THE INFLUENCE OF THE APPLICATION OF THE MATHEMATIC LEARNING TECHNIQUE BASED ON THE DAVID TALL'S THREE WORLDS MATHEMATICS THEORY ON THE ALGEBRAIC THINKING SKILLS OF STUDENTS

(Experimental Study at Seventh Class of *SMP* Syarif Hidayatullah Cirebon)

A THESIS

Submitted to the Mathematics Department of The State Institute for Islamic Studies (IAIN) Syekh Nurjati Cirebon in Partial Fulfillment of the Requirement for Graduate Degree of Scholar in Mathematics Education

IIS SUGIARTI
Reg. Number. 59450987

MATHEMATICS DEPARTMENT OF TARBIYAH FACULTY
THE STATE INSTITUTE FOR ISLAMIC STUDIES
SYEKH NURJATI CIREBON

2013

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ABSTRACT

Iis Sugiarti **THE INFLUENCE OF THE APPLICATION OF THE MATHEMATIC LEARNING TECHNIQUE BASED ON THE DAVID TALL'S THREE WORLDS MATHEMATICS THEORY ON THE ALGEBRAIC THINKING SKILLS OF STUDENTS.**

Algebraic thinking is not single thought, but it is multiple forms of thought and of understanding symbolism. More than that, this skill should be mastered earlier through which students can learn to think productively with good mathematical ideas. Based on observation conducted in Junior High School Syarif Hidayatullah, the majority of students find difficulties in learning algebra. Algebra is considered to be a new subject that is viewed to be too abstract. As an impact, students find difficult to understand mathematical problems in the form of algebra.

The research aims to review: (1) how effective the application of the mathematical learning technique based on the David Tall's Three Worlds Mathematics Theory is (2) how the students' ability to think algebraically is, and (3) the influence of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students.

The application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory is an effective and suitable learning technique to improve the algebraic thinking skills of students. This theory, invites students to learn mathematics from the embodied world, symbolic world up to the axioms world. Algebraic thinking is a generalization of arithmetic, learning about variety of procedures in solving certain problems, learning about relationships and learning about the structure.

The research uses a quantitative approach by using one group pre-test post-test design. The population in this research is all of the students Junior High School Syarif Hidayatullah and the sampling technique used is cluster random sampling with class VII A as an experiment class. The variables in this research are the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory and the algebraic thinking skills of students. The collecting data techniques are using test and scale.

The results of the research show that: (1) 56.25% of students (18 students) gave a very positive response and the rest (14 students) or 43.75% gave a positive response; (2) the mean of gain value of the algebraic thinking skills of students is 0.4606 due to which it is considered into medium category (3) there is a positive influence significantly of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students with regression equation $\hat{Y} = -1.118 + 0.02x$ with 38.5% of the influence.

Key Words : The David Tall's Three Worlds Mathematics Theory, Algebraic Thinking Skills

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(Experimental Study at Seventh Class of *SMP* Syarif Hidayatullah Cirebon)

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Assalamu'alaikum wr., wb.

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1. this thesis is truly work of the writer that proposed to fulfill one of requirement to get Bachelor's Degree in Education (S-1) in The State Institute for Islamic Studies Syekh Nurjati Cirebon;
2. all of sources are used in writing this thesis have been inserted by using scientific methods of writing; and
3. if oneday is proven that this thesis either part or all of the contents are plagiarism work, the writer is ready of getting sanction that be valid in The State Institute for Islamic Studies Syekh Nurjati Cirebon.

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RATIFICATION

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MOTTO

Man jadda wajada:
"siapa yang bersungguh-sungguh akan berhasil"
Man shabara zhafira:
"siapa yang bersabar akan beruntung"

DEDICATION

This work is dedicated to:

Special dedication is given to my incredible parents, Mom Catu and Daddy Satriya. Your love is undoubtable and unsubstitable, your willing and praying are uncomparable, and your sincerity opens and brights my ways.

My great older brothers and sisters (Sahlani, Said, Sofyan, and Suhartini) and Ka Ardi Gunawan Thanks for motivating me. My pride younger sister Aisyah Sinta Balqis

My Beloved friends (Zara Zahra Anasha, Neliyana, Lina Kurniasih, Tia Septianawati, Anisa Rahmawati, Riany Fitrah, Umi Salamah, Putri Hidayani, Devi Maisarah, Bunda, and Pirman) and also The Big Family of MTK-A

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May Allah SWT., gives you blessing life.

-

PREFACE

In the name of Allah, Most Gracious and Merciful. All praises and thanks be to Allah because of His blessing the writer was able to finish this thesis. May invocation and peace always be with Prophet Muhammad Peace be Upon Him, family, colleageus, and his followers up to the end of the world. Making of the thesis entitled is **THE INFLUENCE OF THE APPLICATION OF THE MATHEMATIC LEARNING TECHNIQUE BASED ON THE DAVID TALL'S THREE WORLDS MATHEMATICS THEORY ON THE ALGEBRAIC THINKING SKILLS OF STUDENTS** was companied by challenges that gave satisfaction for the writer.

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8. Syahroni, S.Pd.I., Mathematics Teacher of Junior High School Syarif Hidayatullah Cirebon
9. Students of Junior High School Syarif Hidayatullah Cirebon
10. Special thanks to my parents and family for support and pray.

May this thesis is useful for Stakeholder of education, especially for the writer and mathematics education.

Cirebon, August 2013

The Writer,

Iis Sugiarti

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CHAPTER I

INTRODUCTION

A. Problem Background

Algebra is a branch of mathematics concerning the study of structure, relation and quantity. Basic algebra becomes a part of the curriculum since the secondary education and provides an introduction to the basic ideas of algebra, including adding and multiplying numbers, the concept of variables, definition of polynomials, and factoring and determining root.

Algebra was actually born from the human experience of looking at patterns. The patterns appear in the form of numbers or geometric patterns. Therefore, algebra should be viewed as a process of mathematic maturity.

Mastering algebra is very important because algebra will be the main requirement when students want to learn mathematics in the following stages for example, when studying equations, inequalities, systems of equations, functions, equations of lines, etc. In other words mastering algebra operation will help students understand mathematics more easily.

Thinking is a dynamic process that can be described through its process or operation (Suryabrata, 2011: 55). Algebraic thinking can be found in all areas of mathematics and is quite important to make the math useful in daily life. Algebraic thinking is not a single thought, but it is a multiple forms of thought and of understanding symbolism. Although algebra is a separate section in the curriculum, it should still be linked to all areas of mathematics. More than that this skill should be mastered earlier, through which students can learn to think productively with good mathematical ideas.

According to Mr. Syahroni, a math teacher at SMP Syarif Hidayatullah, “the majority of students' find difficulting in learning algebra”. Some factors can be mentioned including the concept of variable system and symbols that they had never learnt before. Algebra is considered to be a new subject that is viewed to be too abstract. As an impact, students find difficult to understand mathematical problems in the form of algebra.

