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THE EFFECT OF PROBLEM BASED LEARNING MODEL ON LEARNING MOTIVATION AND UNDERSTANDING OF MATHEMATICAL CONCEPT STUDENTS OF SMP NEGERI 2 TUHEMBERUA ACADEMIC YEAR 2019/2020

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ABSTRACK

This research was motivated by the observations of researchers when carrying out learning at SMP Negeri 2 Tuhemberua where the learning carried out did not involve fully active students so that the ability to understand concepts and students' motivation to learn was still lacking. This study aims to determine the effect of the Problem Based Learning learning model on students' learning motivation and understanding of mathematical concepts. This type of research is experimental research using quasi experimental research. The research population was all students of class VIII which consisted of 4 classes with a sample of 2 classes taken by random sampling, namely class VIII-A as the experimental class and class VIII-C as the control class.

Keywords: *Problem Based Learning*, Learning Motivation, and Understanding of Mathematical Concepts.

A. Introduction

Education is basically an effort to provide certain knowledge, insight, skills and expertise to individuals in order to develop themselves so that they are able to face every change that occurs due to advances in science and technology.

To achieve this goal, education must be carried out as well as possible so that it can produce morally qualified human resources and obtain the expected results.

To realize the goals and functions of national education, the handling of education needs to get better attention regarding various issues related to quantity, quality and relevance.

The government has made various efforts to improve the quality of education. Schools as a forum for formal education, become a place for the government to improve the quality of education, one of which is the improvement of the curriculum.

Mathematics as a basic science plays a very important role in the development of science and technology, because mathematics is a means of thinking to grow and develop reasoning, logical, systematic and critical thinking.

To achieve these goals, learning mathematics in schools must be carried out as well as possible and adapted to the desired learning objectives. However, this expectation was not fully achieved in general and specifically in the province of North Sumatra. Based on the results of the 2018 National Science Olympiad, North Sumatra Province is ranked 14th out

of 28 OSN participating provinces in 2018, winning 3 silver medals and 17 bronze medals.

One of the learning models that can increase students' learning motivation to master mathematical concepts is the Problem Based Learning (PBL) model.

Learning with PBL is based on the principle that problems can be used as a starting point for gaining new knowledge. The problems presented in learning are expected to increase students' motivation in understanding the concepts given. It is supported byAs'ari (2017:23) which states that: "Problem based learning is a learning model that presents contextual problems so that it stimulates students to learn".

The Problem Based Learning learning model will direct students to play Fitrah (in Schmit and Moust, 2017: 53) stating that: "With PBL students make theories about the world". Problem Based Learning is a method focused on empowering students to integrate theory, apply knowledge and to develop their own solution-finding skills.

Learning model *Problem based learning* designed in the form of learning that begins with the structure of real problems related to the mathematical concepts to be taught, students not only receive information from the teacher but the teacher must motivate and direct students to be actively involved in the entire learning process.

Therefore, the authors feel it is important to conduct experimental research on "**THE EFFECT OF PROBLEM BASED LEARNING MODEL ON LEARNING MOTIVATION AND UNDERSTANDING OF MATHEMATICS CONCEPTS STUDENTS OF SMP NEGERI 2 TUHEMBERUA FOR THE 2019/2020 ACADEMIC YEAR**

B. discussion

1. Definition

Learning in its idealism means psycho-physical-social activities leading to full personal development. That is, learning is a process of change, namely changes in behavior as a result of interaction with the environment in meeting the needs of life.

These changes will be in all aspects of behavior. In line with that, Slameto (2010: 2) argues that: Learning is a process of effort carried out by a person to obtain a new change in behavior as a whole, as a result of his own experience in interaction with his environment.

Learning is an activity in which there is interaction between teachers and students, in order to achieve the goal of mastering certain competencies by students. That is, teaching is done by the teacher as an educator, while learning is done by students. The same thing was stated by Hamdani (2011: 72) who stated that: "In essence, learning (learning and teaching) is a process of communication between teachers and students". Communication In learning the teacher must understand the nature of the subject matter being taught as a lesson that can develop students' thinking skills and understand various learning models that can stimulate students' ability to learn with careful teaching planning by the teacher.

In line with that, according to a personal (2009:10) who said that:

A. Learning is a process that is intentionally designed to create learning activities within the individual. In other words, learning is something that is external and is deliberately designed to support the internal learning process within the individual.
B. In learning mathematics, it is expected that students should be able to feel the benefits of learning mathematics. Learning mathematics will be more successful if the learning process is directed at the concepts and structures that are interested in the subject being taught. Thus, the way mathematics works is expected to form a critical, creative, honest, and communicative attitude in students.

C. From the various views and understandings above, it can be concluded that learning mathematics is an interaction carried out by teachers and students to learn an exact field of science which is a tool for thinking, communicating, and a tool for solving problems and for developing other knowledge.

2. The Steps of the Problem Based Learning Model

The Problem Based Learning process will be able to run if the teacher is ready with all the necessary tools (problems, complementary forms, etc.). Students must already understand the process and have formed small groups.In As'ari, et al, (2017:27) suggest that the steps for Problem Based Learning are as follows:

Table 1
PROBLEM BASED LEARNING MODEL STEPS

No	Phase	Teacher's Behavior
1	Student Orientation On Problems	Explain the learning objectives, explain the necessary logistical needs, and motivate students to be involved in problem solving
2	Organizing students to learn	Help students define learning tasks related to the problem
3	Guiding individual/group experiences	Encourage students to gather appropriate information, carry out experiments, and seek explanations and solutions
4	Develop and present the work Help	Helping students in planning and preparing materials for presentation and helping them to share assignments with their friends
5	Analyze and evaluate the problem solving process	Help students reflect or evaluate the investigative processes they use in solving problems.

Components of a Contextual Approach

Some characteristics of the Problem Based Learning model according to Amir (2009:22) include:

a) Problems are used as the beginning of learning.
b) Usually, the problem used is a real-world problem that is presented in an ill-structured manner.
c) Problems usually require multiple perspectives. The solution requires students to use and get concepts from several learning chapters or cross-disciplinary to other fields.
d) Problems challenge students to get learning in new learning areas.
e) Highly prioritize self-directed learning.
f) Utilizing various sources of knowledge, not from one source alone. The search, evaluation and use of this knowledge is key.
g) Collaborative, communicative, and cooperative learning. Students work in groups, interact, work with each other (peer teaching), and do.

