagram b. Cartesian diagram
c. Set of consecutive pairs

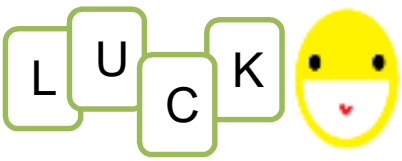
SETTLEMENT NO. 1:

2. A relation between two sets is expressed by: { 4,2), (6,3), (8,4), (10,5), (12,6)}.
a. Write the first set and the second set!
b. Express in words the rule of relations from the first set to the second set!

SETTLEMENT OF NO. 2:

3. Pay attention to the following problems!
In commemoration of the 68th Indonesian Independence Day in Sorong Regency, SMP Negeri 1 Sorong will send its students to participate in competitions between junior high school students in tennis, volleyball, football,competitions badminton, table tennis and chess. There are 6 students (Udin, Joko, Dayu, Siti, Beni, and Tono) who will take part in the competition. The school makes two alternative choices in determining the competition that the six students will participate in. The two choices were: 1) Udin participated in tennis and volleyball matches, Joko participated inmatches badminton, Dayu participated in chess matches, Siti participated in volleyball matches, Beni participated in table tennis matches, and Tono participated in table tennis matches. 2) Dayu and Siti participate in a volleyball match, Joko and Udin participate in a football match, Tono participate in a table tennis match, and Beni participate in a chess match. If the school choice is item (1), match students with the type of competition to be followed using the arrow diagram, ordered pairs, and the Cartesian diagram.

SETTLEMENT OF NO. 3:



Attachment 8

LKPD VALIDATION SHEET

Educational Unit: SMP Negeri 1 Padang
Subject: Mathematics
Class / Semester: VIII / 1

Put a check mark (√) in the answer column below this with the following criteria:
column answer 1: No Good
column answer 2: Less Good
column answer 3: the Good Enough
column answers 4: Good
column answers 5: Very Good

1. format

No	Aspects evaluated	Answer				
		1	2	3	4	5
1	Clarity of material distribution					
2	Clear numbering system					
3	Spatial arrangement / layout					
4	Kinds and sizes of letters accordingly					

2. Contents

No.	Evaluated Aspects	Answer				
		1	2	3	4	5
1	The truth of the material content					
2	Grouped into logical parts					
3	Feasibility as a learning tool					
4 In	accordance with the learning objectives					
5	Conformity with the learning flow					

3. Activity

No.	Evaluated Aspects	Answers				
		1	2	3	4	5
1	In accordance with the concepts learned by students					
2	In accordance with the age of students					
3	Fun for students					
4	Increase the ability to understand concepts systematically					
5	Memberi kesempatan peserta didik untuk bekerja sama					

4. Language

No.	Aspects that are evaluated	Answers				
		1	2	3	4	5
1	Grammatical truth					
2	Suitability of sentences with the level of student development					
3	Simplicity of sentence structure					
4	Clarity of instructions or directions					
5	Communicative nature of the language used					

5. General assessment

a. LKPD can be used without revision.
b. LKPD can be used with a few revisions.
c. LKPD can be used with many revisions.
d. LKPD cannot be used (still requires consultation).

6. Validator Recommendations for LKPD:

Padang, July 2017
Validator

(_____)

Attachment 9

Grid of Problem Solving Ability Trial
Educational Unit : SMP Negeri 1 Padang
Subject : Mathematics
Class / Semester : VIII / 1
Main Material : Relationships andFunction
Time Allocation: 80 minutes

Basic Competency
3. 3 Describe and state relations and functions using various representations (words, tables, graphs, diagrams, and equations).
4. 3 Solve problems related to relations and functions by using various representations.

Achievement Competency	Indicators Indicator Problem	No. Problem	Cognitive Level						Solving Indicators				
			C1	C2	C3	C4	C5	C6	1	2	3	4	5
Calculating the value of the function	Students are able to solve real problems related to calculating the value of the function	1				√			√	√	√	√	√
Solve real problems related to calculating the value of the function													
Determine the form of thefunction	Studentable to solve real problems	2a 2b				√			√	√	√	√	√

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Solving real problems related to determining the form of function	related to determining the form of function												
Calculating the value of changes in function if the variable value changes	Students are able to solve problems	3				√			√	√	√	√	√

Achievement Indicators Competency	**Theproblem indicator**	**no Problems**	**Cognitive Level**						**Solving Indicators**				
			C1	**C2**	**C3**	**C4**	**C5**	**C6**	**1**	**2**	**3**	**4**	**5**
Solving real problems related to calculating the value of a change in function if the variable value changes	realis related to calculating the value of the change in function if the variable value changes												
Expressing a function in the form of a function graph	Students are able to solve real problems related to expressing functions in the form of a function graph	4a 4b 4c				√ √ √ √ √							√
Solving real problems related to declare the function in the form of graphs of functions													

Description

Cognitive Level

C1 : Knowledge	C3 : Aplication	C5 : Evaluation
C2 : Comprehension	C4 : Analysis	C6 : Creation

Problem Solving Indicators

1. Organizing data and selecting relevant information in identifying problems
2. Presenting a mathematical problem formulation in various forms
3. Using the approach or the right strategy in problem solving
4. Solving problems
5. Interpreting the results of the answers obtained to solve the problem

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Attachment 10

TRIAL PROBLEM SOLVING ABILITY TEST

Education Unit : SMP Negeri 1 Padang
Subject : Mathematics
Class / Semester : VIII / 1
Main Material : Relationships and Functions
Time Allocation: 80 minutes

***Instructions for work*:**
1. Pray before starting to work on this problem.
2. Make it known and asked before making the answer to solving the problem.
3. Draw conclusions from the answers you get.

1. Rani and Suci cycled at the same speed. The distance they traveled after minutes can be expressed by the function) (meter). After a minute, Rani stopped cycling. The distance that Rani traveled after minutes was 49 meters. Suci stopped cycling 2 minutes later. If the distance that Suci has traveled is 83 meters. How long does it take for each of Rani and Suci to cycle?

2. A house has a water reservoir. Through a pipe the water is drained from the reservoir into the bath. The volume of water in the bath after 5 minutes is 25 liters and after 10 minutes is 50 liters. The volume of water in the bath after flowing water for t minutes is expressed as)) liters, where) is the volume of water in the bath before the water is drained and a is the water discharge flowed every minute.

a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained.

b. Determine the function formula, where)) and. 3. In the game play which is stated with a function) provided that if you continue the game once you get 0 points but if you don't continue the game you get -2. If Dani continues playing as much as Aisyah continues to play 3 levels

more than Dani, determine the change value to continue playing Dani to Aisyah.

4. A ball of the foot is kicked vertically upwards. The height that the ball reaches after t seconds is determined by the formula) with the domain, {| } where t is

a real number.

a. Graph the function h.

b. Determine the highest distance the ball reaches.

c. Time the ball of your foot to come to the same height when the ball of your foot was kicked

Attachment 11

ANSWER KEY PROBLEM SOLVING SKILLS TEST TEST

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
1	No answer	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters).	Is known: The distance they traveled after t minutes can be expressed by the function (meters). $s(t) = t^2 + 3t$ Asked: How long did Rani and Suci take each other?	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters). The distance that Rani traveled after t minutes was 49 meters. Asked: How long did Rani and Suci take each other?	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters). The distance that Rani traveled after t minutes was 49 meters. Suci stopped cycling 2 minutes later. If the distance that Suci has traveled is 83 meters. Asked: How long did Rani and Suci take each other?	1
	No answer	Answer: The function of distance traveled against time is $s(t) = t^2 + 3t$	Answer: The function of distance traveled against time is $s(t) = t^2 + 3t$	Answer: The function of distance traveled against time is $s(t) = t^2 + 3t$ $s(t) = 49$ ……(1)	Answer: The function of distance traveled against time is $s(t) = t^2 + 3t$ $s(t) =$	2

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
			$s(t) = 49$ …(1)	$s(t) = 83$ ……(2)	49 ……(1) $s(t+2) = 83$ ……(2)	
	No answer	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t =$ 49 ...(1)	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ ....(1) The distance traveled by Suci: $s(t+2) = (t+2)^2 + 3(t+2)$	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ .....(1) The distance traveled by Sucii: $s(t+2) = (t+2)^2 + 3(t+2)$ $83 = (t^2 + 4t + 4) + 3t + 6$ $83 = t^2 + 4t + 4 + 3t + 6$ $83 = t^2 + 7t + 10$	Substitute the known time and distance into the distance function: : $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ .....(1) The distance traveled by Sucii: $s(t+2) = (t+2)^2 + 3(t+2)$ $83 = (t^2 + 4t + 4) + 3t + 6$ $83 = t^2 + 4t + 4 + 3t + 6$ $83 = t^2 + 7t + 10$ $t^2 + 7t = 73$ .....(2)	3
	No answer	From equations (1) and (2) it is obtained: $t^2 + 3t = 49$	From equations (1) and (2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$	From equations (1) and (2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$ $-4t = -24$	From equations (1) and (2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$ $-4t = -24$	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
					$t = 6$	
	No answer	So, the time taken by Rani t minutes = and the time taken by Suci t + 2 minutes = .	So, the time taken by Rani t minutes = 6 minutes	So, the time taken by Rani t minutes = 6 minutesand the time taken by Suci t + 2 minutes = .	So, the time taken by Rani t minutes = 6 minutes and the time taken by Suci t + 2 minutes = 6 + 2 = 8	5
2a	No answer	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters.	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. Asked: a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained.	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. Asked: a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained. b. Determine the formula for the function, wherea $f(x) = V(t)$and $x = t$.	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. The volume of water in the bath after flowing water for t minutes is expressed as V (t) = V (0) + at liter, where is V (0) the volume of water in the bath before the water is drained and a is the water discharge flowed every minute. Asked: a. Determine the water flow rate every minute and the volume of water in the bath	1

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
					before the water is drained. b. Determine the formula for the function, where f (x) = V (t) and x = t.	
	No answer	Answer : $V(5)$	Answer : $V(5) = 25$ ….. (1)	Answer : $V(5) = 25$ ….. (1) $V(10)$	Answer :$V(5) = 25$ ….. (1) $V(10) = 50$ ….. (2)	2
	No answer	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that: $V(5) = V(0) + a.5$	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that: $V(5) = V(0) + a.5$ $25 = V(0) + 5a$. (1)	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that: $V(5) = V(0) + a.5$ $25 = V(0) + 5a$ .. (1) Substitute it $V(10) = 50$ into the equation $V(t) = V(0) + at$ So that: $V(10) = V(0) + a.10$	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that: $V(5) = V(0) + a.5$ $25 = V(0) + 5a$ ..... (1) Substitute it $V(10) = 50$ into the equation $V(t) = V(0) + at$ So that: $V(10) = V(0) + a.10$ $50 = V(0) + 10a$ ..... (2)	3
	No	From equations	From equations (1)	From equations (1) and	From equations (1) and (2)	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
	answer	(1) and (2) it is obtained: $25 = V(0) + 5a$ 50 $= V(0) + 10a$	and (2) it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ __ $-25 = -5a$ $a = 5$	(2) it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ $-25 = -5a$ $a = 5$ Substitute the value a = 5 into equation (1): $25 = V(0) + 5a$ $25 = V(0) + 5(5)$	it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ $-25 = -5a$ $a = 5$ Substitute the value a = 5 into equation (1): $25 = V(0) + 5a$ $25 = V(0) + 5(5)$ $V(0) = 25 - 25$ $V(0) = 0$	
	No answer	So, the water flow that is flowed every minute is the volume of water in the bath before the water is drained.	So, the water flow that is flowed every minute is 5 liters / minute	So, the water flow flowed every minute is 5 liters / minute, the volume of water in the bath before the water is drained is	So, the water flow that is flowed every minute is 5 liters / minute, the volume of water in the bath before the water is flowed is 0 liters.	5
2b	No answer	The if function formula $V(t) = f(x)$ and $x = t$: $V(t)$ $= V(0) + at$	The if function formula $V(t) = f(x)$ and $x = t$: $V(t) = V(0) + 5t$	The if function formula $V(t) = f(x)$ and$x = t$: $V(t) = V(0) + at$ $V(t) = 0 + 5t$	The if function formula $V(t) = f(x)$ and $x = t$: $V(t) = V(0) + at$ $V(t) = 0 + 5t$ $f(x) = 5x$	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
	No answer	So, the formula for the function is $V(t) = V(0) + at$	So, the formula for the function is $V(t) = V(0) + 5t$	So, the formula for the function is $V(t) = 5t$.	So, the formula for the function is $f(x) = 5x$.	5
3	No answer	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points.	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Asked: Is the value of change continuing to play Dani to Aisyah?	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Dani continued the game as much. Aisyah continued playing 3 levels more than Dani. Asked: The value of change continues to play Dani to Aisyah?	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Dani continued the game as much. Aisyah continued playing 3 levels more than Dani. Function formula: f (x) = ax + b Asked: Is the value of change continuing to play Dani to Aisyah?	1
	No answer	Answer: $f(1) = 0$	Answer: $f(1) = 0$ $f(0) = -2$	Answer: $f(1) = 0$ $f(0) = -2$ The general form of the function formula	Answer: $f(1) = 0$ $f(0) = -2$ The general form of the function formula	2