Ausabel (Hudojo, 1990: 89) a psychologist, states that a new knowledge learnt depends on a person's existing knowledge. Thus, in the study of mathematics, if the concept A and B is the pre-requirement of the C, it is not possible to learn the C before learning the A and B.

The changes of method and system in learning process at schools will influence student's learning attitudes and habits. Russefendi states, a positive attitude towards mathematics makes students understand the math and starts to see mathematics as a beautiful lesson. This good attitude will motivate students to learn mathematics (Russefendi, 2004:123).

Mathematics learning process is not always effective as there are still some students who have difficulties in understanding mathematics. The main reason of the difficulty is the true nature of mathematics as an abstract object. This fact needs to be realized and to find out an effective solution, through which students can learn math easily and fun.

Learning materials in mathematics vary and so the teaching methods are. One of the materials is triangles and quadrilaterals that are closely related to the basic concepts of algebra. However, the fact that many teachers prefer to use a lecture method causes students difficult to well understand the materials.

Thus, we need a right teaching method and effective learning through which students can understand the material well and are able to learn the abstract thing. One of the best teaching methods that could be applied is learning technique based on the David Tall's Three Worlds Mathematics Theory.

Learning technique based on the David Tall's Three Worlds Mathematics Theory can help students think systematically. This theory invites students to learn mathematics from the embodied world, symbolic world up to the axioms world.

From the explanation above, the reasoning about this research are:

1. Introduce The David Tall's Three Worlds Mathematics Theory.
2. The students still find difficulties to understand mathematical problems in the form of algebra.

3. The effective learning technique or teaching methods can improve the student's algebraic thinking skills.

B. Identification of Problem

Based on the description of the background above there are some research problems that can be identified as follow:

1. Learning techniques that teachers use are still conventional.
2. Algebraic thinking skills are not used by students up to maximum level.
3. Lack of the supportive facilities that can motivate students to be more active in learning.
4. The absence of reciprocity in the learning process caused students miss an opportunity to express their new ideas.
5. There is still a difficulty for students to well respond algebraic topics.
6. Mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is believed to able to improve students' algebraic thinking skills.
7. Students are still not able to manipulate the algebraic problems.
8. Students still find difficulties when the teacher gave different types of questions from the sample.
9. Algebraic thinking skills are still hard to be done or applied by the students.
10. The level of students' algebraic thinking skill is far from satisfaction.

C. Limitations of Problems

Based on the identification of the problems above, the researcher take the problems to be studied:

a. Learning techniques based on the David Tall's Three Worlds Mathematics Theory is a techniques of presenting mathematic in the three worlds of mathematics; embodied world, symbolic world, and the world of axioms.
b. Algebraic thinking skills are the improvement of ability to generalize from experience with numbers and calculations, to do the math reasoning, explore the concept of patterns and function, formalize ideas with the use of symbols, and to be useful for solving math problems.

c. The research was conducted during the second semester of the 7th grade at Syarif Hidayatullah Junior High School in the 2012-2013 academic years and within two mathematics materials; triangles and quadrilaterals.

D. Formulation of Problems

Based on the limitation of problems above, we propose the following questions:

a. How effective is the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory?
b. How is the students' ability in the algebraic thinking?
c. Is there any influence of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the ability of student's algebraic thinking?

E. Research Objectives

By looking at the questions posed in the formulation of the problem, the purposes of the research are:

a. To review how effective the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory is.
b. To review how the students' ability to think algebraically is.
c. To review the influence of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the ability of student's algebraic thinking.

F. Significance of the Research

As for the usefulness of the research, are divide into two parts:

1. Theoretical Significance

   This research is expected to contribute to the discourse of the mathematics learning techniques based on the David Tall's Three Worlds of Mathematics Theory on the improvement algebraic thinking skills of students.

2. Practical Significance

a. For students, learning mathematics with the use of techniques based on the David Tall's Three Worlds Mathematics Theory is expected to improve thinking skills in solving algebra in math problems.

b. For teachers, learning techniques is aimed at improving the learning ability of students to think algebraically.

c. For schools, this research could further give more information about one of mathematics learning techniques based on the David Tall's Three Worlds Mathematics Theory to give guidelines in improving students' ability to think algebraically.

CHAPTER II

THEORETICAL FRAMEWORK

A. Theoretical Description

1. Cognitive Learning Theory

Learning in the perspective of cognitive theory is a change in perception and understanding that is not always be clearly discarded as thought of behavior that physically appears in science. The cognitive theory emphasizes learning as an internal process. Learning is an activity that involves a very complex thought processes.

Paul Suparno (Suprijono, 2012:23) describes the cognitive development according to Jean Piaget as follows:

STEP	AGE	CHARACTERISTICS OF DEVELOPMENT
Sensory motor	0-2 years	Under the action step by step
Preoperative	2-7 years	Use of symbols / language and Signing of the Intuitive concept
Concrete Operation	8-11years	Clear rules Logical Reversible
Formal Operation	More than 11 years	Hypothesis Abstract Deductive and Inductive Logical and Probably

Sources: Suprijono.2012.Cooperative Learning. Yogyakarta: Pustaka Pelajar, p.23.

Piaget states that cognitive development is a process of intellectual adaptation including schemata, assimilation, accommodation, and equilibration. Schemata is a cognitive structure in the form of ideas, concepts, and notion. Assimilation is a process of changing what is understood in accordance with the cognitive structure (schemata) that exist today. Accommodation is a process of integrating the new information

-

into the cognitive structure in the new situation. Equilibration is a mechanically self-regulation to regulate the balance of assimilation and accommodation.

Jerome Bruner (Suprijono, 2012:23) states that a learning process is when culture influences ones individual behavior. As such, the further explains that the individual cognitive development runs through three phases which include enactive, iconic, and symbolic.

a. The enactive phase is when an individual performing activities in an attempt to understand the world around him or her. Through him or her motoric knowledge.
b. The iconic phase is when individual understand an object through images and verbal visualization. In the forms of parables and comparisons.
c. The symbolic stage is when individuals have been able to have ideas or abstract ideas that are strongly influenced by language and logic abilities. Through language symbols, logic, mathematics, and so on.

So we can conclude that learning is changing perceptions and experiences in which the learners of integrate new information involve a very complex thinking process and influence their behavior. In the process, learning take three phases; enactive stage, iconic, and symbolic.

2. Learning Mathematics

a. Definition of Mathematics Learning

According to Suprijono (2012:13) the differences between learning and teaching is not only in the level of lexical aspect, but also in their implementation in the learning process. In term of lexical meaning learning is a process, method and action of learning. It differs from the term of teaching in the level of teaching. In the process of teaching, students learn, while the teacher is teaching which the teacher organizes the learning progress. The teaching process from the learning perspective is when the teacher provides learning facilities for students to learn. The subject of the learning process is students. The centre of learning process

-

is a interactive dialogue between teacher and students. Thus, learning is a constructive and organic process while teaching is not more mechanical one.