Learning is an activity in which there is interaction between teachers and students, in order to achieve the goal of mastering certain competencies by students. That is, teaching is done by the teacher as an educator, while learning is done by students. The same thing was stated by Hamdani (2011: 72) who stated that: "In essence, learning (learning and teaching) is a process of communication between teachers and students". Communication In learning

the teacher must understand the nature of the subject matter being taught as a lesson that can develop students' thinking skills and understand various learning models that can stimulate students' ability to learn with careful teaching planning by the teacher. In line with that, according to a personal (2009:10) who said that:

> Learning is a process that is intentionally designed to create learning activities within the individual. In other words, learning is something that is external and is deliberately designed to support the internal learning process within the individual.

As teachers, they are aware of what should be done to create teaching and learning conditions that can lead students to their goals. Here, of course, the teacher's job is to try to create a pleasant learning atmosphere for all students. One of the lessons implemented in schools is learning mathematics.

Mathematics is one of the exact sciences that has its own characteristics in studying it. The same thing was stated by Fathani (2016: 19) which stated that: "Mathematics is defined as a branch of science that is exact and systematically organized". That is, mathematics is related to the exact sciences which are all related to reasoning or giving valid reasons. Based on this description, Fathani (2016: 23-24) describes the general definition of mathematics as follows:

1) Mathematics as an organized structure
   Mathematics is an organized structure consisting of several components, which include axioms/postulates, basic/primitive understandings, and theorems/theorems.
2) Mathematics as a tool
   Mathematics is often seen as a tool in finding solutions to various problems in everyday life.
3) Mathematics as a deductive mindset
   A theory or statement in mathematics can be accepted as true if it has been proven deductively.
4) Mathematics as a way of reasoning (the way of thinking)
   Mathematics can be viewed as a way of reasoning for several reasons, such as mathematics contains valid methods of proof, general formulas or rules, or the systematic nature of mathematics.
5) Mathematics as an artificial language
   Symbols are the most prominent feature in metastics. The language of mathematics is an artificial language of symbols, which only has meaning when applied to a context.
6) Mathematics as a creative art
   Because logical and efficient reasoning and a treasury of creative and amazing ideas and patterns, mathematics is often referred to as an art, especially the art of creative thinking.

In learning mathematics, it is expected that students should be able to feel the benefits of learning mathematics. Learning mathematics will be more successful if the learning process is directed at the concepts and structures that are interested in the subject being taught. Thus, the way mathematics works is expected to form a critical, creative, honest, and communicative attitude in students.

From the various views and understandings above, it can be concluded that learning mathematics is an interaction carried out by teachers and students to learn an exact field of science which is a tool for thinking, communicating, and a tool for solving problems and for developing other knowledge.

B. RESEARCH METHODS

1. Research Population

The population of this study was all students of class VIII SMP Negeri 2 Tuhemberua for the academic year 2019/2020, totaling 124 people. The state of the study population is as follows:

Table 2

STATE OF THE NUMBER OF POPULATION

Class	Amount		Total
	Man	Woman	
VIII-A	14	16	30
VIII-B	20	12	32
VIII-C	16	15	31
VIII-D	20	11	31
Amount			124

Source: Administration of SMP Negeri 2 Tuhemberua

The reasons for choosing SMP Negeri 2 Tuhemberua as the research location are:

a. Based on the observations made in the initial observations, it can be seen that the students' ability to understand mathematical concepts in solving mathematical problems is still low.
b. There is openness from the school, especially mathematics subject teachers, to the research carried out.
c. The availability of facilities and infrastructure that supports the implementation of research, making it easier for researchers to carry out data collection.

2. Research Sample

The samples needed are two classes, namely the experimental class and the control class, so from the population consisting of four classes, two classes are determined randomly (random sampling) with the following steps:

a. Researchers Provide 4 small pieces of paper according to the number of classes in the population.
b. The papers are numbered in order. Then it is put in a holder/box and drawn twice in a row.
c. The first random result obtained was class VIII-A as the experimental class.
d. The second random result obtained is class VIII-C as the control class.

D. Types of Data and Research Instruments

1. Data Type

Because this research is designed with a quantitative paradigm, then of course the data is classified as quantitative data in the form of numbers. This data is in the form of learning motivation questionnaires and tests of understanding mathematical concepts obtained directly from the research sample.

2. Research Instruments

To collect data in this study, the researchers used two instruments, namely:

a. Motivation Questionnaire

This questionnaire is compiled based on the questionnaire grid that has been made

previously in the form of an objective questionnaire, which will be given to respondents several questions in the form of statements or questions with four alternative answers. Furthermore, respondents were asked to choose one answer that is considered the most appropriate according to what they experienced.

b. Mathematical Concept Understanding Test

The mathematical concept understanding test is in the form of a description test which is arranged based on a test grid and adapted to the applicable curriculum. The mathematical concept understanding test in this study consisted of:

1) Initial test (pre-test)

The initial test was given to a sample consisting of 2 (two) classes, in the form of a description test of 7 (seven) items from the data presentation material. This test aims to test the normality and homogeneity of the two classes that act as research samples.

2) Final test (post-test)

The final test is the final activity carried out for both classes. This final test is in the form of a description test of 7 (seven) items. Before being designated as a research instrument, the learning outcomes test is logically validated for mathematics teachers who have passed the certification. The data obtained from the logical validation results were processed using the Guttman scale. Daniel Eddy's translation in Harefa (2016:83) Guttman proposes a simple scale reproducibility index:

$$\text{Rep} = 1 - \frac{Jumlah\ banyaknya\ kesalahan}{Jumlah\ banyaknya\ jawaban}$$

with the criteria "... Guttman suggests 0.90 as the minimum acceptable reproducible level". Column 2 with a rating scale: 1 = invalid, 2 = less valid, 3 = quite valid, and 4 = valid.