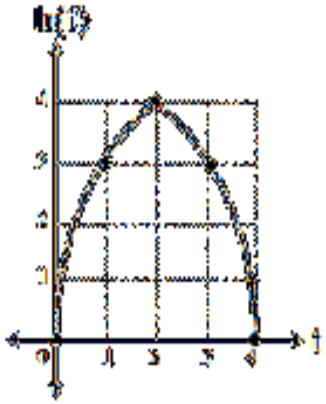
No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
				$f(x) = ax + b$	$f(x) = ax + b$ $f(x + 3) - f(x)$?	
	No answer	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1)	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2)	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2) Substitute equation (2) into equation (1): $a + b = 0$ $a + (-2) = 0$ $a = 2$	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2) Substitute equation (2) into equation (1): $a + b = 0$ $a + (-2) = 0$ $a = 2$ So the formula is the function $f(x) = 2x - 3$	3
	No answer	Change value from $f(x + 3) - f(x)$ $f(x) = 2x - 2$	Change value from $f(x + 3) - f(x)$ $f(x) = 2x - 2$ $f(x + 3) =$	Change value from $f(x + 3) - f(x)$ $f(x) = 2x - 2$ $f(x + 3) =$	Change value from $f(x + 3) - f(x)$ $f(x) = 2x - 2$ $f(x + 3) = 2(x + 3) - 2$	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
		$f(x+3)$ $=2(x+3)-2$	$2(x+3)-2$ $=2x+6-2$ $=2x+4$	$2(x+3)-2$ $=2x+6-2$ $=2x+4$ $f(x+3)-f(x)=$ $=(2x+4)-(2x-2)$ $=2x+4-2x+2$	$=2x+6-2$ $=2x+4$ $f(x+3)-f(x)$ $=(2x+4)-(2x-2)$ $=2x+4-2x+2$ $=6$	
	No answer	So, the value of change is 4.	So, the value of the change in continuing Dani's game to Aisyah is 4	So, the value of change is 6	So, the value of the change in continuing Dani's play to Aisyah is 6.	5
4a	No answer/ wrong answer	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$ Asked: a. Graph the function h	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$ Asked: a. Graph the function h b. Determine the highest distance	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$ The domain $D_h=\{t\|0\leq t\leq 4\}$, where t is a real number. Asked: a. Graph the function h b. Determine the highest distance the ball reaches	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$ The domain $D_h=\{t\|0\leq t\leq 4\}$, where t is a real number. Asked: a. Graph the function h b. Determine the highest distance the ball reaches c. Determine the time the football reaches the same height when the bullet is	1

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
					fired.	
	No answer	$D_h = \{t \mid 0 \leq t \leq 4\}$	$h(t) = 4t - t^2$	$h(t) = 4t - t^2$ $D_h = \{t \mid 0 \leq t \leq 4\}$	$h(t) = 4t - t^2$ $D_h = \{t \mid 0 \leq t \leq 4, t \in R\}$	2

	No answer	Domain substitution
		$D_h = \{t \mid 0 \leq t \leq 4\}$, where t is a real number to the function formula
		$h(t) = 4t - t^2$
		if $t = 0$, then
		$h(0) = 4(0) - (0)^2$
		$h(0) = 0$
		if $t = 1$, then
		$h(1) = 4(1) - (1)^2$
		$h(1) = 3$
			Domain substitution
			$D_h = \{t \mid 0 \leq t \leq 4\}$, where t is a real number to the function formula
			$h(t) = 4t - t^2$
			If $t = 0$, then
			$h(0) = 4(0) - (0)^2$
			$h(0) = 0$
			If $t = 1$, then
			$h(1) = 4(1) - (1)^2$
			$h(1) = 3$
			If $t = 2$, then
			$h(2) = 4(2) - (2)^2$
			$h(2) = 4$
				Domain substitution
				$D_h = \{t \mid 0 \leq t \leq 4\}$, where t is a real number to the function formula
				$h(t) = 4t - t^2$
				If $t = 0$, then
				$h(0) = 4(0) - (0)^2$
				$h(0) = 0$
				If $t = 1$, then
				$h(1) = 4(1) - (1)^2$
				$h(1) = 3$
				If $t = 2$, then
				$h(2) = 4(2) - (2)^2$
				$h(2) = 4$
				If $t = 3$, then
				$h(3) = 4(3) - (3)^2$
				$h(3) = 3$
					Domain substitution $D_h = \{t \mid 0 \leq t \leq 4\}$, where t is a real number to the function formula $h(t) = 4t - t^2$
					If $t = 0$, then
					$h(0) = 4(0) - (0)^2$
					$h(0) = 0$
					If $t = 1$, then
					$h(1) = 4(1) - (1)^2$
					$h(1) = 3$
					If $t = 2$, then
					$h(2) = 4(2) - (2)^2$
					$h(2) = 4$
					If $t = 3$, then
					$h(3) = 4(3) - (3)^2$
					$h(3) = 3$
					If $t = 4$, then
					$h(4) = 4(4) - (4)^2$
					$h(4) = 0$
						3

	No answer	Already made a Cartesian	Already made a Cartesian diagram	Already made a Cartesian diagram of the	a. Function graphic images	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
		diagram but the scale is not correct and does not place the dots (t, f (t)) correctly and does not connect the dots.	with the correct scale but did not place the dots (t, f (t)) correctly and did not connect the dots	correct scale and placed the points (t, f (t)) correctly but did not connect the dots		
4b	No answer	The highest distance that the ball of the foot reaches is 8 meters	The highest distance the ball reaches is (2,4)	The highest distance the ball reaches is 4	The highest distance the ball reaches is 4	5
4c	No answer	The time it takes for the ball of the foot to reach the same height when the ball of the foot is kicked is 3 seconds.	The time it takes for the ball of the foot to reach the same height when the ball of the foot is kicked is (0, 4).	The time it takes for the ball of the foot to reach the same height when the ball of the foot is kicked is 4.	The time it takes for the ball of the foot to reach the same height when the ball of the foot is kicked is 4 seconds.	5

Attachment 12

Validation Sheet of Mathematical Problem Solving Tests Trial Questions

Education Unit : SMP Negeri 1 Padang
Subjects : Mathematics
Class / Semester : VIII / 1
Main Material : Relationships and Functions
Time Allocation : 80 minutes

Basic competencies

3.3 Describe and state relations and functions by using various representations (words, tables, graphs, diagrams and equations).
4. 3 Solve problems related to relations and functions by using various representations

Indicators of Competence Achievement	Problem Indicators	No. Question	Cognitive Level						Problem Solving Indicator					Validity		
			C1	C2	C3	C4	C5	C6	1	2	3	4	5	Valid	Need Repair	Invalid
Calculates the value of the function Solves real problems related to calculating function values	Students are able to solve real problems related to calculating the value of the function	1				√			√	√	√	√	√			
Determines the	Students are	2a				√			√	√	√	√	√			

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Indicators of Competence Achievement	Problem Indicators	No. Question	Cognitive Level						Problem Solving Indicator					Validity		
			C1	C2	C3	C4	C5	C6	1	2	3	4	5	Valid	Need Repair	Invalid
form of the function Solves real problems related to determining the form of the function	able to solve real problems related to determine the form of the function	2b														
Calculates the value of the change in function if the variable value changes Solves a real problem related to calculating the value of a function change if the variable value changes	Students are able to solve real problems related to calculating the value of the change in function if the variable value changes	3				√			√	√	√	√	√			
Represent the function in the form of a	Students are able to solve real problems	4a 4b 4c				√			√	√	√	√	√			

Indicators of Competence Achievement	Problem Indicators	No. Question	Cognitive Level						Problem Solving Indicator					Validity		
			C1	C2	C3	C4	C5	C6	1	2	3	4	5	Valid	Need Repair	Invalid
function graph Solves real problems related to declaring a function in the form of a function graph	related to expressing functions in the form of function graphs															

Information

Cognitive Level

C1: Knowledge
C2: Comprehension
C3: Application
C4: Analysis
C5: Evaluation
C6: Creation

Problem Solving Indicator

1. Organizing data and selecting relevant information in identifying problems
2. Presenting a problem formulation mathematically in various forms
3. Using the right approach or strategy in problem solving
4. Solve problems
5. Interpret the answers obtained to solve the problem

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Suggestion:

……...……
……..…….....
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……...
……...

Padang, September 2017
Validator,

(.....)