Mathematics (Mu'minatus, 2010:29) is one of the ways of the learning abstract things. In mathematics there are so many patterns, concepts and abstract elaborated. It is probably one of the factors that students find the difficulties and are reluctant to learn and understand it. As the impact they tend to be less motivated and get achievement low marks.

Ruseffendi (2006:260) says that the nature of mathematics among other thing, are:

1) Mathematics is a science about a structure that is well organized. Learning math is to learn about the concepts and structures as well as to find out their relations. A truth category in mathematics consists of observation, guessing, feeling, testing hypotheses, searching for analogies, and so on.
2) Mathematics is the study of relation patterns. Mathematics is called the science of patterns and relationships because we often look for uniformity through which generalizations can be made. As such, we need to pay attention to patterns of regularity, systematic and connection through which a pattern and model of mathematical concept and be constructed.

Thus, mathematic learning is a process about learning concepts and structures as well as looking for a relationship between concepts and structures by learning mathematics, students are expected to have reasoning ability that is in reality reflected through critical, logical and systematic thinking skills and to have good attitudes that are manifested in the principle of objective, honesty and discipline in solving problems in mathematics, other subject studies, as well as those in everyday life.

-

b. Triangles and Quadrilaterals

1) Triangles

A triangle is a plane figure with three straight sides.

Classifying Triangles by Its Angles

In term of the measure of their angles (Siswono, 2007 : 284), there are three types of triangles i.e. acute triangle, right triangle, and obtuse triangle.

- A triangle is acute if all three of its angles are acute.
- A triangle is obtuse if one of their angles is obtuse.
- A triangle is right if one of their angles is right.

Classifying Triangles by Its Sides

In term of the length of their sides there are three types of triangles i.e. isosceles triangle, equilateral triangle, and scalene triangle.

- A triangle is isosceles if two sides are equal.
- A triangle is equilateral if all three sides are equal, i.e. 60^0.
- A triangle is scalene if no two of its sides are equal in length.

Classifying Triangles by Its Angles and Sides

In term of the length of their sides and the measure of their angles, there are some types of triangles as follows:

- A right isosceles triangle is a triangle in which one of their angles is right and two sides are equal.
- An acute isosceles triangle is a triangle in which all three of its angles are acute and two sides are equal.
- An obtuse isosceles triangle is a triangle in which one of their angles is obtuse and two sides are equal.
- A right scalene triangle in which one of their angles is right and no two of its sides are equal in length.
- An acute scalene triangle is a triangle in which all three of its angles are acute and no two of its sides are equal in length.

-

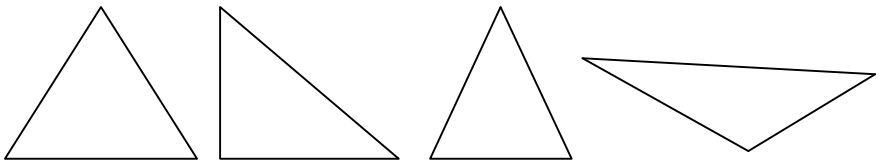
- ❖ An obtuse scalene triangle is a triangle in which one of their angles is obtuse and no two of its sides are equal in length.

Lines in Triangles

There are specific lines in a certain triangle:

- ❖ The altitude of triangle is the line passing through one vertex of the triangle, perpendicular to the line including the side opposite this angle.
- ❖ Bisector of triangle is the line that divides the certain angle of a given triangle into smaller angles of equal size.
- ❖ Perpendicular bisector of triangle is a line passing through the mid-point and perpendicular to a certain side of a given triangle.
- ❖ A median of triangle is a line passing through one vertex of the triangle and the midpoint of the side opposite this angle.

Figure 2.1
Triangles



Perimeter of a triangle is the sum of its three sides

Area of triangle = $\frac{1}{2}\ x\ base\ x\ height$

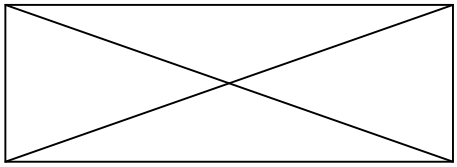
2) Quadrilaterals

a) Rectangles

A rectangle is a quadrilateral with two pairs of parallel sides, four right angles, opposite sides equal in length, equal diagonals bisecting one another (Setyaningtyas, 2009: 52).

-

Figure 2.2
Rectangles



Followings are the properties of rectangle.

- ❖ Opposite sides of rectangles are equal and parallel.
- ❖ Each interior angle of rectangles is a right angle.
- ❖ Diagonals of rectangles are equal.
- ❖ Diagonals of rectangles have the same midpoint.

Let, a rectangle has its length p and width l then:

Perimeter (K) of the rectangles is K = 2 (p + l)

Area (L) of the rectangles is L = p x l

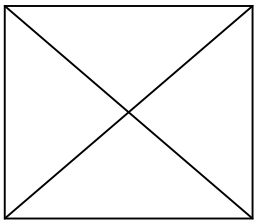
b) Squares

A square is two-dimensional figure with four straight sides, whose four interior angles are right angles (90^0), and whose four sides are the equal length (Cunayah, 2007: 344).

The properties of square are (Winarti, 2008: 261):

- ❖ All four sides of a square are equal length,
- ❖ The diagonals of a square are the bisectors, and
- ❖ The diagonals of a square are perpendicular bisector of each other.

Figure 2.3
Square



The perimeter of the square

$K = 4s$

The area of the square $L = s^2$

-

c) Parallelograms

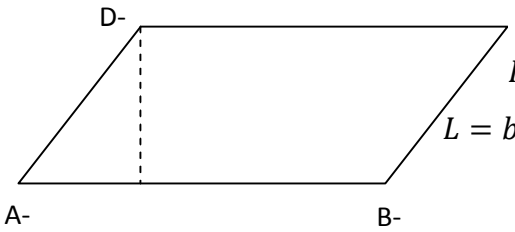
We can form the parallelogram by combining two congruence triangles.

The properties of parallelogram are:

- ❖ The opposite sides are equal and parallel to each other
- ❖ The opposite angles are equal
- ❖ The sum of the consecutive angles is 180^0
- ❖ The diagonals are perpendicular bisector to each other.

We can determine the perimeter of parallelogram by adding up all sides

Figure 2.4
Parallelogram



$K = 2(AB + BC)$

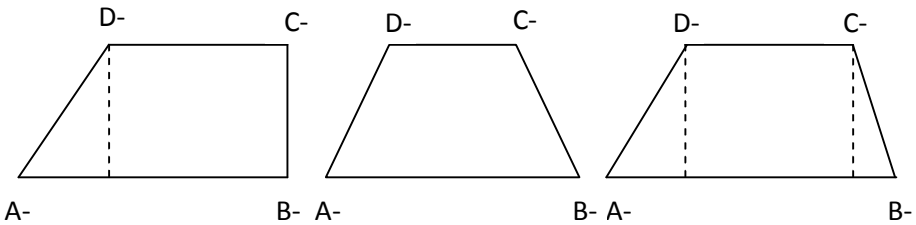
$L = base\ x\ height = a\ x\ t$

d) Trapezoid

A trapezoid is a quadrilateral figure which only has a pair of parallel sides.