Specifically for the final test, it was tested in other schools for the purpose of testing the feasibility of the test, namely: 1) testing the validity of the test; 2) test reliability test; 3) calculation of difficulty level; and 4) calculation of discriminating power.

a) **Validity test**

The form of validity test used by the researcher is the item validity test to determine whether each item of the test is valid or not. The formula used to test the validity, namely:

$$r_{xy} = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left\{N\sum X^2 - \left(\sum X\right)^2\right\}\left\{N\sum Y^2 - \left(\sum Y\right)^2\right\}}}$$

Information:

rxy = Correlation coefficient between item scores and total scores
X = Item score
Y = Total Score
N = Number of students taking the test

Lestari and Yudhanegara (2017: 193)

Furthermore, rxy was consulted on the table of critical values of r product moment at a significant level of 5% (α = 0.05). Each test item is declared valid if rxy rt.

b) Reliability Test

Reliability test is conducted to find out whether the measurements made with an instrument give consistent results. Because the test used in this study is in the form of a description test, for the reliability test, the alpha formula is used, namely:

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

where:

r_{11} = reliability coefficient
k = number of test items
$\sum \sigma_i^2$ = Total score variance for each item
σ_t^2 = Total score variance

To calculate the variance of scores for each test item, the formula is used:

$$\sigma_i^2 = \frac{\sum x_i^2 - \frac{(\sum x_i)^2}{N}}{N}$$

and $\sum \sigma_i^2 = \sigma_1^2 + \sigma_2^2 + \sigma_3^2 + \cdots + \sigma_k^2$

And for calculating the variance of the total score for each, the formula is used:

$$\sigma_t^2 = \frac{\sum x_t^2 - \frac{(\sum x_t)^2}{N}}{N}$$

To interpret the reliability price, the rtable price was consulted at a significant level of 5% (α=0.05). It is said to be reliable if r11 rt.

Lestari and Yudhanegara (2017:206-207)

c) Test Difficulty Level

The calculation of the level of difficulty is carried out using the formula:

$$\text{TK} = \frac{\sum B}{\sum P}$$

Information:
Kindergarten = Difficulty level
$\sum B$ = Number of students who answered correctly
$\sum P$ = Number of students taking the test

Furthermore, the results of the calculation of the level of difficulty are consulted on the following criteria:

0.00 – 0.30 = Question is classified as difficult
0.31 – 0.70 = Question is classified as moderate
0.71 – 1.00 = Question is quite easy

Lestari and Yudhanegara (2017:224-226)

d) Distinguishing Test

The calculation of discriminating power is carried out using the formula:

$$\text{DP} = \frac{\text{Mean kelompok atas} - \text{Mean kelompok bawah}}{\text{Skor maksimum soal}}$$

Information:
DP = Distinguishing power of the question

Furthermore, the results of the calculation of discriminating power are consulted on the following criteria:

0.40 – 1.00 question is accepted/good
0.30 – 0.39 the question is accepted but needs to be fixed
0.20 – 0.29 problem fixed
0.00 – 0.19 the question is not used / thrown away

Lestari and Yudhanegara (2017:217-218)

E. Data Collection Procedure

In the process of collecting data in this study, researchers used a test technique, with the following steps:

1. Before the learning process was carried out, the experimental class and the control class were given an initial test.
2. Based on the results of the initial test in both classes, a normality test was carried out with the aim of knowing the selected sample represented the population.
3. If the selected sample is normally distributed, it is continued with the homogeneity test with the aim of seeing the equality of the selected sample. If it is not homogeneous, the research sample is reviewed. If it is homogeneous, then it is continued by giving treatment in the form of a learning process using the Problem Based Learning learning model in the experimental class and using conventional learning models in the control class.
4. After the learning process was carried out, both the experimental class and the control class were given a final test with the aim of knowing what hypothesis testing was used. Based on the learning outcomes test in the experimental class and the control class, normality and homogeneity tests were carried out. If it is not normally distributed and homogeneous, then the hypothesis testing uses non-parametric statistics (chi-square test).
5. If it is normally distributed then it is continued with homogeneity test, and if it is homogeneous then hypothesis testing is done using parametric statistics (independent t test).

F. Data analysis technique

The data obtained in this study were processed based on data analysis techniques. The data analysis techniques used in this study are as follows:

1. Processing of Motivation Questionnaire Results

Based on the categories and scores given, the results of the questionnaire (student learning motivation instrument) were processed using a Likert scale with the following criteria: Very often (4); Often (3); Sometimes (2); Less (1). In the Likert scale, the way to calculate the score for each item is:

Total score for respondent category (SS) = Number of respondents (SS) x 4
Total score for respondent category (S) = Number of respondents (S) x 3
Total score for category respondents (KK) = Number of respondents (KK) x 2
Total score for respondents category (K) = Number of respondents (K) x 1

To calculate the number of ideal scores and the number of low scores using the formula:

Total score ideal = Highest score x total number of respondents
Low score count = Low score x total number of respondents

The data from each item of the questionnaire is converted in percent by using the formula:

Percentage of observations of each item = $\frac{Jumlah\,skor\,setiap\,item}{Jumlah\,skor\,ideal} \times 100\%$

The results of the percentage of observations of each item are grouped into:

Score below 50% = Not Good

Score 50% - 69% = Enough

Score 70% - 85% = OK

Score 86% - 100% = Very Good

Lestari and Yudhanegara (2017:334-335)

2. Processing of Concept Understanding Test Results

a. NPKM Every Student

The processing of learning outcomes is adjusted to the form of the mathematical concept understanding test used, namely the description test. To process the results of the description test, it will be guided as in the following table:

Table 3

GUIDELINES FOR SCORE TEST ABILITY TO UNDERSTAND STUDENTS MATHEMATICS CONCEPTS

No	Indicator	Information	Score
1	Restate a concept	There is no answer or no mathematical idea that appears according to the problem	0
		Mathematical ideas have emerged but have not been able to restate the concept correctly and there are still many mistakes	1
		Has been able to restate a concept according to the definition and essential concepts possessed by an object but still make some mistakes.	2
		Can restate a concept according to the definition and essential concepts possessed by an object appropriately	3
		Can restate a concept according to the definition and essential concepts possessed by an object correctly.	4
		There is no answer or no mathematical idea that appears according to the problem	0
		Mathematical ideas have emerged but have not analyzed an object and classified it according to certain properties / characteristics possessed according to the concept.	1