Attachment 13

DISTRIBUTION OF TEST RESULTS TRY THE PROBLEM SOLVING ABILITY TEST

NO	STUDENT	SCORE EACH INDICATORS																						SCORE PER NUMBER							TOTAL SCORE
		1					2							3					4							1	2a	2b	3	4a	4b	4c	
							a					b							a				b	c								
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5	20	20	8	20	16	4	4	92
1	SUC1	4	1	0	0	0	4	0	0	1	3	1	1	4	2	0	1	0	4	2	4	3	4	1	5	8	2	7	13	4	1	40
2	SUC2	3	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	1	2	4	3	4	1	4	7	2	5	10	4	1	33
3	SUC3	4	1	0	0	0	3	0	0	1	3	1	1	4	2	0	1	0	4	2	3	2	2	1	5	7	2	7	11	2	1	35
4	SUC4	3	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	3	2	4	3	4	1	4	7	2	5	12	4	1	35
5	SUC5	3	1	0	0	0	2	0	0	1	3	1	0	2	2	0	1	0	1	2	4	3	2	0	4	6	1	5	10	2	0	28
6	SUC6	2	1	0	0	0	3	2	2	2	4	2	1	2	2	0	1	0	3	2	3	2	4	1	3	13	3	5	10	4	1	39
7	SUC7	2	1	0	0	0	3	2	0	1	1	0	0	1	2	0	1	0	0	2	4	2	3	0	3	7	0	4	8	3	0	25
8	SUC8	4	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	1	2	4	3	4	1	5	7	2	5	10	4	1	34
9	SUC9	2	1	0	0	0	2	0	0	1	3	1	0	4	2	0	1	0	1	4	4	2	0	0	3	6	1	7	11	0	0	28
10	SUC10	2	1	0	0	0	3	0	0	1	3	1	1	3	2	0	1	0	1	2	4	3	4	4	3	7	2	6	10	4	4	36

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NO	STUDENT	SCORE EACH INDICATORS																						SCORE PER NUMBER							TOTAL SCORE
		1					2					a		b		3					4				a		b	c	1	2a	2b	3	4a	4b	4c	
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5	20	20	8	20	16	4	4	92
11	SUC11	2	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	3	2	4	3	4	1	3	7	2	5	12	4	1	34
12	SUC12	2	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	1	2	4	3	4	1	3	7	2	5	10	4	1	32
13	SUC13	1	1	0	0	0	2	2	0	1	3	1	0	1	2	0	1	0	0	2	4	2	3	0	2	8	1	4	8	3	0	26
14	SUC14	4	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	1	2	4	3	4	1	5	7	2	5	10	4	1	34
15	SUC15	4	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	1	4	2	3	4	4	5	7	2	5	10	4	4	37
16	SUC16	2	1	0	0	0	4	0	0	1	3	1	1	4	2	0	1	0	3	2	4	3	4	1	3	8	2	7	12	4	1	37
17	SUC17	2	1	0	0	0	2	4	2	3	3	2	1	2	2	0	1	0	0	2	4	3	4	4	3	14	3	5	9	4	4	42
18	SUC18	1	1	0	0	0	0	2	0	0	1	1	1	1	2	0	1	0	0	2	4	1	1	0	2	3	2	4	7	1	0	19
19	SUC19	2	1	0	0	0	2	2	0	0	1	1	0	0	2	0	1	0	0	2	4	3	3	0	3	5	1	3	9	3	0	24
20	SUC20	4	0	0	0	0	4	0	0	1	3	1	1	4	2	0	1	0	4	2	3	2	2	1	4	8	2	7	11	2	1	35
21	SUC21	3	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	3	2	4	3	4	1	4	7	2	5	12	4	1	35
22	SUC22	2	1	0	0	0	3	0	0	1	3	1	1	1	2	0	1	0	2	4	4	3	4	1	3	7	2	4	13	4	1	34
23	SUC23	2	1	0	0	0	3	0	0	1	3	1	1	2	2	0	1	0	3	2	4	2	2	1	3	7	2	5	11	2	1	31

NO	STUDENT	SCORE EACH INDICATORS																						SCORE PER NUMBER							TOTAL SCORE
		1					2					a		b		3					4				a		b	c	1	2a	2b	3	4a	4b	4c	
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5	20	20	8	20	16	4	4	92
24	SUC24	3	1	0	0	0	3	0	0	1	1	1	1	1	2	0	1	0	3	2	4	3	4	1	4	5	2	4	12	4	1	32
25	SUC25	3	1	0	0	0	3	4	2	3	4	2	2	3	2	0	1	0	1	2	4	2	2	1	4	16	4	6	9	2	1	42
26	SUC26	4	1	0	0	0	3	2	0	2	4	1	1	4	2	0	1	0	0	2	4	3	4	1	5	11	2	7	9	4	1	39
27	SUC27	2	1	0	0	0	2	0	0	1	3	2	1	4	2	0	0	0	4	2	3	2	4	1	3	6	3	6	11	4	1	34
28	SUC28	2	1	0	0	0	3	0	0	1	3	1	0	1	2	0	1	0	1	2	4	3	4	2	3	7	1	4	10	4	2	31
29	SUC29	2	1	0	0	0	2	0	0	1	3	1	0	2	2	0	1	0	1	2	4	3	4	1	3	6	1	5	10	4	1	30
30	SUC30	2	1	0	0	0	0	0	0	1	3	1	1	0	2	0	0	0	1	2	0	3	1	1	3	4	2	2	6	1	1	19

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Attachment 14

GROUP HIGH

STUDENT	TOTAL SCORE
SUC17	42
SUC25	42
SUC1	40
SUC6	39
SUC26	39
SUC15	37
SUC16	37
SUC10	36
SUC3	35

LOW GROUP

STUDENT	TOTAL SCORE
SUC28	31
SUC29	30
SUC5	28
SUC9	28
SUC13	26
SUC7	25
SUC19	24
SUC18	19
SUC30	18

Attachment 15

CALCULATION OF DIFFERENT INDEX RESULTS TRIAL TRIAL FINAL

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^2 + \sum X_r^2}{n\ (n-1)}}}$$

Information :

I_p: distinguishing power index question

M_t:the average group score is high

M_r: the group's average score was low

$\sum X_t^2$:the sum of the squares of the high group deviation

$\sum X_r^2$:the sum of the squares of the low group deviation

n: 27% x N

N:many students

N = 30 student people

$$n = 27\% \times N = 27\% \times 30 = 8{,}1 \approx 9$$

So that, $n_t = n_r = 9$

$$df = (n_t - 1) + (n_r - 1) = (9 - 1) + (9 - 1) = 16, I_p Tabel = 2{,}12$$

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Problem Number 1

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	3	-1,00	1,00	SUC28	3	0,11	0,01
SUC25	4	0,00	0,00	SUC29	3	0,11	0,01
SUC1	5	1,00	1,00	SUC5	4	1,11	1,23
SUC6	3	-1,00	1,00	SUC9	3	0,11	0,01
SUC26	5	1,00	1,00	SUC13	2	-0,89	0,79
SUC15	5	1,00	1,00	SUC7	3	0,11	0,01
SUC16	3	-1,00	1,00	SUC19	3	0,11	0,01
SUC10	3	-1,00	1,00	SUC18	2	-0,89	0,79
SUC3	5	1,00	1,00	SUC30	3	0,11	0,01
Total	36		8,00	Total	26		2,89
M_t	4,00			M_r	2,89		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{4{,}00 - 2{,}89}{\sqrt{\frac{8{,}00 + 2{,}89}{72}}} = 2{,}854140099$$

Because I_p count greater than I_p table then the question is significant,

Problem Number 2a

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	14	3,89	15,12	SUC29	7	1,22	1,49
SUC25	16	5,89	34,68	SUC5	6	0,22	0,05
SUC1	8	-2,11	4,46	SUC9	6	0,22	0,05
SUC6	13	2,89	8,35	SUC23	6	0,22	0,05
SUC26	11	0,89	0,79	SUC25	8	2,22	4,94
SUC15	7	-3,11	9,68	SUC28	7	1,22	1,49
SUC16	8	-2,11	4,46	SUC13	5	-0,78	0,60
SUC10	7	-3,11	9,68	SUC19	3	-2,78	7,72
SUC3	7	-3,11	9,68	SUC30	4	-1,78	3,16
Total	91		96,89	Total	52		19,56
M_t	10,11			M_r	5,78		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{10{,}11 - 5{,}78}{\sqrt{\frac{96{,}89 + 19{,}56}{72}}} = 53{,}40474349$$

Because I_p count greater than I_p table then the question is significant,

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Problem Number 2b

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	3	0,56	0,31	SUC28	1	-0,11	0,01
SUC25	4	1,56	2,42	SUC29	1	-0,11	0,01
SUC1	2	-0,44	0,20	SUC5	1	-0,11	0,01
SUC6	3	0,56	0,31	SUC9	1	-0,11	0,01
SUC26	2	-0,44	0,20	SUC13	1	-0,11	0,01
SUC15	2	-0,44	0,20	SUC7	0	-1,11	1,23
SUC16	2	-0,44	0,20	SUC19	1	-0,11	0,01
SUC10	2	-0,44	0,20	SUC18	2	0,89	0,79
SUC3	2	-0,44	0,20	SUC30	2	0,89	0,79
Total	22		4,22	Total	10		2,89
M_t	2,44			M_r	1,11		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{2,44 - 1,11}{\sqrt{\frac{4,22 + 2,89}{72}}} = 4,232364752$$

Because I_p count greater than I_p table then the question is significant,

Problem Number 3

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	5	-1,11	1,23	SUC28	4	-0,22	0,05
SUC25	6	-0,11	0,01	SUC29	5	0,78	0,60
SUC1	7	0,89	0,79	SUC5	5	0,78	0,60
SUC6	5	-1,11	1,23	SUC9	7	2,78	7,72
SUC26	7	0,89	0,79	SUC13	4	-0,22	0,05
SUC15	5	-1,11	1,23	SUC7	4	-0,22	0,05
SUC16	7	0,89	0,79	SUC19	3	-1,22	1,49
SUC10	6	-0,11	0,01	SUC18	4	-0,22	0,05
SUC3	7	0,89	0,79	SUC30	2	-2,22	4,94
Total	55		6,89	Total	38		15,56
M_t	6,11			M_r	4,22		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{6{,}11 - 4{,}22}{\sqrt{\frac{6{,}89 + 15{,}56}{72}}} = 3{,}384697649$$

Because I_p count greater than I_p table then the question is significant,

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Problem Number 4a

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	9	-1,33	1,78	SUC28	10	1,22	1,49
SUC25	9	-1,33	1,78	SUC29	10	1,22	1,49
SUC1	13	2,67	7,11	SUC5	10	1,22	1,49
SUC6	10	-0,33	0,11	SUC9	11	2,22	4,94
SUC26	9	-1,33	1,78	SUC13	8	-0,78	0,60
SUC15	10	-0,33	0,11	SUC7	8	-0,78	0,60
SUC16	12	1,67	2,78	SUC19	9	0,22	0,05
SUC10	10	-0,33	0,11	SUC18	7	-1,78	3,16
SUC3	11	0,67	0,44	SUC30	6	-2,78	7,72
Total	93		16,00	Total	79		21,56
M_t	10,33			M_r	8,78		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{10,33 - 8,78}{\sqrt{\frac{16,00 + 21,56}{72}}} = 2,146026866$$

BecauseI_p count greater than I_p table then the question is significant,

Problem Number 4b

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	4	0,44	0,20	SUC28	4	1,67	2,78
SUC25	2	-1,56	2,42	SUC29	4	1,67	2,78
SUC1	4	0,44	0,20	SUC5	2	-0,33	0,11
SUC6	4	0,44	0,20	SUC9	0	-2,33	5,44
SUC26	4	0,44	0,20	SUC13	3	0,67	0,44
SUC15	4	0,44	0,20	SUC7	3	0,67	0,44
SUC16	4	0,44	0,20	SUC19	3	0,67	0,44
SUC10	4	0,44	0,20	SUC18	1	-1,33	1,78
SUC3	2	-1,56	2,42	SUC30	1	-1,33	1,78
Total	32		6,22	Total	21		16,00
M_t	3,56			M_r	2,33		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{3{,}56 - 2{,}33}{\sqrt{\frac{6{,}22 + 16{,}00}{72}}} = 2{,}214110708$$

Because I_p count greater than $I_p$table then the question is significant,

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Problem Number 4c

High Group	Score (X)	X-M_t (X_t)	X_t^2	Low Group	Score (X)	X-Mt (X_r)	X_r^2
SUC17	4	2,00	4,00	SUC28	2	1,67	2,78
SUC25	1	-1,00	1,00	SUC29	1	0,67	0,44
SUC1	1	-1,00	1,00	SUC5	0	-0,33	0,11
SUC6	1	-1,00	1,00	SUC9	0	-0,33	0,11
SUC26	1	-1,00	1,00	SUC13	0	-0,33	0,11
SUC15	4	2,00	4,00	SUC7	0	-0,33	0,11
SUC16	1	-1,00	1,00	SUC19	0	-0,33	0,11
SUC10	4	2,00	4,00	SUC18	0	-0,33	0,11
SUC3	1	-1,00	1,00	SUC30	0	-0,33	0,11
Total	18		18,00	Total	3		4,00
M_t	2,00			M_r	0,33		

$$I_p = \frac{M_t - M_r}{\sqrt{\frac{\sum X_t^{\,2} + \sum X_r^{\,2}}{n(n-1)}}} = \frac{2{,}00 - 0{,}33}{\sqrt{\frac{18{,}00 + 4{,}00}{72}}} = 3{,}021143673$$

Because I_p count greater than I_p table then the question is significant.