Basically, trapezoid consists of 3 types, i.e. right trapezoid, isosceles trapezoid, and scalene trapezoid.

Figure 2.5
Trapezoid



The perimeter and area of trapezoid are:

$$K = AB + BC + CD + AD$$

$$L = \frac{1}{2}\ x\ (AB + DC)x\ t$$

-

e) Kite

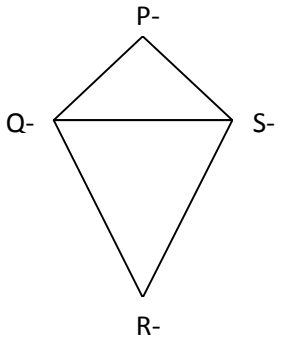
A kite can be formed from two congruence triangles by joining them through their bases.

The properties of kite are:

- ❖ Two pairs of adjacent sides are equal.
- ❖ One of the diagonals is a perpendicular bisector of the other
- ❖ Two pairs of the opposite angles are equal.

The perimeter and the area of a kite are:

Figure 2.6
Kite



$$K = 2\ (PQ + QR)$$

$$L = \frac{1}{2}\ x\ QS\ x\ PR$$

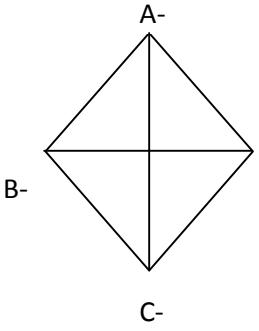
f) Rhombus

Rhombus can be formed by combining two congruence isosceles triangles through its bases.

The properties of rhombus:

- ❖ The four sides of rhombus are equal
- ❖ The opposite angles of rhombus are equal
- ❖ The diagonals are perpendicular bisector to each other

Figure 2.7
Rhombus



The perimeter and the area of rhombus are:

$$K = 4s$$

$$L = \frac{1}{2}\ x\ AC\ x\ BD$$

-

3. Mathematics Learning techniques based on the David Tall's Three Worlds Mathematics Theory

According to Indonesian Dictionary (2005: 1158) technique is a method or a system to do something, how to make or do something artistic. Gerlach and Ely (Uno, 2009: 2) defines engineering as the path, device or media used by the teacher to direct the activities of learners towards the goal to be achieved. Technique also interpreted literally as a person in ways that do apply and practice a method. Sudrajat (2008:1) describes the learning technique as a way of teaching that is done in applying certain learning methods.

Learning techniques can also be interpreted as one way in which to implement a specific learning method. For example, the use of the method of discussion is necessary to use different techniques between classes with students classified as active and passive students (Chatib, 2011: 131). From the above explanation we can conclude that the technique is a system or a way of learning that is done by someone to deliver learning material.

David Tall is one of Richard Skemp education students who study mathematics from the point of psychology view. In his paper, Tall and Grey writes, "The more successful perform in a way which often makes the mathematics seem so effortless for them. If they seem to use so little effort, there must be an internal engine creating the motive force. What is the nature of this engine? We shall see that the more able have a kind of self-generates new knowledge.

If other failed at mathematics, why is it that they often fail so catastriphically? We shall see that the catastrophe occurs because their mathematical thinking are qualitatively different. The less able fail because the mathematics they are doing is more difficult than the mathematics of the more able". (David Tall and Eddie Gray, 1992: 216-221)

-

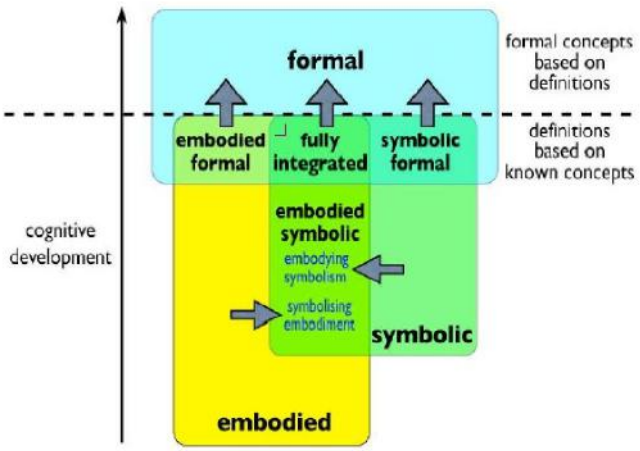
Gray and Tall argues that mathematics is the difficulty lies in "how students see mathematics". For simplicity, it is necessary to makes students understand about the use of mathematical symbols.

Tall (2008:3) divides mathematics into three world, embodied world, symbolic world, and axiomatic-formal world. Embodied world (Object-based) is the world of mathematics based on the perception of and reflection on the object's properties. Originally seen and felt in the real world and then imagine a form of image concept in mind. Antonio Domingos (in Minanur Rohman, 2011:31) states that the Concept is something nonverbal image associated with the name of a concept you have in mind. Concept image can be used to describe the cognitive structures associated with a concept, properties and processes associated with the concept.

Symbolic world (Action-based) is the world that emerged from the embodied world to take action against the object and is symbolized as a concept where the symbol indicates that the process should be carried out and the concepts associated with the process (Procept).

Axiomatic-formal world (Property-based) is the world of mathematics is based on formal theory and evidence, constructing an understanding of object based on a formal definition of the concept associated with the object, so that children make concept definition.

Figure 2.8 Cognitive Development among David Tall's Three Worlds Mathematics Theory



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Sources: David Tall. , 2008. "The Transition to Formal Thinking in Mathematics", Mathematics Education Research Journal, p. 3.

Tall (Minanur Rohman, 2011:32) proposes the term set- before and met-before that a generator transitions between the three worlds. Set-before refer to mental structure at the time we are born, which may take time to become mature in the brain when we make a connection with the outside world at the beginning of life. For example, the visual structure of our brain has a built-in system to identify colors and situations. There are three based set-before that built long-term memory and cause us to think mathematically in a certain way. Three basic set-before are recognition (understand) patterns, similarities, and differences; repetition (repeating) sequence of actions until the actions become automatic; language (language) to describe and improve the way of thinking about something.

Met-before are certain mental facility based on the specific experience of previous students. Met-before are sometimes consistent with the new situation and sometimes inconsistent. Suppose the met-before '5-2 = 3' consistent with all positive numbers where the minus sign (-) means the taking, and not consistent with the negative number '5 - (-2)'. How take (-) of something that has been taken (-2). Set-before and met-before continues to grow along with the child's efforts to make the transition between the three worlds.