2	Classifying objects according to certain properties according to the concept	Has been able to analyze an object but has not been able to classify it according to the properties / characteristics and concepts it has.	2
		Can analyze an object and classify it according to certain properties / characteristics and concepts that it has but still make some mathematical operations errors.	3
		Can claim to be able to analyze an object but has not been able to classify it according to certain properties / characteristics and concepts that are owned appropriately.	4
3	Give examples and not examples of concepts	There is no answer or no mathematical idea that appears according to the problem	0
		Mathematical ideas have emerged but have not been able to name the concepts possessed by each of the examples given.	1
		Have been able to provide examples and non-examples in accordance with the concept of the object but it is not appropriate and has not been developed	2
		Has been able to provide examples and non-examples according to the concept of the object but the development is not yet appropriate.	3
		Has been able to provide examples and non-examples according to the concept that the object has but and has been developed.	4
4	Presenting concepts in various forms of mathematical representation	There is no answer or no mathematical idea that appears according to the problem	0
		Mathematical ideas have emerged but have not been able to present concepts in various forms of mathematical representation.	1
		Can present concepts in various forms of mathematical representation but do not understand the logarithm of understanding the concept.	2
		Can present concepts in various forms of mathematical representation as a logarithm of understanding the concept but still make mistakes	3
		Can present concepts in various forms of	4

		mathematical representation correctly.	
5	Develop necessary or sufficient conditions of a concept	There is no answer or no mathematical idea that appears according to the problem	0
		Mathematical ideas have emerged but have not been able to develop the necessary or sufficient conditions of a concept.	1
		Can develop the necessary or sufficient conditions of a concept but it is not appropriate.	2
		Can develop necessary or sufficient conditions of a concept but there are still errors.	3
		Can develop the necessary or sufficient conditions of a concept appropriately.	4
6	Using, utilizing, and selecting certain procedures or operations.	There is no answer or no mathematical idea that appears according to the problem.	0
		Mathematical ideas have emerged but have not been able to present concepts in various forms of mathematical representation.	1
		Can present concepts in various forms of mathematical representation but do not understand the logarithm of understanding the concept.	2
		Can present concepts in various forms of mathematical representation as a logarithm of understanding the concept but still make mistakes	3
		Able to use, utilize and choose procedures correctly.	4
7	Applying concepts or algorithms in problem solving	There is no answer or no mathematical idea that appears according to the problem.	0
		Mathematical ideas have emerged but have not been able to present the concept in various forms of mathematical representation as a logarithm of understanding the concept.	1
		Can present concepts in various forms of mathematical representation as an algorithm for understanding concepts but not yet understanding algorithms for understanding concepts.	2
		Can present concepts in various forms of mathematical representation as an algorithm for understanding concepts but	3

		still make some mistakes.	
		Can present concepts in various forms of mathematical representation as a logarithm of understanding the concept correctly.	4

Kasum's Adaptation in Kartika (2018:780-781)

Processing of students' concept understanding test results using the formula:

$$\text{NPKM} = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ total} x100$$

Information:

NPKM = Student's Mathematical Concept Understanding Value.

Furthermore, the average value of the ability to understand mathematical concepts in mathematics subjects is interpretedfish in the following table:

Table 4

VALUE INTEPRETATION OF UNDERSTANDING MATHEMATICAL CONCEPT

NO.	Score	Criteria
1.	85.00-100	Very good
2.	70.00-84.99	Well
3.	55.00-69.99	Enough
4.	40.00-54.99	Low
5.	0.00-39.99	Very low

Kartika(2018:782)

Average Count

To determine the concentration of the data, then the calculated average is determined. To determine the arithmetic mean (mean), the formula is used:

$$\bar{x} = \frac{\sum x_i}{n}$$

Information:

$\bar{x}$ = Calculated average (mean)

$\sum x_i$ = Score *x* to i to n

n = Number of samples

Riadi (2016:45)

b. Variance and Standard Deviation

To determine the distribution of the data, the variance and standard deviation are determined. To determine the variance and standard deviation used the formula:

$$S^2 = \frac{(N)\left(\sum X^2\right) - \left(\sum X\right)^2}{N(N-1)}$$

Information:

S = Deviation standard (standard deviation)

N = Amount of data

ΣX2 = The total score of X after first squared

(ΣX)2 = The sum of all X scores, which is then squared

Nazir (2015:387)

c. Normality test

The normality test in this study was carried out by the Kolmogorov Smirnov test with

the following steps:

1) Arrange the data in the frequency distribution table.
2) Calculates the cumulative frequency less than (fk).
3) Calculating the average ($\overline{X}$) and standard deviation (S).
4) Calculating the standard value (Z) with the formula $z = \frac{x-\bar{x}}{s}$
5) Determines the area under the standard normal curvature from 0 to Z
6) Calculate F(Z) with the following conditions:
   1) For Z which is negative;

   F(Z) = 0.5 – area under the standard normal curvature from 0 to Z.
   2) For Z which is positive;

   F(Z) = 0.5 + area under the standard normal curvature from 0 to Z.
7) Count $S(Z) = \frac{f_k - f}{n}$
8) Calculates the largest absolute value of F(Z) – S(Z) as Dcount.
9) Determine the value of Dtable by looking at the critical value of D for the test of one sample of Kolmogorov Smirnov, namely Dα(n).
10) Make a conclusion with the following conditions:
    a) If Dcount Dtable then the data is normally distributed.
    b) If Dcount > Dtable then the data is not normally distributed.

Riadi (2016:96-97)

d. Homogeneity Test

In the initial test, homogeneity test was conducted to determine the equality of the samples. Meanwhile, in the final test, homogeneity test was conducted to determine the type of statistical hypothesis testing used. Because the two samples are different in size, to test the homogeneity of the sample and population, Fisher's exact test (F-Test) is used with the following steps:

1) Determine the significance level () to test the hypothesis.α
   H0 : σ_1^2= (variant 1 is equal to variant 2 or homogeneous)σ_2^2
   H0 : $\sigma_1^2 \neq \sigma_2^2$ (variant 1 is not the same as variant 2 or not homogeneous)
   By test criteria:
   - Accept H0 if FcountFtable and<
   - Reject H0 if F countFtable>
2) Create a helper table
3) Calculate the variance of each data group, with the formula:
   $S_A^2 = \frac{\sum(X-\bar{X})^2}{n\text{-}1}$
   $S_B^2 = \frac{\sum(X-\bar{X})^2}{n\text{-}1}$
4) Determine the value of Fcount= $\frac{varian\ terbesar}{varian\ terkecil}$
5) Determine the value of Ftable for the significant level , dk1 = dk the numerator = n-1, and dk2 = dk the denominator = n-1

Riadi (2016:102-103)

e. Hypothesis test

1) Student's motivation to study

Hypothesis testing on students' learning motivation was tested with the Z test using the formula:

$$Z = \frac{\frac{X_1}{n_1} - \frac{X_2}{n_2}}{\sqrt{pq[\frac{1}{n_1} + \frac{1}{n_2}]}}$$

$dengan: p = \frac{X_1 + X_2}{n_1 + n_2}$ and q = 1 - p

Information:

Z = Value Zcount

X_1 = Number of events in group 1

X_2 = Number of events in group 2

p = Proportion of overall occurrence of both groups

q = Proportion of non-occurrence of the two groups as a whole

n_1 = Number of samples 1

n_2 = Number of samples 2.