Attachment 16

CALCULATION OF ADVANTAGES OF TRIAL PROBLEMS

$$I_k = \frac{D_t + D_r}{2mn} \times 100\%$$

Information :

I_k = difficulty index question n = 27% x N

D_t =the total score of the high group N = the number of test takers

D_r =the total score of the low group

m =score each question if correct

n = 27 % x N = 27 % x 30 = 8,1 ≈ 9 person

Problem Number 1

No	High Group Score	Low Group Score	Difficulty Index
1	3	3	$I_k = \frac{D_t+D_r}{2.m.n} \times 100\%$ $= \frac{36 + 26}{2 \times 20 \times 9} \times 100\%$
2	4	3	
3	5	4	
4	3	3	

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5	5	2	$= 17{,}22222222\%$ Because $I_k = 17{,}22222222\%$ then the difficulty level of question number 1 is difficult.
6	5	3	
7	3	3	
8	3	2	
9	5	3	
	36	26	

Problem Number 2a

No	High Group Score	Low Group Score	Difficulty Index
1	14	7	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$ $= \frac{91 + 52}{2 \times 20 \times 9} \times 100\%$ $= 39{,}72222222\%$ Because $I_k = 39{,}72222222\%$ then the difficulty level of question number 2a is moderate.
2	16	6	
3	8	6	
4	13	6	
5	11	8	
6	7	7	
7	8	5	
8	7	3	
9	7	4	
	91	52	

Problem Number 2b

No	High Group Score	Low Group Score	Difficulty Index
1	3	1	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$ $= \frac{22 + 10}{2 \times 8 \times 9} \times 100\%$ $= 22{,}22222222\%$ Because I_k =22,22222222%then the difficulty level of question number 2b is difficult.
2	4	1	
3	2	1	
4	3	1	
5	2	1	
6	2	0	
7	2	1	
8	2	2	
9	2	2	
	22	10	

Problem Number 3

No	High Group Score	Low Group Score	Difficulty Index
1	5	4	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$ $= \frac{55 + 38}{2 \times 20 \times 9} \times 100\%$ $= 25{,}83333333\%$ Because I_k = 25,83333333%then the difficulty level of question
2	6	5	
3	7	5	
4	5	7	
5	7	4	
6	5	4	
7	7	3	

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8	6	4	number 3 is difficult.
9	7	2	
	55	38	

Problem Number 4a

No	High Group Score	Low Group Score	Difficulty Index
1	9	10	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$ $= \frac{93 + 79}{2 \times 16 \times 9} \times 100\%$ $= 59{,}72222222\%$ Because $I_k =$ $59{,}72222222\%$ then the difficulty level of question number 4a is moderate.
2	9	10	
3	13	10	
4	10	11	
5	9	8	
6	10	8	
7	12	9	
8	10	7	
9	11	6	
	93	79	

Problem Number 4b

No	High Group Score	Low Group Score	Difficulty Index
1	4	4	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$
2	2	4	

3	4	2	$= \frac{32 + 21}{2 \times 4 \times 9} \times 100\%$ $= 73{,}61111111\%$ Because I_k = 73,61111111%then the difficulty level of question number 4b is easy.
4	4	0	
5	4	3	
6	4	3	
7	4	3	
8	4	1	
9	2	1	
	32	21	

Problem Number 4c

No	High Group Score	Low Group Score	Difficulty Index
1	4	2	$I_k = \frac{D_t + D_r}{2.m.n} \times 100\%$ $= \frac{18 + 3}{2 \times 4 \times 9} \times 100\%$ $= 29{,}16666667\%$ Because I_k=29,16666667%then the difficulty level of question number 4c is moderate.
2	1	1	
3	1	0	
4	1	0	
5	1	0	
6	4	0	
7	1	0	
8	4	0	
9	1	0	
	18	3	

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Attachment 17

CLASSIFICATION OF TEST PROBLEMS TRY THE FINAL TEST

Question Number	I_p	Information	I_k	Information	Classification
1	2,854	significant	17,22%	hard	used
2a	53,40	significant	39,72%	moderate	used
2b	4,232	significant	22,22%	hard	used
3	3,384	significant	25,83%	hard	used
4a	2,146	significant	59,72%	moderate	used
4b	2,214	significant	73,61%	easy	used
4c	3,021	significant	29,17%	moderate	used

Attachment 18

Calculation of the Reliability Testing Problem Solving Ability Test Questions

No	Code Students	Score Score (X)							Total Score (Xt)	Xt^2
		1	**2a**	**2b**	**3**	**4a**	**4b**	**4c**		
		20	**20**	**8**	**20**	**16**	**4**	**4**	**96**	
1	SUC1	5	8	2	7	13	4	1	40	1600
2	SUC2	4	7	2	5	10	4	1	33	1089
3	SUC3	5	7	2	7	11	2	1	35	1225
4	SUC4	4	7	2	5	12	4	1	35	1225
5	SUC5	4	6	1	5	10	2	0	28	784
6	SUC6	3	13	3	5	10	4	1	39	1521
7	SUC7	3	7	0	4	8	3	0	25	625
8	SUC8	5	7	2	5	10	4	1	34	1156
9	SUC9	3	6	1	7	11	0	0	28	784
10	SUC10	3	7	2	6	10	4	4	36	1296
11	SUC11	3	7	2	5	12	4	1	34	1156
12	SUC12	3	7	2	5	10	4	1	32	1024
13	SUC13	2	8	1	4	8	3	0	26	676
14	SUC14	5	7	2	5	10	4	1	34	1156
15	SUC15	5	7	2	5	10	4	4	37	1369
16	SUC16	3	8	2	7	12	4	1	37	1369
17	SUC17	3	14	3	5	9	4	4	42	1764
18	SUC18	2	3	2	4	7	1	0	19	361

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19	SUC19	3	5	1	3	9	3	0	24	576
20	SUC20	4	8	2	7	11	2	1	35	1225
21	SUC21	4	7	2	5	12	4	1	35	1225
22	SUC22	3	7	2	4	13	4	1	34	1156
23	SUC23	3	7	2	5	11	2	1	31	961
24	SUC24	4	5	2	4	12	4	1	32	1024
25	SUC25	4	16	4	6	9	2	1	42	1764
26	SUC26	5	11	2	7	9	4	1	39	1521
27	SUC27	3	6	3	6	11	4	1	34	1156
28	SUC28	3	7	1	4	10	4	2	31	961
29	SUC29	3	6	1	5	10	4	1	30	900
30	SUC30	3	4	2	2	6	1	0	18	324
Total		**107**	**225**	**57**	**154**	**306**	**97**	**33**	**979**	**32973**

No	**Code Students**	**X^2**							**Total (Xt^2)**
		1	**2a**	**2b**	**3**	**4a**	**4b**	**4c**	
1	SUC1	25	64	4	49	169	16	1	328
2	SUC2	16	49	4	25	100	16	1	211
3	SUC3	25	49	4	49	121	4	1	253
4	SUC4	16	49	4	25	144	16	1	255
5	SUC5	16	36	1	25	100	4	0	182
6	SUC6	9	169	9	25	100	16	1	329
7	SUC7	9	49	0	16	64	9	0	147
8	SUC8	25	49	4	25	100	16	1	220
9	SUC9	9	36	1	49	121	0	0	216

10	SUC10	9	49	4	36	100	16	16	230
11	SUC11	9	49	4	25	144	16	1	248
12	SUC12	9	49	4	25	100	16	1	204
13	SUC13	4	64	1	16	64	9	0	158
14	SUC14	25	49	4	25	100	16	1	220
15	SUC15	25	49	4	25	100	16	16	235
16	SUC16	9	64	4	49	144	16	1	287
17	SUC17	9	196	9	25	81	16	16	352
18	SUC18	4	9	4	16	49	1	0	83
19	SUC19	9	25	1	9	81	9	0	134
20	SUC20	16	64	4	49	121	4	1	259
21	SUC21	16	49	4	25	144	16	1	255
22	SUC22	9	49	4	16	169	16	1	264
23	SUC23	9	49	4	25	121	4	1	213
24	SUC24	16	25	4	16	144	16	1	222
25	SUC25	16	256	16	36	81	4	1	410
26	SUC26	25	121	4	49	81	16	1	297
27	SUC27	9	36	9	36	121	16	1	228
28	SUC28	9	49	1	16	100	16	4	195
29	SUC29	9	36	1	25	100	16	1	188
30	SUC30	9	16	4	4	36	1	0	70
Total		**405**	**1903**	**125**	**836**	**3200**	**353**	**71**	**6893**

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The variant score for question number 1

$$\sigma_1{}^2 = \frac{\sum x_1{}^2 - \frac{(\sum x_1)^2}{N}}{N}$$

$$= \frac{405 - \frac{(107)^2}{30}}{30}$$

$$= 0{,}7788888889$$

The variant score for question number 2a

$$\sigma_{2a}{}^2 = \frac{\sum x_{2a}{}^2 - \frac{(\sum x_{2a})^2}{N}}{N}$$

$$= \frac{1903 - \frac{(225)^2}{30}}{30}$$

$$= 7{,}1833333333$$

The variant score for question number 2b

$$\sigma_{2b}{}^2 = \frac{\sum x_{2b}{}^2 - \frac{(\sum x_{2b})^2}{N}}{N}$$

$$= \frac{125 - \frac{(57)^2}{30}}{30}$$

$$= 0{,}5566666667$$

The variant score for question number 3

$$\sigma_3{}^2 = \frac{\sum x_3{}^2 - \frac{(\sum x_3)^2}{N}}{N}$$

$$= \frac{836 - \frac{(154)^2}{30}}{30}$$

$$= 1{,}5155555556$$

The variant score for question number 4a

$$\sigma_{4a}{}^2 = \frac{\sum x_{4a}{}^2 - \frac{(\sum x_{4a})^2}{N}}{N}$$

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$$= \frac{3200 - \frac{(306)^2}{30}}{30}$$

$$= 2{,}6266666667$$

The variant score for question number 4b

$$\sigma_{4b}{}^2 = \frac{\sum x_{4b}{}^2 - \frac{(\sum x_{4b})^2}{N}}{N}$$

$$= \frac{353 - \frac{(97)^2}{30}}{30}$$

$$= 1{,}3122222222$$

The variant score for question number 4c

$$\sigma_{4c}{}^2 = \frac{\sum x_{4c}{}^2 - \frac{(\sum x_{4c})^2}{N}}{N}$$

$$= \frac{71 - \frac{(33)^2}{30}}{30}$$

$$= 1{,}1566666667$$

$$\sum {\sigma_i}^2 = {\sigma_1}^2 + {\sigma_{2a}}^2 + {\sigma_{2b}}^2 + {\sigma_3}^2 + {\sigma_{4a}}^2 + {\sigma_{4b}}^2 + {\sigma_{4c}}^2$$
$$= 0{,}7788888889 + 7{,}1833333333 + 0{,}5566666667 + 1{,}5155555556 + 2{,}6266666667 + 1{,}3122222222 + 1{,}1566666667$$
$$= 15{,}13$$

Total variant :

$${\sigma_t}^2 = \frac{\sum {X_t}^2 - \frac{(\sum X_t)^2}{N}}{N} = \frac{32973 - \frac{(6893)^2}{30}}{30} = 34{,}1655555556$$

Calculate Reliability

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum {\sigma_i}^2}{{\sigma_t}^2}\right) = \left(\frac{7}{6}\right)\left(1 - \frac{15{,}13}{34{,}1655555556}\right) = 0{,}6500157187$$

Because it is obtained
r_{11} = 0,6500157187 then the test test questions have high reliability.