Based on the above explanation, it can be concluded that the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is special way or method to delivery of material in the design based on the mathematical theory of the three worlds of mathematics in which the learning process starts from the embodied world and the symbolic world then continued on axiomatic-formal world.

4. Algebraic Thinking Skills

Algebra is the basic for understanding mathematical thinking. This includes an understanding of the patterns and functions, how to represent

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and analyze mathematical situations and structures, models that represent the ideas and quantitative relationships, and approaches that analyze changes in a variety of situations. Most people realize that algebra is needed by scientists or engineers, but algebraic thinking and reasoning are also used by a variety of professions, including health care providers, and graphic designers.

Think algebra is arranged into two main components, the development of a tool to think mathematically and study of basic algebraic ideas (Kreigler, 2007). Mathematical thinking tools structured around three topics; skills of problem solving, representation skills, and quantitative reasoning skills. While the fundamental ideas of algebraic domain is represents content which tool developed mathematical thinking. The fundamental idea explored into 3 parts: algebra as generalized arithmetic, algebra as a language, and algebra and functions as a tool for mathematical modeling.

According to Mark Driscoll (1999:1) argues, there are 2 aspects of algebraic thinking is facilitated by the habit of thinking, namely:

- Build a formula to describe a function. Emergency algebraic thinking is an ability to find patterns and organize data to describe the situation in entering data into the output combined with excellent definition members for the formula of the function.
- Abstracts of calculation. It is the capacity to think about counting independently researched to something. One of the most important characteristics of the facts is always an abstract algebra.

Herbert and Brown (1997) states that "Algebraic thinking is using mathematical symbols and tools to analyze different situations by (1) extracting information from the situation ... (2) representing that information mathematically in words, diagrams, tables, graphs, and equations; and (3) interpreting and applying mathematical findings, such

as solving for unknowns, testing conjectures, and identifying functional relationships ".

Kieran and Chalouh (1993): “Algebraic thinking involves the development of mathematical reasoning within an algebraic frame of mind by building meaning for the symbols and operations of algebra in terms of arithmetic”.

Kaput (NCTM, 1993) says that algebraic thinking is a thought pattern that includes the built of patterns, generalizations, and the most important is an active exploration and parables. Kaput (1999) states that the algebra includes generalizing and display such generalizations using more formal language, which begins generalization of arithmetic, situation modeling, geometry and almost all of mathematics at the elementary level. According to Kaput, there are five forms of algebra, namely:

1. Generalization of Arithmetic and patterns in mathematics.
2. The use of symbols is quite useful.
3. Learning about the structure of the number system.
4. Learning about patterns and functions.
5. Mathematical modeling process, which united together the four ideas above.

The NCTM (2001:282) states that algebraic thinking is to present information from everyday language into symbolic form, determine patterns and generalizations, look for relationships in the function. Usiskin (fostering Algebraic Thinking, 1999) states that algebraic thinking is a generalization of arithmetic, learning about a variety of procedures in solving certain problems, learning about relationships and learn about the structure.

Algebra is often concludes as a generalization of arithmetic. Algebraic Thinking (algebraic thinking) or algebraic reasoning (algebraic reasoning) involves the formation of a generalization of experience with numbers, formalizing ideas using meaningful symbolic systems, and explores the concept of patterns and functions. In addition, algebraic

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thinking involves skills in mathematical modeling, predicting, perform calculations with variables. As, Blanton and Kaput (2003) states that "... teachers must find ways to support algebraic thinking and create a classroom culture that values" students modeling, exploring, arguing, predicting, conjecturing, and testing their ideas, as well as practicing computational skills .. ".

Based on the above explanation, it can be concluded that algebraic thinking is the ability to generalize from experience with numbers and calculations, reasoning against doing math problems, exploring the concepts of pattern and function, and formalize the ideas with the use of a symbol system useful for solving a variety of math problems.

5. Linkage Mathematics Learning Techniques Based on The David Tall's Three Worlds Mathematics Theory with Algebraic Thinking.

Linkage Mathematics Learning Techniques Based on David Tall's Three Worlds Mathematics Theory with Algebraic Thinking is very close. As described above, the Three Worlds Theory Mathematics itself consists of:

a. The conceptual-embodied world, based on the perceptions and reflections on the properties of objects, initially seen and sensed in the real world but then imagined in the mind;
b. The proceptual-symbolic world, that grows out of the embodied world through action (such as counting) and is symbolized as thinkable concepts (such as number) that function both as processes to do and concepts to think about (procepts);
c. The axiomatic-formal world (based on formal definitions and proof), which reverses the sequence of construction of meaning from definitions based on known objects to formal concepts based on set-theoretic definitions. (Tall, 2004:285, 2008a: 5).

Thus, in learning by using learning techniques based on the Three Worlds Theory Mathematics, students are expected to be more effective in making generalizations from experience with numbers and calculations,

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reasoning the math problems, exploring the concepts of pattern and function, and formalize ideas with the use of a symbol system that is useful for solving a variety of math problems.

B. Review of Relevant Research

Of some search results to previous studies, there are many studies that have been conducted relating to the issues to be studied by researchers. Some of the results of previous studies, namely:

1. The influence of Algebraic Thinking Skill to Critical Thinking student's in Mathematics (Case Studies In Class XI IPA 1 SMAN Dukupuntang Cirebon district). Investigated by Agus Machrus, Student Department of Mathematics Education Faculty Tarbiyah IAIN Sheikh Nurjati Cirebon in 2012. From the results obtained Algebraic Thinking known that students demonstrate the criteria being the average value of 67.82 and standard deviation test 13.12. Creativity think math students had an average test score of 69.72 and a standard deviation of 11.08. The resulting regression equation is Y = 35.401 + 0.493 X with the coefficient of determination in the model significance test of 27.6%. This means that whenever there is the addition of (increasing) the ability to think algebraically, it will affect the students' creative thinking by 0.493.
2. Analysis Of Algebraic Thinking Skills Based On The Origin Of School And The Sex Of First Grade Students Academic Year 2011/2012 Faculty Tarbiyah Department Of Mathematics In The State Institute for Islamic Studies Nurjati Sheikh Cirebon. Investigated by Samari, Department of Mathematics Education Students IAIN Sheikh Nurjati Cirebon. Results of research Showed that: (1) the mean greatest achievement of algebraic thinking skills related to solving story problems by mathematical achievement was 40.88% and the one of choices related to representation skills by achievement was 2:55%, (2) there was no difference of algebraic thinking skills based on the origin of the school by the achievement of significance Obtained 0.735 (significance 0.735> 0.05),, (3) there was no

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difference of algebraic thinking skills based on the sex by the achievement of significance Obtained 0.631 (significance 0.631> 00:05), and (4) there were the most dominant seven indicators that can explain algebraic thinking skills by the achievement of cumulative eigen value Obtained 89 345%.