The steps for testing the hypothesis for learning motivation are as follows:the following gai:

a) Statistical hypothesis formulation:

H0 : "Students' learning motivation by using learning models *Problem Based Learning* not better than using conventional learning models".

Ha : "Students' learning motivation by using the learning model" *Problem Based Learning* better than using conventional learning models.

With statistical model

H0 :$P_1 \leq P_2$

Ha :$P_1 > P_2$

Meaning: right side test

b) Table values of the z distribution:

The significant level for this study was 5% (= 0.05)∝

Ztable = =$Z_{(\propto)} Z_{(0,05)}$

c) Test criteria: One-sided test

Accept H0 and reject Ha if and reject H0 and accept Ha for the opposite.$Z \leq Z_{tabel}$,

d) Statistical test using the formula:

$$Z = \frac{\frac{X_1}{n_1} - \frac{X_2}{n_2}}{\sqrt{pq[\frac{1}{n_1} + \frac{1}{n_2}]}}$$

e) Conclusion

Conclusions are based on test criteria.

Riadi (2016:155-157)

2) Understanding of Students' Mathematical Concepts

Hypothesis testing is done by using the data from the final test both in the experimental class and in the control class. If the final test data is normally distributed and homogeneous, then hypothesis testing is carried out using parametric statistics (independent t test), with the following steps:

a) Statistical hypothesis formulation

H0 : "Understanding students' mathematical concepts by using learning models" *Problem Based Learning* not better than using conventional learning models".

Ha : "Understanding students' mathematical concepts by using learning models" *Problem Based Learning* better than using conventional learning models.

With statistical models:

H_o : $\mu_1 \leq \mu_2$

H_a : $\mu_1 > \mu_2$

b) Table value of t distribution

dk = n1 +n2 -2 and the significance level is 5% (α = 0.05).

Because the test is two-sided, then ttable = t1/2α(dk)

c) Test criteria:

Because the test is one-sided, then: Accept H0 and reject Ha if and reject H0 and accept Ha for the opposite situation.$t \leq t_{tabel}$

d) Statistic test

The formula used is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

Where:

t count = Price t count

$\bar{X}_1$ = The average value of the experimental class

$\bar{X}_2$ =The average value of the control class

n1 = Number of experimental class samples

n2 = Number of control class samples

s2 = The variance of the two classes

s12 = Experimental class variance

s22 = Control class variance

Riadi (2016:237-239)

e) Conclusion

The results of statistical tests are confirmed in the table of price values for the t-b distribution with a significant level $\alpha = 5\%$ dan $\mathrm{dk} = (\mathrm{n}_1 + \mathrm{n}_2 - 2)$. The test criteria are accept H0 and reject Ha if and reject H0 and accept Ha for the opposite situation.$t \leq t_{tabel}$

C. Research results

Logical Validation

Before the initial test and final test were determined as research instruments, they were logically validated for the mathematics teacher/lecturer. The results of the validation by the validator for the initial test are listed in the following table:

Table 5

ANALYSIS RESULTS LOGICAL VALIDATION QUESTION TEXT (Initial Test)

No	Validator 1				Validator 2				Validator 3				Aver age R	R level	Average Validation	**TV**
	JJ	JK	R	TV	JJ	JK	R	TV	JJ	JK	R	TV				
1.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
2.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
3.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
4.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
5.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
6.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
7.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid

Information:
JJ : Number of Answers
JK : Number of Errors
R : Reproducible
TV : Validation Level

Based on the table above, it can be concluded that the initial test is valid.

The results of the validation by the validator for the final test are listed in the following table:

Table 6
ANALYSIS RESULTS LOGICAL VALIDATION QUESTION TEXT (Initial Test)

No	Validator 1				Validator 2				Validator 3				Aver age R	R level	Average Validation	**TV**
	JJ	JK	R	TV	JJ	JK	R	TV	JJ	JK	R	TV				
1.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
2.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
3.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
4.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
5.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
6.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid
7.	14	0	1	4	14	0	1	4	14	0	1	4	1	Accepted	4	Valid

Information:
JJ : Number of Answers
JK : Number of Errors
R : Reproducible
TV : Validation Level

Based on the table above, it can be concluded that the final test is valid.

b. Test Results of Research Instruments

After the concept understanding test was declared valid by the three validators, then the test was piloted at SMP Negeri 2 Tuhemberua class VIII for the 2019/2020 school year with 7 items in the form of a description test. The test results of the research instrument are listed in appendix 10 table 11. Furthermore, the data from the test results are used to test the test validity, test reliability, test difficulty level, and test discriminatory power.

1) Test Validity Test

Based on the test data of the concept understanding test, the calculation of the validity test using the product moment correlation formula gives results as shown in the following table:

Table 7

RESULT OF CALCULATION OF VALIDITY TEST TRIAL INSTRUMENT CONCEPT UNDERSTANDING TEST FOR CLASS VIII SMP NEGERI 2 TUHEMBERUA FOR THE 2019/2020 ACADEMIC YEAR

No	rcount	rtable	Information
1	0.724	0.381	Valid
2	0.768	0.381	Valid
3	0.802	0.381	Valid
4	0.784	0.381	Valid
5	0.736	0.381	Valid
6	0.846	0.381	Valid
7	0.786	0.381	Valid

From the table above, it can be concluded that all the concept understanding tests are valid.

2) Test Reliability Test

To test the reliability of the test is done by using the alpha formula. From the calculation of the variance of each item, the results are shown in the following table:

Table 8

ITEM VARIANCE CALCULATION RESULT NUMBER 1 UNTIL ITEM NUMBER 7

No	Item Number	i2
1	1	1.77
2	2	1.33
3	3	1.77
4	4	1.31
5	5	1.77
6	6	1.21
7	7	1.02
Amount		**10,17**

Based on the calculation of the variance of each item of the question, the variance of the total score is obtained (∂_t^2) = 42,44. By using the alpha formula, we get r11 = 0.887 thenconsulted on the value of the product moment table with N = 28 with a significant level of 5% with dk = 28-1 = 27, then rtable = 0.381 so that r11 > rtable. Thus, the test is declared Reliable.