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Attachment 19

Problem-Solving Test Question Grid

Education Unit: SMP Negeri 1 Padang
Subjects: Mathematics
Class / Semester: VIII / 1
Main Material: Relationships and Functions
Time Allocation: 80 minutes

Basic competencies
3.3 Describe and state relations and functions by using various representations (words, tables, graphs, diagrams and equations).
4. 3 Solve problems related to relations and functions by using various representations.

Indicators of Competence Achievement	Problem Indicators	No. Question	Cognitive Level						Problem Solving Indicator				
			C1	C2	C3	C4	C5	C6	1	2	3	4	5
Calculates the value of the function Solves real problems related to calculating function values	Students are able to solve real problems related to calculating the value of the function	1				√			√	√	√	√	√
Determines the form of the function Solves real problems related to determining the form of the function	Students are able to solve real problems related to determine the form of the function	2a 2b				√			√	√	√	√	√

Indicators of Competence Achievement	Problem Indicators	No. Question	Cognitive Level						Problem Solving Indicator				
			C1	C2	C3	C4	C5	C6	1	2	3	4	5
Calculates the value of the change in function if the variable value changes Solves a real problem related to calculating the value of a function change if the variable value changes	Students are able to solve real problems related to calculating the value of the change in function if the variable value changes	3				√			√	√	√	√	√
Represent the function in the form of a function graph Solves real problems related to declaring a function in the form of a function graph	Students are able to solve real problems related to expressing functions in the form of function graphs	4a 4b 4c				√			√	√	√	√	√

Information

Cognitive Level

C1: knowledge C3: application C5: Evaluation

C2: understanding C4: Analysis C6: Creation

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Problem Solving Indicator

1. Organizing data and selecting relevant information in identifying problems

2. Presenting a problem formulation mathematically in various forms

3. Using the right approach or strategy in problem solving

4. Solve problems

5. Interpret the answers obtained to solve the problem

Attachment 20

PROBLEM SOLVING ABILITY TEST PROBLEMS

Education Unit: SMP Negeri 1 Padang
Subjects: Mathematics
Class / Semester: VIII / 1
Main Material: Relationships and Functions
Time Allocation: 80 minutes

Working instructions:

1. **Pray before starting to work on this problem.**
2. **Make it known and asked before making the answer to solving the problem.**
3. **Make conclusions from the answers you get.**

1. Rani and Suci ride at the same speed. The distance they traveled after minutes can be expressed by the function $s(t) = t^2 + 3t$ (meter).After a minute, Rani stopped cycling. The distance that Rani traveled after minutes was 49 meters. Suci stopped cycling 2 minutes later. If the distance that Suci has traveled is 83 meters. How long does each RanidanSuci cycle?

2. A house has a water reservoir. Through a pipe the water flows from the reservoir into the bath. The volume of water in the bath after 5 minutes is 25 liters and after 10 minutes is 50 liters. The volume of water in the bath after flowing water for t minutes is expressed as V (t) = V (0) + at liter, where V (0) is the volume of water in the bath before the water is drained and a is the water discharge that is flowed every minute. a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained. b. Determine the formula for the function, where f (x) = V (t) and x = t.

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3. In the game play which is stated with the function f (x) = ax + b with the condition that if you continue the game once you get 0 points but if you don't continue the game you get -2. If Dani continues playing x times while Aisyah continues playing 3 levels more than Dani, determine the change value to continue playing Dani to Aisyah.

4. A ball of the foot is kicked vertically upwards. The height that the ball reaches after t seconds is determined by the formula $h(t) = 4t - t^2$with the domain, $D_h = \{t|0 \leq t \leq 4\}$ where t is a real number.

   a. Draw a graph of the function h.

   b. b.Determine the highest distance that the ball of the foot reaches.

   c. Time the football to arrive at the same height when the football was kicked.

Attachment 21

ANSWER KEY
PROBLEM SOLVING ABILITY TEST PROBLEMS

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
1	No answer	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters).	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters). Asked: How long did Rani and Suci take each other?	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meter). The distance that Rani traveled after t minutes was 49 meters. Asked: How long did Rani and Suci take each other?	Is known: The distance they traveled after t minutes can be expressed by the function $s(t) = t^2 + 3t$ (meters). The distance that Rani traveled after t minutes was 49 meters. Suci stopped cycling 2 minutes later. If the distance that Suci has traveled is 83 meters. Asked: How long did Rani and Suci take each other?	1
	No answer	Answer: The function of distance traveled	Answer: The function of distance traveled against time is	Answer: The function of distance traveled against time is	Answer: The function of distance traveled against time is	2

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No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
		against time is $s(t) = t^2 + 3t$	$s(t) = t^2 + 3t$ $s(t) = 49$ …(1)	$s(t) = t^2 + 3t$ $s(t) = 49$ ……(1) $s(t) = 83$ ……(2)	$s(t) = t^2 + 3t$ $s(t) =$ 49 ……(1) $s(t+2) = 83$ ……(2)	
	No answer	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t =$ 49 ...(1)	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ ....(1) The distance traveled by Suci: $s(t+2) = (t+2)^2 + 3(t+2)$	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ .....(1) The distance traveled by Suci: $s(t+2) = (t+2)^2 + 3(t+2)$ $83 = (t^2 + 4t + 4) + 3t + 6$ $83 = t^2 + 4t + 4 + 3t + 6$ $83 = t^2 + 7t + 10$	Substitute the known time and distance into the distance function: $s(t) = t^2 + 3t$ The distance traveled by Rani: $s(t) = t^2 + 3t$ $49 = t^2 + 3t$ $t^2 + 3t = 49$ .....(1) The distance traveled by Suci: $s(t+2) = (t+2)^2 + 3(t+2)$ $83 = (t^2 + 4t + 4) + 3t + 6$ $83 = t^2 + 4t + 4 + 3t + 6$ $83 = t^2 + 7t + 10$ $t^2 + 7t = 73$ .....(2)	3
	No	From equations	From equations (1)	From equations (1)	From equations (1) and	4

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
	answer	(1) and (2) it is obtained: $t^2 + 3t = 49$	and (2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$	and (2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$ $-4t = -24$	(2) it is obtained: $t^2 + 3t = 49$ $t^2 + 7t = 73$ $-4t = -24$ $t = 6$	
	No answer	So, the time taken by Rani t minutes = and the time taken by Suci t + 2 minutes =	So, the time taken by Rani t minutes = 6 minutes	So, the time taken by Rani t minutes = 6 minutes and the time taken by Suci t + 2 minutes =	So, the time taken by Rani t minutes = 6 minutes and the time taken by Suci t + 2 minutes = 6 + 2 = minutes	5
2a	No answer	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters.	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. Asked: a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained.	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. Asked: a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained. b. Determine the formula for the function, where f	Is known: The volume of water in the bath after 5 minutes is 25 liters. The volume of water in the bath after 10 minutes is 50 liters. The volume of water in the bath after flowing water for t minutes is expressed as V (t) = V (0) + at liter, where V (0) is the volume of water in the bath before the water is drained and a is the water discharge that is flowed	1

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No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
				(x) = V (t) and x = t.	every minute. Asked: a. Determine the water flow rate every minute and the volume of water in the bath before the water is drained. b. Determine the formula for the function, where f (x) = V (t) and x = t.	
	No answer	Answer : $V(5)$	Answer : $V(5) = 25$ ….. (1)	Answer : $V(5) = 25$ ….. (1) $V(10)$	Answer : $V(5) = 25$ ….. (1) $V(10) = 50$ ….. (2)	2
	No answer	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that it is obtained : $V(5)$ $= V(0) + a.5$	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that it is obtained : $V(5) = V(0) + a.5$ $25 = V(0) + 5a$. (1)	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that it is obtained : $V(5) = V(0) + a.5$ $25 = V(0) + 5a$ .. (1) Substitute it $V(10) = 50$into the equation $V(t) = V(0) + at$ So that it is obtained :	Substitute it $V(5) = 25$ into the equation $V(t) = V(0) + at$ So that it is obtained : $V(5) = V(0) + a.5$ $25 = V(0) + 5a$ ..... (1) Substitute it $V(10) = 50$ into the equation $V(t) = V(0) + at$ So that it is obtained : $V(10) = V(0) + a.10$	3

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
				$V(10) = V(0) + a.10$	$50 = V(0) + 10a$ ..... (2)	
	No answer	From equations (1) and (2) it is obtained: $25 = V(0) + 5a$ 50 $= V(0) + 10a$	From equations (1) and (2) it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ — $-25 = -5a$ $a = 5$	From equations (1) and (2) it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ $-25 = -5a$ $a = 5$ Substitute the value a = 5 into equation (1): $25 = V(0) + 5a$ $25 = V(0) + 5(5)$	From equations (1) and (2) it is obtained: $25 = V(0) + 5a$ $50 = V(0) + 10a$ $-25 = -5a$ $a = 5$ Substitute the value a = 5 into equation (1): $25 = V(0) + 5a$ $25 = V(0) + 5(5)$ $V(0) = 25 - 25$ $V(0) = 0$	4
	No answer	So, the water flow flowed every minute is, the volume of water in the bath before the water is drained is.	So, the water flow that is flowed every minute is 5 liters / minute	So, the water flow flowed every minute is 5 liters / minute, the volume of water in the bath before the water is drained is	So, the water flow that is flowed every minute is 5 liters / minute, the volume of water in the bath before the water is flowed is 0 liters.	5
2b	No answer	The if function formula	The if function formula	The if function formula $V(t) = f(x)$ dan $x = t$:	The if function formula $V(t) = f(x)$ dan $x = t$:	4

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No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
		$V(t) = f(x)$ dan $x = t$: $V(t) = V(0) + at$	$V(t) = f(x)$ dan $x = t$: $V(t) = V(0) + 5t$	$V(t) = V(0) + at$ $V(t) = 0 + 5t$	$V(t) = V(0) + at$ $V(t) = 0 + 5t$ $f(x) = 5x$	
	No answer	So, the formula for the function is $V(t) = V(0) + at$	So, the formula for the function is $V(t) = V(0) + 5t$	So, the formula for the function is $V(t) = 5t$.	So, the formula for the function is $f(x) = 5x$.	5
3	No answer	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points.	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Asked: Is the value of change continuing to play Dani to Aisyah?	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Dani continued the game as much x. Aisyah continued playing 3 levels more than Dani. Asked: Is the value of change continuing to play Dani to Aisyah?	Is known: If you continue the game once you get 0 points. If you don't continue the game you will get -2 points. Dani continued the game as much x. Aisyah continued playing 3 levels more than Dani. Function formula: $f(x) = ax + b$ Asked: Is the value of change continuing to play Dani to Aisyah?	1

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
	No answer	Answer : $f(1) = 0$	Answer : $f(1) = 0$ $f(0) = -2$	Answer : $f(1) = 0$ $f(0) = -2$ The general form of the function formula $f(x) = ax + b$	Answer : $f(1) = 0$ $f(0) = -2$ The general form of the function formula $f(x) = ax + b$ $f(x + 3) - f(x)$?	2
	No answer	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1)	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2)	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2) Substitute equation (2) into equation (1): $a + b = 0$ $a + (-2) = 0$ $a = 2$	$f(1) = 0$, then $f(1) = a(1) + b$ $0 = a + b$ $a + b = 0$ ..... (1) $f(0) = -2$, then $f(0) = a(0) + b$ $-2 = b$ $b = -2$ ..... (2) Substitute equation (2) into equation (1): $a + b = 0$ $a + (-2) = 0$ $a = 2$ So the formula is the function $f(x) = 2x - 3$	3