3. “The Influence of Problem Solving Methods in Learning Mathematics to student results of VII a MTs Al-Kautsar Badag Brebes". Investigated by Fatimah, Student Department of Mathematics Education Faculty Tarbiyah IAIN Sheikh Nurjati Cirebon in 2011. Results were obtained value is 5.33 t_{test} □ t_{table} □ 1.99, then the H_0 is rejected. It can be concluded that there is a great influence in the application of methods Problem Solving math on student learning results.

The first research, its independent variable is algebraic thinking skills of students, but in this research the algebraic thinking skills of students is dependent variable.

The second research, almost the same dependent variable discusses it is algebraic thinking skills of students, it’s just a different independent variables are gender and origin school students.

The third research, its independent variable is similar that is about teaching methods. The research is in the same field, its experimental research.

While the research is to be done is experimental research with its independent variable is the application of the mathematic learning technique based on the David Tall’s Three World Mathematics Theory and its dependent variable is algebraic thinking skills of students.

Therefore, the study entitled "The Influence of the application of the mathematic learning technique based on the David Tall’s Three Worlds Mathematics Theory on the algebraic thinking skills of students “in VII grade Syarif Hidayatullah Junior High School Cirebon on the subject Triangles and Quadrilaterals is appropriate doing because of the problem to be studied is not duplication of studies that has been done before.

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C. Framework

Learning activities that take place in the classroom is an essential activity. The learning process is important, because through the process of learning, you will see changes in the attitude of students. It is more to the students' level of understanding and activity of the material presented, so that here also need approaches to teaching. Discuss about the approach can't be separated from teaching techniques and methods used.

According to Syah (2010: 123) approach that meant in terms of learning a foreign language (approach to learning) and implement strategies or tips as well as methods of learning approaches, including the factors that determines the success rate of student learning. "In the learning process, the students are heterogeneous capabilities coupled with the factors that affect student learning from the environment". So for an educator to convey the subject matter is a need for teach technique.

Teaching techniques used by one of the Three Worlds Theory Mathematics David Tall. Learning to use these techniques is expected to create teaching and learning process for students who are more active. Learning process with this technique leads students to learn generalize the problem, so that it can improve students' ability to think algebraically.

Starting from the premise that lead students actively in the learning will facilitate students in accepting the concept. Then automatically move to bring active students. Learning is an effective step to deliver a teaching material.

Graphically thought by researchers can be described by the following diagram:

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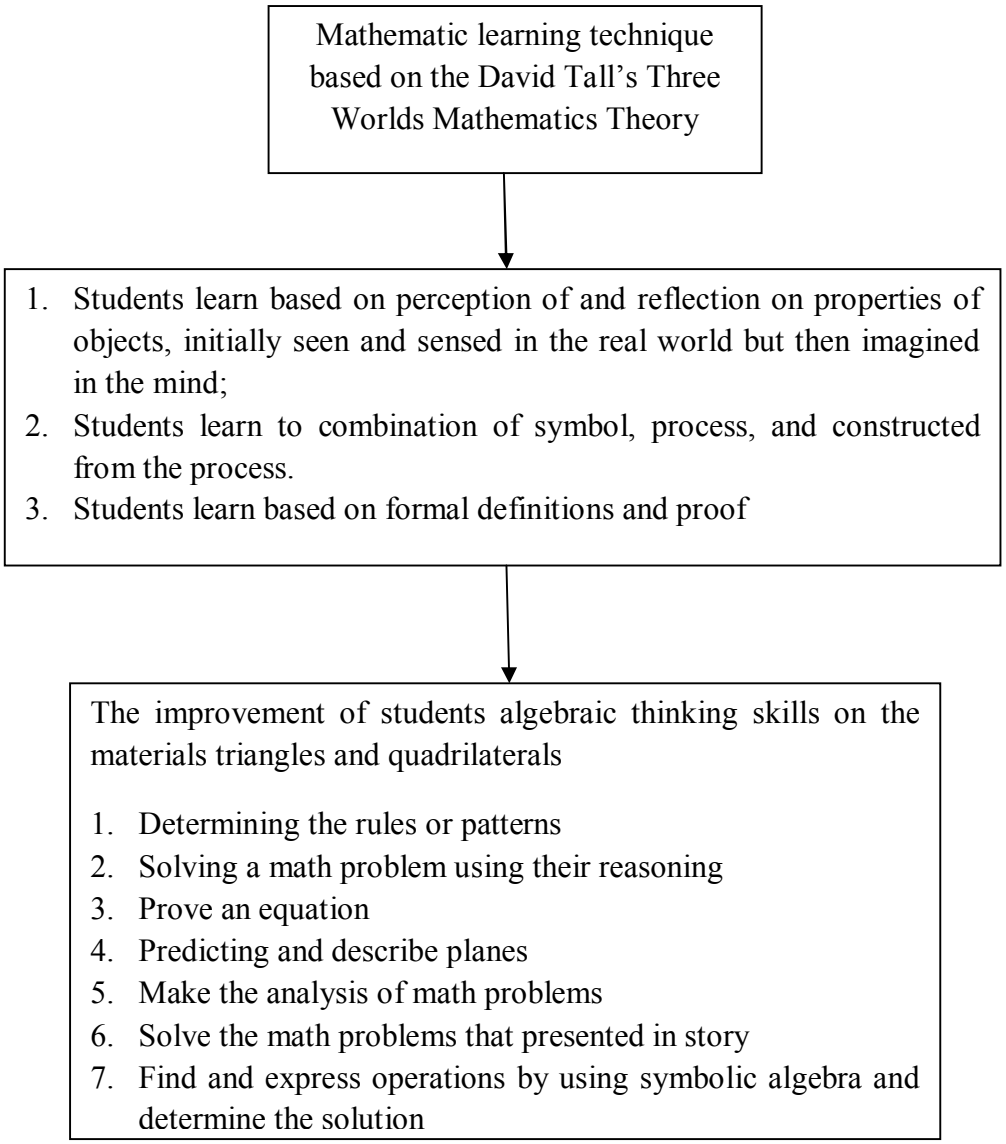


Chart 2.1
Framework Diagram

D. Research Hypothesis

With reference to the above framework, the hypotheses to be proposed and testing the truth is: "There is a positive influence significantly of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students" in mathematics on the materials of triangles and quadrilaterals.

CHAPTER III

RESEARCH METHODOLOGY

A. Place and Time of The Research

The research was carried out in The Syarif Hidayatullah Junior High School addressed at Jl. Ki Gede Mayaguna Cirebon. The time required by the researcher in conducting this study is for approximately 3 months, starting from April 1 to July 1, 2013.

Table 3.1
Schedule of Research

No	Activity	Month										
		April				May				June		
		1	2	3	4	1	2	3	4	1	2	3
1	Preparation	√										
2	Instrument test		√									
3	Teaching and learning activities		√	√	√							
4	Instrument test in experiment class					√	√					
5	Data collecting							√				
6	Data analysis								√	√		
7	Preparation of reports										√	√

B. Methods and Design of The Research

1. Method of The Research

Method research according Sugiyono (2012: 2) is basically a scientific way to get the data for the purpose and usefulness. The method used in this study was pre-experimental methods. Experimental method used to see the influence of the treatment given to the students.