3) Difficulty Test

From calculating the difficulty level of item number 1 to item number 7 as shown in the table below:

Table 9

TEST DIFFICULTY LEVEL

No. Question Items	mean	Maximum Score	kindergarten	Information
1	2,857	4	0.714	Easy
2	1,750	4	0.438	Currently
3	2,857	4	0.714	Easy
4	2,214	4	0.554	Currently
5	2,857	4	0.714	Easy
6	1,929	4	0.482	Currently
7	0.893	4	0.223	Hard

From the table above, it can be concluded that the level of difficulty of each test item corresponds to the level of difficulty on the test grid.

4) Distinguishing Power Test

To find out whether each test item can distinguish the ability of each student, the discriminatory power is calculated with the results as shown in the following table:

Table 10

DIFFERENTIAL POWER INDEX TRIAL INSTRUMENTS OF CONCEPT UNDERSTANDING TESTS FOR CLASS VIII SMP NEGERI 2 TUHEMBERUA STUDY YEAR 2019/2020

No Item	Mean KA	Mean KB	KA-KB	Maximum Score	Distinguishing Power	Information
1	3,786	1,929	1,857	4	0.464	Accepted
2	2,571	0.929	1,643	4	0.411	Accepted
3	3,786	1,929	1,857	4	0.464	Accepted
4	3,143	1,286	1,857	4	0.464	Accepted

5	3,786	1,929	1,857	4	0.464	Accepted
6	2,857	1,000	1,857	4	0.464	Accepted
7	1,714	0.071	1,643	4	0.411	Accepted

From calculating the discriminatory power of item number 1 to item number 7, it was stated that all test items were acceptable/good.

2. Data processing

a. Processing of Motivation Questionnaire Results

1) Experiment Class

Based on the results of the scores for each item of the learning motivation questionnaire in the experimental class from 18 questions and statements with an ideal score = 120, an average percentage of 77.91 was obtained with a good category.

2) Control Class

Based on the results of the scores for each item of the learning motivation questionnaire in the control class from 18 questions and statements with an ideal score = 124, an average percentage of 49.96 was obtained in the less category.

b. NPKM Processing

1) Pre-Test

a) The Result of Understanding the Experiment Class Concept

From the test results, it was obtained the acquisition score of each student on the concept understanding test (initial test) for each number of questions. Furthermore, from the acquisition scores, processing of each item was carried out to obtain the value of understanding students' mathematical concepts as follows:

$$\text{NPKM} = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ total} x100$$

b) Understanding Control Class Concept

From the test results obtained scores of each student on the concept understanding test (initial test) for each number of questions. Furthermore, from the acquisition score, processing of each item is carried out to get the value of understanding students' mathematical concepts as follows:

$$\text{NPKM} = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ total} x100$$

2) Final Test

a) Understanding the Experiment Class Concept

From the test results obtained scores of each student on the concept understanding test (final test) for each number of questions. Furthermore, from the acquisition score, processing of each item is carried out to get the value of understanding students' mathematical concepts as follows:

$$\text{NPKM} = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ total} x100$$

b) Understanding Control Class Concept

From the test results obtained scores of each student on the concept understanding test (final test) for each number of questions. Furthermore, from the acquisition

score, processing of each item is carried out to get the value of understanding students' mathematical concepts as shown in the following table:

$$\text{NPKM} = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ total} x100$$

3. Average value

a. Average Value of Motivation Questionnaire Results

Based on the results of the calculation of the average percentage of student motivation questionnaires (attachment 15a), it is obtained:

1) The average percentage of the results of the experimental class student motivation questionnaire was 77.91 which was classified as good.
2) The average percentage of control class students' motivation questionnaire results was 49.96 which was classified as less.

b. Average NPKM

1) Initial Test Average

Based on the results of calculating the average score of students on the initial test (appendix 20), the following data were obtained:

a) The average student learning outcomes in the experimental class were 57.13, which was considered sufficient.
b) The average control class student learning outcomes of 51.74 is low.

The results of the average scores of each indicator of the concept understanding of the experimental class and control class students on the initial test can be illustrated in the following diagram:

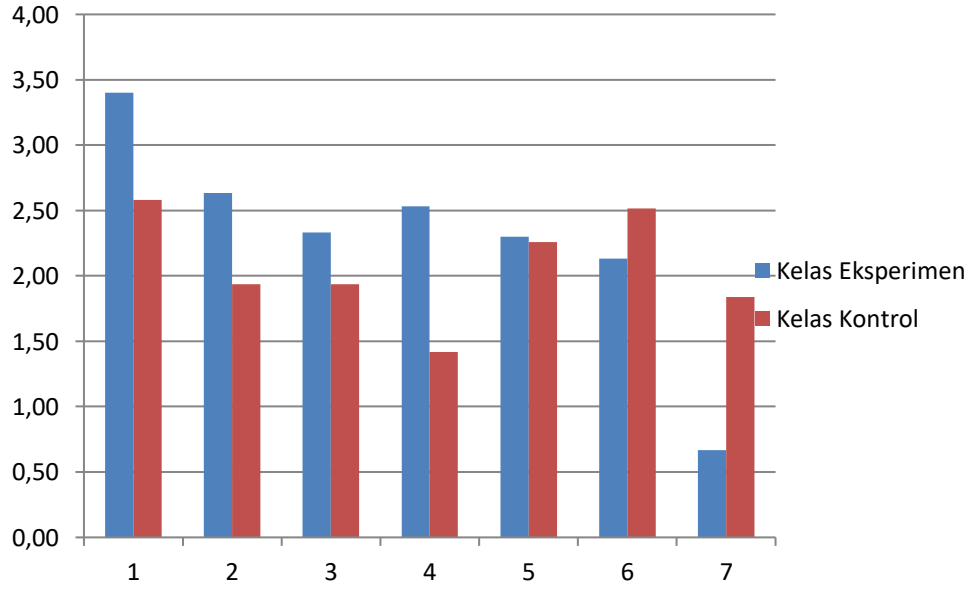

Figure 6. Average Score of Each Indicator of Understanding Mathematical Concepts Pre-Test

Information:

1. Restate a concept.
2. Classify objects according to certain properties according to the concept.
3. Give examples and not examples of concepts.