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No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
	No answer	Change value from $f(x+3)-f(x)$ $f(x)=2x-2$ $f(x+3)$ $=2(x+3)-2$	Change value from $f(x+3)-f(x)$ $f(x)=2x-2$ $f(x+3)=$ $2(x+3)-2$ $=2x+6-2$ $=2x+4$	Change value from $f(x+3)-f(x)$ $f(x)=2x-2$ $f(x+3)=$ $2(x+3)-2$ $=2x+6-2$ $=2x+4$ $f(x+3)-f(x)=$ $=(2x+4)-(2x-2)$ $=2x+4-2x+2$	Change value from $f(x+3)-f(x)$ $f(x)=2x-2$ $f(x+3)=2(x+3)-2$ $=2x+6-2$ $=2x+4$ $f(x+3)-f(x)$ $=(2x+4)-(2x-2)$ $=2x+4-2x+2$ $=6$	4
	No answer	So, the value of change is 4.	So, the value of the change in continuing Dani's game to Aisyah is 4	So, the value of change is 6	So, the value of the change in continuing Dani's play to Aisyah is 6.	5
4a	No answer/ wrong answer	Is known: The height that the ball reaches after t seconds is determined by the formula	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$	Is known: The height that the ball reaches after t seconds is determined by the formula $h(t)=4t-t^2$ The domain $D_h=$	1

No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
		$h(t) = 4t - t^2$ Asked: a. Graph the function h	Asked: a. Graph the function h b. Determine the highest distance	The domain $D_h = \{t\|0 \leq t \leq 4\}$, where t is a real number. Asked: a. Graph the function h b. Determine the highest distance the ball reaches	$\{t\|0 \leq t \leq 4\}$, where t is a real number. Asked: a. Graph the function h b. Determine the highest distance the ball reaches c. Determine the time the football reaches the same height when the bullet is fired.	
	No answer	$D_h = \{t\|0 \leq t \leq 4\}$	$h(t) = 4t - t^2$	$h(t) = 4t - t^2$ $D_h = \{t\|0 \leq t \leq 4\}$	$h(t) = 4t - t^2$ $D_h = \{t\|0 \leq t \leq 4, t \in R\}$	2
	No answe	Domain substitution $D_h = \{t\|0 \leq t \leq 4\}$, where t is a real number to the function formula $h(t) = 4t - t^2$ If $t = 0$, then $h(0) = 4(0) - (0)^2$ $h(0) = 0$	Domain substitution $D_h = \{t\|0 \leq t \leq 4\}$, where t is a real number to the function formula $h(t) = 4t - t^2$ If $t = 0$, then $h(0) = 4(0) - (0)^2$ $h(0) = 0$ If $t = 1$, then $h(1) = 4(1) - (1)^2$ $h(1) = 3$ If $t = 2$, then	Domain substitution $D_h = \{t\|0 \leq t \leq 4\}$, where t is a real number to the function formula $h(t) = 4t - t^2$ If $t = 0$, then $h(0) = 4(0) - (0)^2$ $h(0) = 0$ $t = 1$, then $h(1) = 4(1) - (1)^2$ $h(1) = 3$ If $t = 2$, then $h(2) = 4(2) - (2)^2$	Domain substitution $D_h = \{t\|0 \leq t \leq 4\}$, where t is a real number to the function formula $h(t) = 4t - t^2$ If $t = 0$, then $h(0) = 4(0) - (0)^2$ $h(0) = 0$ If $t = 1$, then $h(1) = 4(1) - (1)^2$ $h(1) = 3$ If $t = 2$, then $h(2) = 4(2) - (2)^2$ $h(2) = 4$	3

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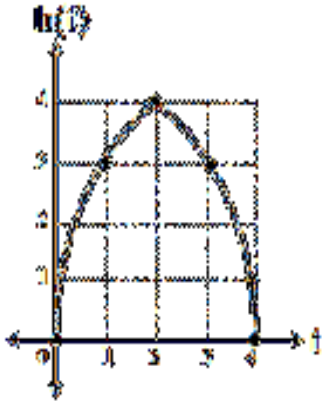
No	Answer key					Problem Solving Indicator
	Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	

		If $t = 1$, then
		$h(1)$
		$= 4(1)-(1)^2$
		$h(1) = 3$
			$h(2) = 4(2)-(2)^2$
			$h(2) = 4$
				$h(2) = 4$
				If $t = 3$, then
				$h(3) = 4(3)-(3)^2$
				$h(3) = 3$
					If $t = 3$, then
					$h(3) = 4(3)-(3)^2$
					$h(3) = 3$
					If $t = 4$, then
					$h(4) = 4(4)-(4)^2$
					$h(4) = 0$	

	No answer	Already made a Cartesian diagram but the scale is not correct and does not place the dots (t, f (t)) correctly and does not connect the dots.	Already made a Cartesian diagram with the correct scale and did not place the dots (t, f (t)) correctly and did not connect the dots.	Already made a Cartesian diagram of the correct scale and placed the dots (t, f (t)) correctly but did not connect the dots.	A.Function graph images 	4
4b	No answer	The highest distance that the ball of the foot reaches is 8 meters	The highest distance the ball reaches is (2,4)	The highest distance the ball reaches is 4	The highest distance that the ball of the foot reaches is 4 meters.	5
4c	No answer	The time it takes for the ball	The time it takes for the ball of the foot to	The time it takes for the ball of the foot to reach	The time it takes for the ball of the foot to reach the same	5

No	Answer key					Problem Solving Indicator
	Score 0	Score 1	Score 2	Score 3	Score 4	
		of the foot to reach the same height when the ball of the foot is kicked is 3 seconds.	reach the same height when the ball of the foot is kicked is (0.4)	the same height when the ball of the foot is kicked is 4	height when the ball of the foot is kicked is 4 seconds.	

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Attachment 22

EXPERIMENT CLASS VALUE DISTRIBUTION 1

NO	STUDENT	SCORE EACH INDICATORS																						TOTAL SCORE	SCORE
		1					2							3					4							
							A					B							a				b	c		
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
1	SE1	4	4	4	4	4	4	4	4	4	4	2	1	4	2	4	2	0	4	4	4	3	3	2	75	81.5
2	SE2	4	4	4	4	4	4	4	4	4	3	2	2	4	2	3	0	0	4	4	4	3	4	2	73	79.3
3	SE3	4	4	4	4	4	4	4	4	4	3	3	3	4	4	4	4	2	3	2	4	3	3	1	79	85.9
4	SE4	4	4	4	4	4	2	4	4	4	4	2	2	4	2	2	0	0	3	2	4	4	2	2	67	72.8
5	SE5	4	4	4	4	4	3	4	4	4	3	4	2	4	2	2	0	0	4	2	4	3	1	1	67	72.8
6	SE6	4	4	4	0	0	4	4	4	4	3	4	4	4	0	0	0	0	4	2	4	4	3	1	61	66.3
7	SE7	4	2	1	0	0	4	4	4	4	3	3	2	3	0	0	0	0	4	4	4	3	4	4	57	62.0
8	SE8	4	4	4	4	4	4	4	4	4	3	4	4	4	3	4	1	1	4	4	3	2	1	2	76	82.6
9	SE9	4	4	4	4	4	4	4	4	2	3	1	1	4	2	2	0	3	4	4	4	3	4	4	73	79.3
10	SE10	4	4	4	4	4	4	4	4	4	3	4	4	4	0	0	0	0	4	2	4	4	3	1	69	75.0
11	SE11	4	4	4	4	4	3	4	4	4	4	4	4	4	0	0	0	0	4	2	4	4	1	3	69	75.0
12	SE12	4	4	4	4	0	4	4	4	4	4	4	4	4	0	0	0	0	4	4	4	4	3	1	68	73.9
13	SE13	3	4	4	4	0	3	0	2	4	0	1	0	4	0	0	0	0	4	2	3	0	0	0	38	41.3
14	SE14	4	4	4	2	0	3	4	4	4	2	2	1	4	2	0	0	0	4	4	0	0	0	0	48	52.2
15	SE15	3	4	4	4	4	4	4	4	4	3	2	1	3	2	4	2	0	4	4	4	3	3	2	72	78.3
16	SE16	4	0	0	0	0	4	4	0	1	3	3	2	4	1	4	0	2	4	2	4	0	3	1	46	50.0
17	SE17	4	4	4	0	0	4	4	4	4	3	2	2	2	0	0	0	0	3	2	4	4	3	2	55	59.8
18	SE18	4	4	4	4	0	2	4	4	4	2	4	4	4	0	0	0	0	4	2	4	3	4	4	65	70.7

NO	STUDENT	SCORE EACH INDICATORS																							TOTAL SCORE	SCORE
		1					2							3					4								
							A					B							a				b	c		
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
19	SE19	4	4	4	4	4	2	4	4	4	3	4	4	4	2	3	0	0	3	2	4	3	4	1	71	77.2
20	SE20	4	4	4	4	1	4	4	4	4	3	4	4	3	2	4	0	0	4	4	4	3	3	2	73	79.3
21	SE21	4	4	4	4	3	4	4	4	4	3	2	0	4	4	4	4	4	4	4	4	4	4	1	81	88.0
22	SE22	4	4	3	1	4	4	4	4	4	3	4	4	4	2	3	0	4	4	4	3	1	3	1	72	78.3
23	SE23	4	2	4	4	1	4	2	0	2	2	2	2	4	0	0	0	1	4	2	4	3	4	2	53	57.6
24	SE24	4	4	4	4	4	4	4	4	4	4	2	2	4	4	4	2	0	4	2	4	3	3	1	75	81.5
25	SE25	4	4	4	4	4	4	4	4	4	4	4	4	4	3	2	0	2	4	2	4	2	1	1	73	79.3
26	SE26	2	4	1	1	0	3	4	4	4	3	3	3	1	0	0	0	0	4	2	4	4	1	0	48	52.2
27	SE27	4	3	0	1	4	4	4	4	4	1	4	4	4	2	3	0	0	4	2	4	3	4	1	64	69.6
28	SE28	4	4	4	4	0	4	4	4	4	4	2	1	4	0	0	0	0	4	4	4	3	3	1	62	67.4
29	SE29	4	4	2	0	0	4	4	4	4	3	2	2	4	1	2	0	1	4	4	4	4	3	1	61	66.3
30	SE30	4	3	3	4	4	3	4	4	4	3	4	3	2	1	0	0	0	4	2	4	4	4	1	65	70.7
31	SE31	4	3	1	0	1	4	2	0	0	2	2	1	4	0	0	0	1	4	2	2	3	3	1	40	43.5
32	SE32	4	4	4	4	4	4	4	4	4	2	2	2	4	2	0	0	0	4	4	4	4	4	2	70	76.1
TOTAL																									**2066.0**	**2245.7**
AVERAGE																									**64.6**	**70.2**
PERCENTAGE																									**1614.1**	**1754.4**
MAX																									**81.0**	**88.0**
MIN																									**38.0**	**41.3**