In this research required the class to be tested in the study. This research is quantitative research because the data in the form of values or numbers to be processed mathematically by statistical calculations. This

study will measure how much influence among the variables X (the application of mathematics learning technique based on David Tall's Three Worlds Mathematics Theory) of the variable Y (algebraic thinking skills of students).

2. Design of The Research

In this research was use one group pre-test post-test design (Sugiyono, 2012: 74) to measure algebraic thinking skills of students. This design can be described as follows.

O_1 X O_2

O_1 = pre-test
X = treatment
O_2 = post-test

C. Population and Sample of Research

1. Population of Research

Population is a generalization area consisting of object or subject that has certain qualities and characteristics are determined by researcher to be studied and then drawn conclusions (Sugiyono, 2012:80). The population in this research is all of students at *SMP* Syarif Hidayatullah,

Table 3.2
Number of students of VII *SMP* Syarif Hidayatullah Cirebon
Academic Year 2012/2013

NO	CLASS	NUMBER OF STUDENTS
1	IX	30
2	VIII	32
3	VII A	32
4	VII B	21
TOTAL		115

Sources: Administration of *SMP* Syarif Hidayatullah Cirebon

2. Sample of Research

According to Arikunto (2006: 131), "The sample is representative of the majority or the population studied". While the definition of the sample according to Saifuddin Anwar (2012: 79), "The sample is part of the population". Because the sample is a part of the population, surely it must

have possessed a characteristic population". The sampling technique used is cluster random sampling with class VII A (32 students) as experiment class.

According to Sugiyono (2012:83), "cluster random sampling use to determine the sample of research if the sample is wide-scale". Sampling was done by cluster random sampling from a normal population is assumed to be homogeneous with consideration of the students in the same level, students have the same ability, based on the material being taught the same curriculum, and class divisions no superior class.

D. Data Collecting Technique

1. Conceptual Definition of Variables

Based on the theoretical framework. Mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is a way to implement a teaching method to transfer the materials in the design based on three worlds of mathematics theory in which the learning process starts from the embodied and symbolic world then up to axioms world.

Algebraic thinking is the ability to generalize from experience with numbers and calculations. Algebraic thinking also reasoning to the math problems, exploring the concepts of pattern and function, and formalizing ideas with the use of a symbol system that is useful for solving a variety of math problems.

2. Operational Definition of Variables

Mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is score of the scale of the application of the mathematic learning technique based on the David Tall's Mathematics Theory which developed based on embodied world, symbolic world and formal world.

Algebraic thinking skills is the score of the essay test which developed based on definition and indicators algebraic thinking skill's there are generalizing from experience with numbers and calculations, reasoning the math problems, exploring the concepts of pattern and function, and

formalizing ideas with the use of a symbol system that is useful for solving a variety of math problems.

3. Instruments and Development

The research instrument is used to measure natural and social phenomena were observed (Sugiyono, 2012:102). The instrument used in this study include the test instrument algebraic thinking skills tests and non-test instrument that is scale application of mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory.

a. Test Instruments

Test instrument used in this research is essay test of the algebraic thinking skills of students. This test as many as 10 questions about triangles and quadrilaterals.

On test of algebraic thinking skills using analytic scoring technique, which requires that the researcher to determine the list of essential elements (resolution steps) that must be assessed and then give the number of each of these elements. (Sumarna Surapranata, 2004: 220).

b. Non-Test Instruments

Non-test instruments used in this study is the Likert scale. Likert scale is used to measure the students' response to the application of mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory. The scale consists of 20 statements. Contain a number of statements in which students were asked to rate the statement by marking checklist (√). According to Riduwan (2007:38), Scale arranged in the form of statements with five response levels that show. This model uses five selected items from the lowest to the highest. Scores are used to measure the scale as follows:

a) Positive Statement

1) Score 5 (five) to answer or choice of strongly agree (SS)

2) Score 4 (four) to answer or agree option (S)

3) A score of 3 (three) to answer or doubt choice (RR)

4) Score 2 (two) for answers or disagree option (TS)

5) Score 1 (one) for answers or options strongly disagree (STS)

b) Negative Declaration

1) Score 1 (one) for answers or options strongly agree (SS)

2) Score 2 (two) to answer or agree option (S)

3) A score of 3 (three) to answer or undecided choice (RR)

4) Score 4 (four) for answers or disagree option (TS)

5) Score 5 (five) option to answer or strongly disagree (STS)

4. Testing Instruments

In order for a test that is used to meet the criteria to be used as an instrument it would require some testing such as validity of instrument, estimation of reliability, item discrimination and index of difficulty.

a. The Validity of Instrument

Validity of the tests and scales in this study were performed by testing the validity of the content. Technically testing content validity can be helped by using lattice instrument. (Sugiyono, 2012:129). Content validity of the test is done through expert judgment by a few experts about the suitability of the aspects to be measured with items that will test. Validity of the content in this study was conducted in two phases. More detail can be found in appendix C.

b. The Estimation of Reliability

According to Arikunto (2010:223), reliability is a measure of regularity of an instrument to obtain information. Reliability of the tests used in this research was calculated by using the software Anates V4. At Anates V4 formula used to calculate reliability is reliability Spearman-Brown formula to the split second method

$$r_{11} = \frac{2r_{1/2\,1/2}}{\left(1 + r_{1/2\,1/2}\right)}$$

With:

r_{11} = Reliability of the whole test

$r_{1/2\,1/2}$ = Correlation between test scores of each hemisphere

Table 3.3 The Interpretation of Reliability

Correlation Coefficient	Reliability Criteria
0,81 ≤ r ≤ 1,00	Very High
0,61 ≤ r ≤ 0,80	High
0,41 ≤ r ≤ 0,60	Enough
0,21 ≤ r ≤ 0,40	Low
0,00 ≤ r ≤ 0,20	Very low

From the results of a calculation using the software Anates V4 with the number of participants 32 students, the reliability of the test in this study was 0.90 included in the very high category.

c. The Item Discrimination

The item discrimination is the ability of items to discriminate students on the top and under group students. Figures show the amount of the difference is called the index of discrimination (D). The item discrimination each of the items used in this study was calculated by using the software Anates V4. Anates V4 In the formula used to calculate the differentiator is the formula by Arikunto (2009:213) as follows:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

With:

J = Number of participants test

J_A = Number of top participants group

J_B = Number of under participants group

B_A = Number of top participants group who answered the question correctly

B_B = Number of under participants group who answered questions correctly

According to Arikunto (2009: 218), to interpret of the item discrimination of an instrument that is obtained by looking at the following table 3.4.