4. Presenting concepts in various forms of mathematical representation.
5. Develop necessary or sufficient conditions of a concept.
6. Using, utilizing and selecting certain procedures or operations.
7. Apply concepts or algorithms in problem solving.

2) Final Test Average

Based on the results of calculating the average score of students on the final test (appendix 21), the following data were obtained:

a) The average student learning outcomes of the experimental class were classified as good.82,30
b) The average student learning outcomes of the control class were quite adequate.58,97

The results of the average scores of each indicator of the concept understanding of the experimental class and control class students on the initial test can be illustrated in the following diagram:

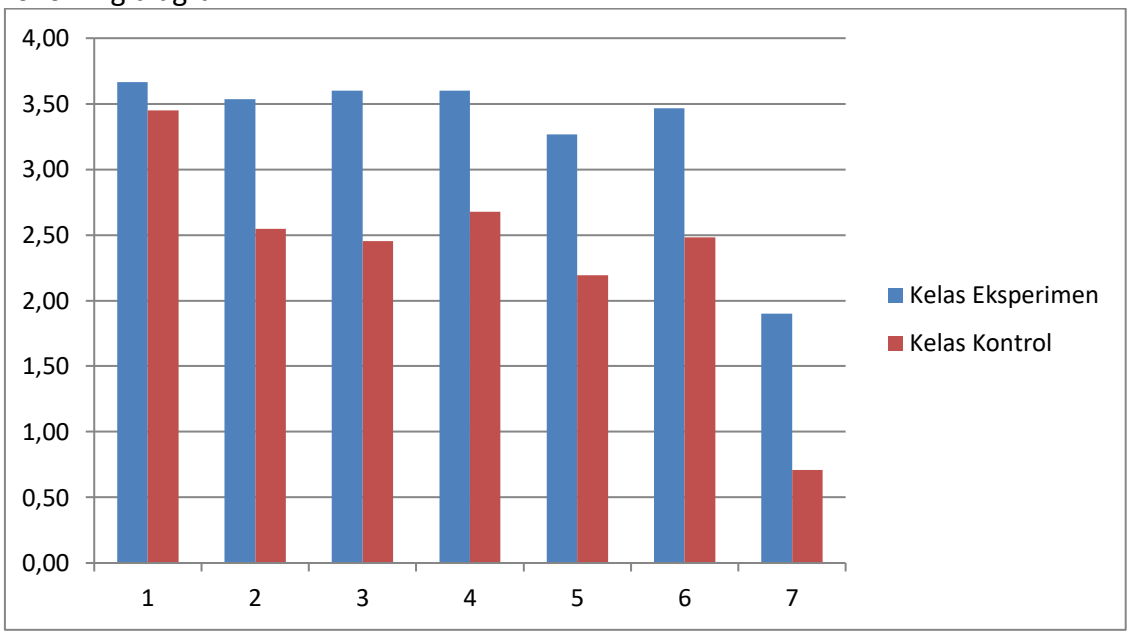

Figure 7. Average Score of Each Indicator of Understanding Mathematical Concepts Final Test

Information:

1. Restate a concept.
2. Classify objects according to certain properties according to the concept.
3. Give examples and not examples of concepts.
4. Presenting concepts in various forms of mathematical representation.
5. Develop necessary or sufficient conditions of a concept.
6. Using, utilizing and selecting certain procedures or operations.
7. Apply concepts or algorithms in problem solving.

4. Standard Deviation (Standard Deviation)

a. Initial Test Standard Deviation

Based on the calculation of the standard deviation in the initial test (appendix 22), the following data were obtained:

1) The standard deviation (standard deviation) of learning outcomes in the experimental class is 7.305.
2) The standard deviation (standard deviation) of learning outcomes in the control class is 9.081.

b. Final Test Standard Deviation

Based on the calculation of the standard deviation on the final test (appendix 23), the following data were obtained:

1) The standard deviation (standard deviation) of learning outcomes in the experimental class is 9,89.
2) The standard deviation (standard deviation) of learning outcomes in the control class is 9,58.

5. Normality test

a. Initial Test Normality Test

1) Experiment Class
Based on the calculation of the normality test in the experimental class (attachment 24table 27) obtained and . Because then the sample which is the experimental class is normally distributed.D_{hitung}=0,1352D_{tabel}=$D_{0,05(30)}$=0,2400D_{hitung}<D_{tabel}
2) Control Class
Based on the calculation of the normality test in the control class (attachment 24 table 28) obtained and . Because then the sample that becomes the control class is normally distributed.D_{hitung}=0,1246D_{tabel} = $D_{0,05(31)}$=0,2400D_{hitung}<D_{tabel}

b. Final Test Normality Test

1) Experiment Class
Based on the calculation of the normality test in the experimental class (attachment 25 table 29) obtained and. Because then the sample that becomes the experimental class is normally distributed.D_{hitung}=0,1443D_{tabel}=$D_{0,05(30)}$=0,2400D_{hitung}<D_{tabel}
2) Control Class
Based on the calculation of the normality test in the control class (attachment 25 table 30) obtained and. Because then the sample that becomes the control class is normally distributed.D_{hitung}=0,0885D_{tabel} = $D_{0,05(31)}$=0,2400D_{hitung}<D_{tabel}

6. Homogeneity Test

a. Initial Test Homogeneity Test

Based on the calculation of homogeneity test (attachment 26) obtained. While obtained . Because that is, then accept H0 which means that the sample is homogeneous.F_{hitung} = 0,67F_{tabel} =1,85F_{hitung}<F_{tabel}0,67 <1,85

b. Final Test Homogeneity Test

Based on the calculation of homogeneity test (attachment 27) obtained. While obtained . Because that is, then accept H0 which means that the sample is homogeneous. Because the sample is homogeneous, it is continued to test the hypothesis by using parametric statistics.F_{hitung} = 1,11F_{tabel} =1,85F_{hitung}<F_{tabel}0,67 <1,85

7. Hypothesis testing

a. Learning Motivation Hypothesis Test

To prove the hypothesis of this study, hypothesis testing is carried out through the Z test formula. In this study the statistical hypotheses to be tested are:

H0 :$P_1 \leq P_2$

Ha :$P_1 > P_2$

Based on the calculation of the hypothesis test (attachment 28) it is known that Z = then the results are confirmed with the value of Ztable = = = 1.64 Because Zcount = and ztable = 1.64, where Zcount then rejects H0 accepts Ha which means "student learning motivation using the Problem Based learning model Learning is better than using conventional learning models". Because the right side, then the normal curve is as follows:25,335$Z_{(\propto)}Z_{(0,05)}$25,335 $> z_{tabel}$

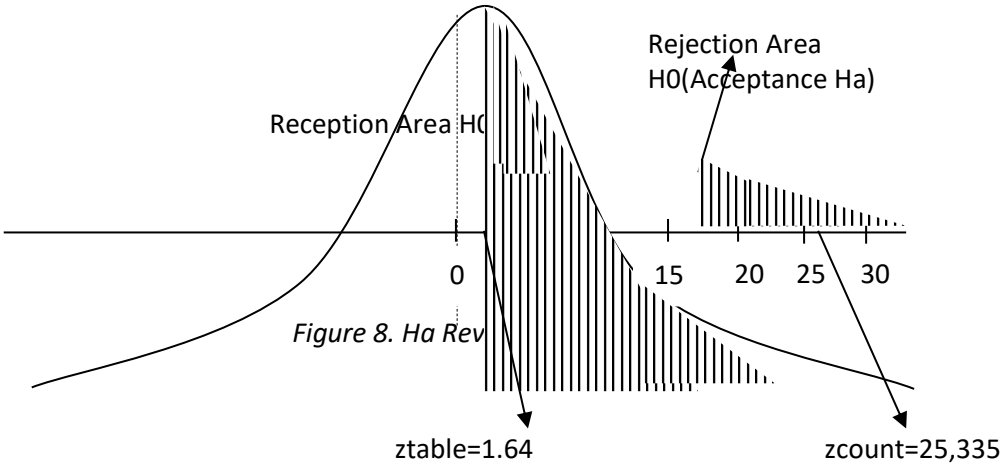

Figure 8. Ha Rev

b. Hypothesis Testing for Understanding Mathematical Concepts

To prove the hypothesis of this study, hypothesis testing was carried out through the independent t test formula. In this study the statistical hypotheses to be tested are:

Ho : $\mu_1 \leq \mu_2$

Ha : $\mu_1 > \mu_2$

Based on the calculation of the hypothesis test (attachment 29) it is known that tcount = then the results are confirmed with the value of ttable for dk = n1 + n2 – 2 = 30 + 31 – 2 = 59 at a significant level of 5% (α = 0.05), because the right side test , then: ttable = tα(dk) = t(0,5)(59) = t0,5(59) = 1,684. Because t count = and t table = 1.684, wherein reject H0 accept Ha which means "Understanding of students' mathematical concepts using the Problem Based Learning learning model is better than using conventional learning models". Because the test is right-handed, the normal curve is as follows:9,357 9,357$t_{hitung} > t_{tabel}$,

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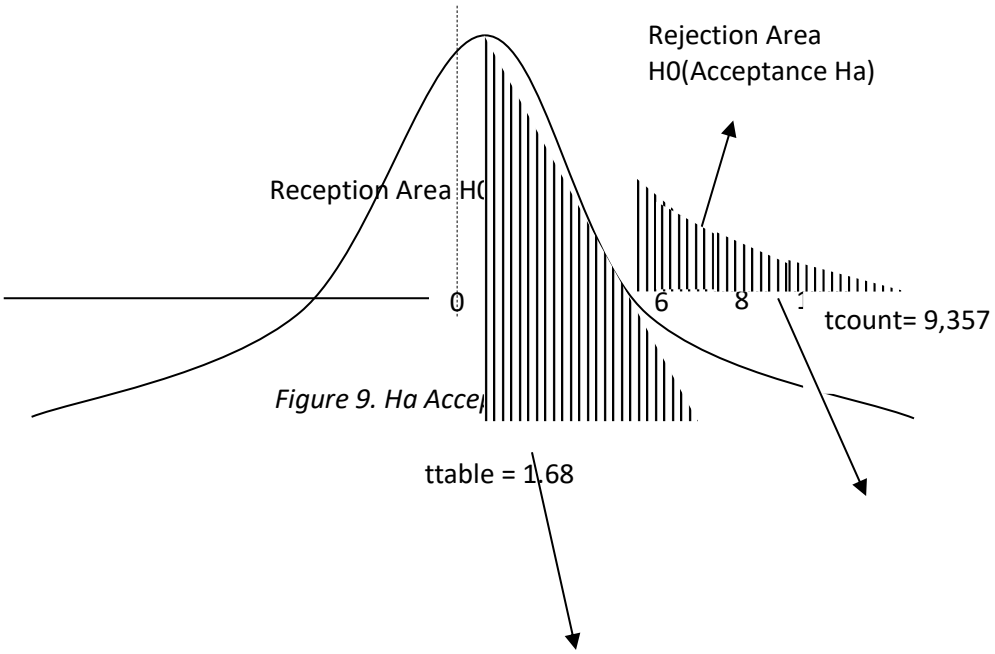

Figure 9. Ha Accep

CONCLUSIONS AND SUGGESTIONS

A. Conclusion

Based on the results of the discussion that has been carried out by taking into account the formulation of the problem and research objectives, several conclusions can be made, namely:

1. Based on the results of hypothesis testing obtained and Ztable 1.64. Because $Z = 25{,}335 z_{hitung} > z_{tabel}$ then reject H0 accept Ha which means "student learning motivation by using the Problem Based Learning learning model is better than using conventional learning models".

Based on the results of hypothesis testing, it is obtained tcount = and ttable 2.021. Because then reject H0 accept Ha which means "Understanding of students' mathematical concepts by using the Problem Based Learning learning model is better than using conventional learning models".9,357 $t_{hitung} > t_{tabel}$,

B. Suggestion

Based on the research findings, discussions and conclusions, the researchers submit several suggestions, namely:

1. In the learning process, a teacher should choose a learning model that is in accordance with the material being taught.
2. For students are expected to be more active in learning in order to obtain very satisfactory results.
3. Learning with Problem Based Learning is one of the learning models that can be used in teaching and learning activities, especially in mathematics.
4. The results of this study should be used as material for comparison to future researchers.

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