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Attachment 23

EXPERIMENT CLASS VALUE DISTRIBUTION 2

NO	STUDENT	SCORE EACH INDICATORS																						TOTAL SCORE	SCORE
		1					2					a		b		3					4				a		b	C		
		1	2	3	4	5	1	2	3	4	5	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
1	SE1	4	0	0	0	0	2	4	4	3	3	2	1	4	2	3	4	0	4	4	4	3	4	1	56	60.9
2	SE2	4	4	4	4	4	4	4	4	4	3	4	4	3	2	3	3	4	4	2	4	2	3	4	81	88.0
3	SE3	3	4	4	2	4	2	4	4	3	3	4	1	0	2	3	3	4	1	4	4	2	0	0	61	66.3
4	SE4	4	3	3	4	4	2	4	2	2	3	2	1	3	2	3	4	0	4	4	4	3	4	1	66	71.7
5	SE5	4	0	2	0	0	4	2	0	0	1	1	1	4	2	3	0	2	4	4	4	0	0	0	38	41.3
6	SE6	2	3	3	4	4	3	4	4	4	3	4	1	4	4	3	4	4	4	2	4	3	1	1	73	79.3
7	SE7	4	4	4	4	4	4	4	4	4	3	3	0	2	4	3	4	3	4	4	3	2	1	1	73	79.3
8	SE8	3	4	4	4	2	2	4	4	3	3	2	1	4	2	3	0	3	4	2	4	3	4	0	65	70.7
9	SE9	4	1	0	0	0	0	4	4	3	1	4	3	4	2	3	3	4	1	2	4	3	3	4	57	62.0
10	SE10	3	4	4	4	4	3	4	4	3	2	4	3	4	2	3	3	4	4	2	3	2	2	1	72	78.3
11	SE11	4	4	4	4	4	4	4	4	4	3	3	3	4	2	4	1	1	4	2	3	4	4	3	77	83.7
12	SE12	2	3	4	4	1	3	4	4	1	1	1	0	3	2	3	3	0	4	2	4	0	1	1	51	55.4
13	SE13	2	4	4	4	4	4	4	4	4	3	4	4	2	2	3	3	3	4	2	3	2	2	3	74	80.4
14	SE14	3	4	4	4	2	3	4	2	3	1	4	1	2	2	3	3	3	3	2	4	3	0	0	60	65.2
15	SE15	4	4	4	4	2	3	4	4	2	2	4	4	4	2	3	3	4	4	2	4	3	2	0	72	78.3
16	SE16	4	3	4	4	4	4	4	4	4	3	0	1	4	2	3	0	1	4	4	4	3	3	3	70	76.1
17	SE17	2	4	4	4	4	2	4	4	4	3	4	1	2	4	3	2	3	4	2	4	4	3	1	72	78.3
18	SE18	4	4	4	4	4	3	4	4	2	1	3	1	4	2	3	3	0	4	4	4	0	0	0	62	67.4

NO	STUDENT	SCORE EACH INDICATORS																						TOTAL SCORE	SCORE
		1					2							3					4							
							a					b							a				b	C		
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
19	SE19	4	0	0	0	0	4	4	4	4	3	3	3	3	4	3	2	3	4	2	4	3	3	0	60	65.2
20	SE20	3	4	4	4	4	3	4	4	4	4	4	4	2	4	4	4	4	0	2	4	2	2	0	74	80.4
21	SE21	4	4	4	4	4	3	4	4	3	3	3	1	4	2	3	4	4	4	4	4	4	4	4	82	89.1
22	SE22	3	4	4	4	4	2	4	4	3	3	4	1	4	2	3	3	2	4	4	4	3	0	0	69	75.0
23	SE23	4	4	4	4	4	3	0	0	3	2	4	3	4	2	3	3	3	4	2	4	0	3	1	64	69.6
24	SE24	3	4	4	1	0	2	4	4	1	1	1	0	4	2	3	3	0	1	2	3	1	0	0	44	47.8
25	SE25	3	4	4	4	4	3	4	4	4	3	4	4	2	2	3	3	3	4	2	3	2	1	0	70	76.1
26	SE26	4	3	3	4	4	4	4	4	2	1	3	1	4	2	3	4	0	4	4	4	3	3	1	69	75.0
27	SE27	3	2	3	0	0	2	0	0	0	0	0	0	2	2	2	0	2	0	2	3	0	0	0	23	25.0
28	SE28	4	3	1	1	0	4	4	0	3	3	2	0	4	2	4	0	0	4	2	3	1	1	0	46	50.0
29	SE29	4	4	4	3	4	4	0	0	3	3	4	3	4	2	3	3	3	4	4	3	1	3	1	67	72.8
30	SE30	4	4	4	3	4	2	4	4	3	3	4	1	4	2	3	0	2	3	4	4	3	0	0	65	70.7
31	SE31	4	4	4	4	4	3	4	4	4	3	3	1	2	2	3	4	3	3	2	4	4	3	4	76	82.6
TOTAL																								**1989.0**	**2162.0**
AVERAGE																								**64.2**	**69.7**
PERCENTAGE																								**1604.0**	**1743.5**
MAX																								**82.0**	**89.1**
MIN																								**23.0**	**25.0**

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Attachment 24

CONTROL CLASS VALUE DISTRIBUTION

NO	STUDENT	SCORE EACH INDICATORS																						TOTAL SCORE	SCORE
		1					2							3					4							
							a					b							a				b	C		
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
1	SK1	4	4	4	4	3	3	4	4	4	2	4	3	3	4	4	4	2	4	2	4	0	3	0	73	79.3
2	SK2	4	4	3	2	2	0	2	1	0	0	0	0	3	4	4	3	0	1	2	0	0	0	0	35	38.0
3	SK3	4	4	2	0	0	0	0	0	0	0	0	0	4	2	4	4	0	3	2	0	0	0	0	29	31.5
4	SK4	3	4	4	4	4	3	4	4	2	2	2	0	3	0	1	2	0	4	4	0	0	0	0	50	54.3
5	SK5	4	4	4	4	4	2	4	3	4	2	3	0	4	2	4	1	0	3	2	1	1	0	0	56	60.9
6	SK6	4	4	3	4	4	2	4	4	4	2	2	1	1	0	0	0	1	3	2	3	1	1	1	51	55.4
7	SK7	4	4	4	4	2	2	2	4	4	0	4	0	4	2	4	2	0	4	2	4	1	3	1	61	66.3
8	SK8	3	4	4	4	2	2	4	4	4	3	4	4	3	4	3	4	0	1	4	4	3	2	0	70	76.1
9	SK9	4	4	4	4	4	4	4	4	4	0	2	1	4	2	4	2	0	4	2	0	0	0	0	57	62.0
10	SK10	4	4	4	3	4	0	0	0	0	0	0	0	4	2	4	2	0	1	2	0	0	0	0	34	37.0
11	SK11	4	4	4	4	4	4	4	4	4	0	4	0	4	2	4	2	0	4	4	4	0	0	0	64	69.6
12	SK12	3	4	3	4	4	2	4	4	4	0	3	1	3	2	4	1	0	1	2	0	0	0	0	49	53.3
13	SK13	0	4	4	4	4	0	2	3	3	0	0	0	3	4	2	1	0	1	2	0	0	0	0	37	40.2
14	SK14	4	4	4	4	4	2	4	0	0	0	0	0	4	4	4	3	3	1	2	3	0	0	0	50	54.3
15	SK15	4	4	3	0	4	2	4	4	3	0	0	0	4	2	3	1	0	1	4	0	0	0	0	43	46.7
16	SK16	4	4	4	4	4	4	3	4	4	0	4	0	4	2	4	2	0	4	4	4	0	0	0	63	68.5
17	SK17	1	3	3	4	2	1	4	4	4	0	3	0	4	4	4	4	0	1	2	2	1	3	1	55	59.8
18	SK18	3	4	4	4	2	2	4	2	3	3	0	0	2	2	1	0	0	1	4	4	0	0	0	45	48.9

NO	STUDENT	SCORE EACH INDICATORS																						TOTAL SCORE	SCORE
		1					2							3					4							
							a					b							a				b	C		
		1	2	3	4	5	1	2	3	4	5	4	5	1	2	3	4	5	1	2	3	4	5	5		
19	SK19	4	4	2	4	0	4	2	2	2	0	2	0	3	0	0	0	0	3	2	4	1	2	1	42	45.7
20	SK20	4	4	4	2	4	3	4	4	4	0	4	0	4	2	4	2	0	3	4	0	0	0	0	56	60.9
21	SK21	1	4	4	4	4	0	0	0	0	0	0	0	2	0	0	0	0	4	4	4	3	2	1	37	40.2
22	SK22	4	4	3	4	4	3	4	4	4	2	4	4	3	4	2	4	0	3	2	0	0	0	0	62	67.4
23	SK23	4	4	4	4	4	3	4	4	4	0	2	1	4	2	4	1	0	4	4	0	0	2	0	59	64.1
24	SK24	3	3	4	4	3	1	4	4	4	3	4	4	3	4	4	3	0	1	4	3	2	2	0	67	72.8
25	SK25	4	4	4	4	3	2	4	4	4	3	4	4	4	4	4	4	0	1	2	3	2	2	0	70	76.1
26	SK26	1	3	4	4	4	2	2	4	3	0	0	0	3	4	4	4	2	1	2	0	0	0	0	47	51.1
27	SK27	1	3	4	4	4	1	2	2	2	0	0	0	2	0	0	0	0	2	2	4	0	0	0	33	35.9
28	SK28	3	4	4	4	3	3	4	2	4	3	1	0	3	2	3	0	0	1	2	4	1	0	0	51	55.4
29	SK29	4	4	4	4	4	3	4	4	4	0	2	0	4	3	4	1	0	1	2	0	1	0	0	53	57.6
30	SK30	1	4	4	4	4	3	4	2	3	3	1	0	2	4	4	4	2	0	2	3	0	0	0	54	58.7
31	SK31	4	4	4	4	4	2	4	4	4	3	4	4	2	2	4	3	0	1	2	4	3	4	1	71	77.2
32	SK32	4	4	4	4	4	2	4	4	4	0	2	1	3	2	4	1	0	3	2	3	1	0	0	56	60.9
TOTAL																									**1680.0**	**1826.1**
AVERAGE																									**52.5**	**57.1**
PERCENTAGE																									**1312.5**	**1426.6**
MAX																									**73.0**	**79.3**
MIN																									**29.0**	**31.5**

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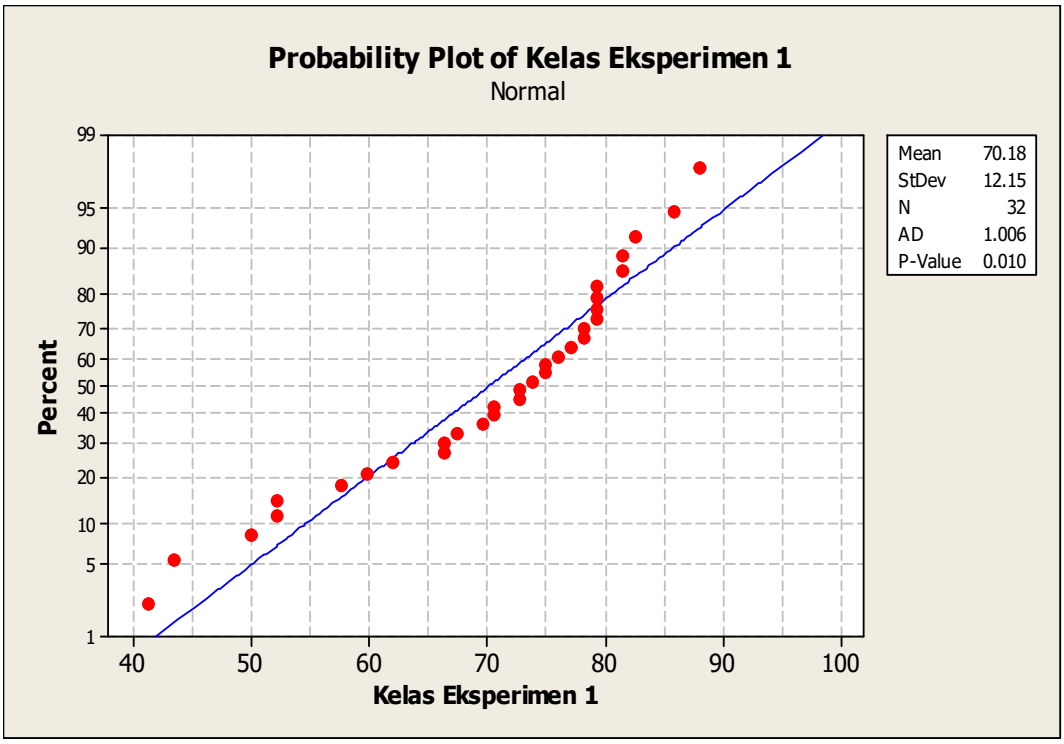
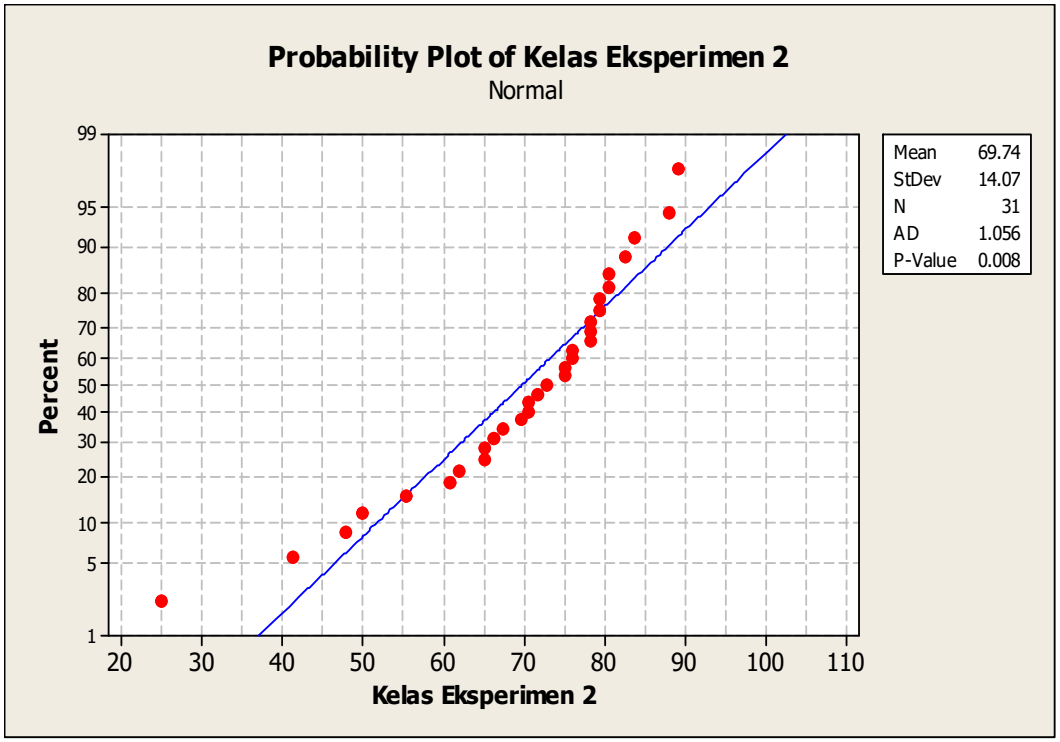
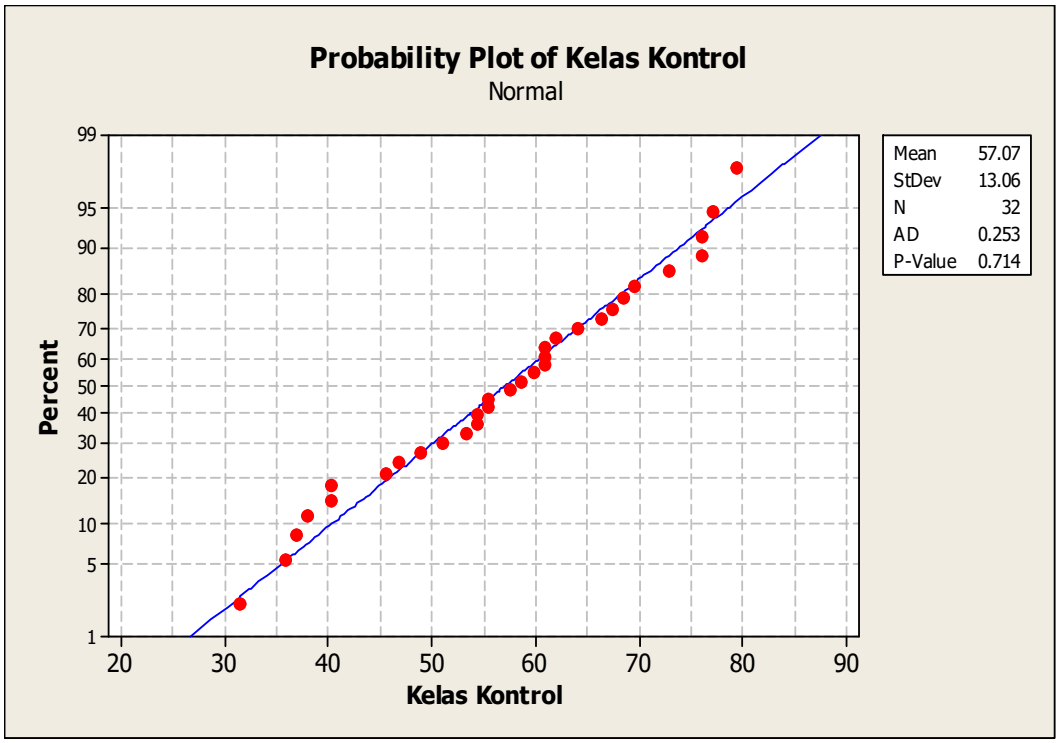
Attachment 25

SAMPLE CLASS NORMALITY TEST




Probability Plot of Kelas Eksperimen 2
Normal
Percent
Kelas Eksperimen 2
Mean 69.74
StDev 14.07
N 31
AD 1.056
P-Value 0.008


Probability Plot of Kelas Kontrol
Normal
Percent
Kelas Kontrol
Mean 57.07
StDev 13.06
N 32
AD 0.253
P-Value 0.714

Attachment 26

HYPOTHESIS TESTING

A. First Hypothesis Test

Mann-Whitney Test and CI : Experiment Class 1, Experiment Class 2

	N	Median
Experiment Class 1	32	73.37
Experiment Class 2	31	72.83

Point estimate for ETA1-ETA2 is -0.00
95.1 Percent CI for ETA1-ETA2 is (-5.44,5.44)
W = 1025.5
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.9890
The test is significant at 0.9890 (adjusted for ties)

B. Second Hypothesis Test

Mann-Whitney Test and CI: Experiment Class 1, Control Class

	N	Median
Experiment Class 1	32	73.37
Control Class	32	58.15

Point estimate for ETA1-ETA2 is 14.13
95.1 Percent CI for ETA1-ETA2 is (6.52,19.57)
W = 1322.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0001
The test is significant at 0.0001 (adjusted for ties)

C. Third Hypothesis Test

Mann-Whitney Test and CI: Experiment Class 2, Control Class

	N	Median
Experiment Class 2	31	72.83
Control Class	32	58.15

Point estimate for ETA1-ETA2 is 14.13
95.1 Percent CI for ETA1-ETA2 is (6.52,20.65)
W = 1265.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.0001
The test is significant at 0.0001 (adjusted for ties)

Attachment 27

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI PADANG
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
Jln. Prof. Dr. Hamka, Kampus Air Tawar Padang 25131 Telp. (0751) 7057420

Number :2565/UN35.1.1/PP/2017 26 July 2017

Subject: research permit

Dear. Head of the Padang City Education Office
Jalan Bagindo Aziz Chan No. 8A
In Padang

Sincerely,

We hereby convey that in order to complete the final project / thesis / thesis, our students from the undergraduate level of FMIPA UNP intend to carry out research at SMP NEGERI 1 Padang.

In connection with the above, we ask for your consent and provide a permit to conduct research for these students below:

No	Name / NIM/ Prodi	Research place	Research time	Thesis title / final project
1	Anisa Safitri / 1301376/ mathematics educations	SMP Negeri 1 Padang	14-08-2017 s/d 14-10-2017	Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Class VIII SMP NEGERI 1 Padang

Thus we convey, for your help and cooperation, we thank you

a.n dean
Deputy Dean 1

Dr. Yulkifli S.Pd.,M.Si
NIP. 197307022003121002

Copy:
1. Dean of FMIPA UNP, as a report.
2. Ketya, majoring in mathematics / mathematics education study program FMIPA UNP
3. Principal of SMP NEGERI 1 PADANG

Attachment 28

PEMERINTAH KOTA PADANG

DINAS PENDIDIKAN

JL. Bagindo Aziz Chan no. 8 Padang Telp. (0751) 21554-21825 fax (0751 21554)

Website : http//www.diskdik.padang.go.id

RESEARCH PERMIT

Number: 070/4825/DP.PPMP1/2017

The head of the education office based on the letter of the deputy dean of FMIPA UNP number: 5365 / UN35.1.1 / PP / 2017 dated 26 July 2017 regarding research permits in order to collect data to complete the final thesis, in principle, given to:

Name	: ANISA SAFITRI
NIM	: 1301376
Department	: Mathematics
Study Program	: Mathematics Educations
Level	: S1
Title	: Comparison of Students' Mathematical Problem Solving Ability Using Group Investigation Learning with Problem Based Learning Class VIII SMP NEGERI 1 Padang
Location	: SMP Negeri 1 Padang
Time	: August to October 2017

Under the condition :

1. During the activity, it does not interfere with the teaching and learning process
2. After conducting the research in order to be able to provide a duplicate report to the Padang city education office, Cq, the PPMP planning section
3. These activities are carried out in student learning hours

Thus to be able to be used properly.

Padang, 7 August 2017
A/n head of planning

Win Atriosa.,S.Si,.ME
NIP. 19760921 200212 1010

Copy:
1. mayor of padang (as report)
2. Head of Education Office
3. Deputy Dean of FMIPA UNP
4. Principal of SMP Negeri 1 Padang
5. Archives

Attachment 29

PEMERINTAH KOTA PADANG
DINAS PENDIDIKAN
SMP NEGERI 1 PADANG
Jalan Sudirman No.3 Kelurahan Kampung Jao Kecamatan Padang Barat
Telepon/Faksimile: 0751 21849 Kode Pos. 25111
Laman: smpn1-padang.sch.id ; Pos-el: smpn1kotapadang@gmail.com

LETTER OF STATEMENT
Number:000/806/DP SMP.01/2017

The undersigned, the principal of SMP NEGERI 1 PADANG, West Sumatra province, hereby explains that :

No	Name	NIM	Prodi / department	Level
1	Anisa Safitri	1301376	Mathematics Education	S1

The aforementioned name has actually carried out research in the context of data collection for the completion of a thesis with the title "Comparison of students' mathematical problem solving abilities using Group Investigation learning with problem based learning class VIII SMP Negeri 1 Padang" with the research time from August to October 2017. in accordance with the research permit Number: 070/4825 / DP. PPMP1 / 2017 dated 7 August 2017

Thus we provide this certificate, to be used properly.

Padang, 28 November 2017

Drs. Hakim, M.Pd
NIP. 19601129 198403 1 004