Table 3.4 The Interpretation of Item Discrimination

Coefficient	Criteria The Differentiator
0,70 ≤ D ≤ 1,00	Very Good
0,40 ≤ D ≤ 0,69	Good
0,20 ≤ D ≤ 0,39	Enough
0,00 ≤ D ≤ 0,19	Bad
D < 0,00	Discarded

The result of the calculation is the item discrimination for instrument obtained some algebraic thinking skills about the criteria, which is about enough with the numbers 1, 2 and 9. The numbers 3, 4, 6, 7, 8, and 10 is good and the number 5 is very good. (The results of the calculations can be seen in Appendix C).

d. The Index of Difficulty

This test is done to determine the level of difficulty of the items. According to Arikunto (2009:207), the higher of the difficulty index of the easier questions. About the level of difficulty of each item used in this study was calculated by using the software Anates V4. At Anates V4 formula used to calculate the level of difficulty is the formula to find the level of difficulty according to Arikunto (2009:208).

$$P = \frac{B}{JS}$$

With:

P = Index lurch

B = Number of students who answered the questions with correct

JS = total number of student participants test

The level of difficulty of an item is between 0.00 to 1.00. The following is index of difficulty table of interpretation of items according Arikunto (2009:210).

Table 3.5 The Interpretation of Index Difficulty

The difficulty level	Index of Difficulty
0,00 ≤ IK ≤ 0,29	Difficult
0,30 ≤ IK ≤ 0,69	Medium
0,70 ≤ IK ≤ 1,00	Easy

From the results of the calculations for the level of difficulty of the instrument obtained some algebraic thinking skills about the criteria, the difficult question number 2, about the medium question numbers 1, 3, 4, 5, 6, 7, 8, 9 and 10. (The results of the calculations can be seen in Appendix C).

e. Recapitulation of Analysis of The Test Algebraic Thinking Skills

With Anates V4 software, the validity of the test is 0.81 is at a very high category. While reliability tests were obtained of 0.90 is included in the very high category. The following is a summary analysis of the items obtained Anates V4 software.

Table 3.6 Summary of Item-Analysis Test (Anates V4)

Items	ID(%)	Interpretation	Index of Difficulty (%)	Interpretation	Explanation
1	25,00	Enough	37,50	Medium	Used
2	33,33	Enough	16,67	Difficult	Used
3	44,44	Enough	55,56	Medium	Used
4	61,11	Enough	61,11	Medium	Used
5	77,78	Very good	47,22	Medium	Used
6	47,22	Good	54,17	Medium	Used
7	50,00	Good	44,44	Medium	Used
8	46,67	Good	41,11	Medium	Used
9	35,56	Enough	51,11	Medium	Used
10	44,44	Enough	40,00	Medium	Used

E. Data Analysis Techniques

After the data collected from the experimental class, the data needs to be analyzed in order to find answers to fundamental problems that have been formulated. The dependent variable in this research is an improvement the algebraic thinking skills of students, the first prerequisite test data analysis is calculated gain value from the value of pre-test and post-test. Gain value is the difference of the value of pre-test and post-test. Gain value can be determined by the following formula:

$$NG = \frac{S_{posttest} - S_{pretest}}{S_{max} - S_{pretest}}$$

Description:

NG = Value Gain

Spre-test = Score pre-test

Spost-test = Score post-test

Smax = Maximum score

High and low gain normalized (N-gain) can be classified as follows: (1) if g ≥ 0.7 considered into high category, (2) if 0.7> g ≥ 0.3, considered into medium category, and (3) if g <0.3 considered into low category.

(http://biologipedia.blogspot.com/2011/01/uj-normalitas-gain.html)

Step of the data analysis are:

1. Normality of The Test

Normality test is used to determine the sample was normally distributed or not. Before testing the normality of the data then the first step is to analyze the value of Error (residue) of the regression equation.

The formula used to find the value Error or Residual according to Sudjana (2001:32) as follows:

$$e = Y - Y\square$$

Description:

e = Error value

Y = The value of Y

Y□ = Predicted value of Y is projected

After the error or residual values obtained, it can be done to test the normality with normality test methods Liliefors. Normality test results can be seen from the output Test of normality by using SPSS 19, if the significance value is greater than 0.05, it can be concluded that the data were normally distributed.

2. Homogeneity of the Test

The function of homogeneity test to determine the samples have similar (homogeneous) or not. Homogeneity test performed using the Levene test statistic using the formula:

$$W = \frac{(N-k)\sum_{i=1}^{k} N_i (Z_{i.} - Z_{..}{}^2}{(k-1)\sum_{i-1}^{k}\sum_{j=1}^{N_i}(Z_{ij} - Z_{i.})^2}$$

Description:

W = Result test

K = Number of different groups who possessed the sample

N = Total number of samples

Ni = Number of samples in the i-th group

Y_{ij} = the value of the j-th sample of the i-th group

Researcher using SPSS 19 to tested the homogeneity of the data. Homogeneity test results can be seen from the output Test homogeneity of variance, if the significance value is greater than 0.05, it can be concluded that the data are homogeneous.

3. The Linearity Regression Test

Linearity test aims to determine whether two variables have a linear relationship or not significantly. This test is usually used as a prerequisite in linear regression analysis. Researcher using SPSS 19 to tested the linearity of data. Two variables have a linear relationship when the significance is less than 0.05.

4. The Regression Analysis

Regression is a process of systematically estimate of what's most likely to occur in the future based on past and current information possessed so errors can be minimized. Regression analysis was used to predict the relationship between the dependent variable with the independent variable is determined by the formula:

$$\hat{Y} = a + bx$$ (Sugiyono, 2011: 188)

Description:

$\hat{Y}$ = The subjects in the dependent variable that predicted

x = The subjects in the independent variables that have a certain value

a = The value of Y when the value of X = 0 (constant value)

b = Number of direction or linear regression coefficients

To find a and b using the formula:

$$a = \frac{\sum Y - b\sum X}{n} \qquad b = \frac{n\sum XY - (\sum X)(\sum Y)}{n\sum X^2 - (\sum X)^2}$$

5. The Applicable of The Model Test

According Subana (2005:137) coefficient of determination is the square of the correlation coefficient multiplied by 100. This coefficient is used to determine the contribution of variable X to Y. determination of the coefficient is determined by the formula:

$$KM = (KK)^2 \; x \; 100\%$$

(M. Iqbal Hasan, 2012:112-113)

Description:

KM = Applicable Model

KK = Coefficient of correlation (r)

Table 3.7
Interpretation of Correlation Index
(Anas Sudijono, 2008:193)

The amount of "r" Product Moment (rxy)	Interpretation
0,00 – 0,20	Very weak or Very low
0,20 – 0,40	Weak or Low
0,40 – 0,70	Medium or Enough
0,70 – 0,90	Strong or High
0,90 – 1,00	Very Strong or Very High

6. The Test of Hypothesis

T test was conducted to determine the value r significant or not with the formula t as follows: (Arikunto, 2010:349)

$$t = \frac{Md}{\sqrt{\frac{\sum X^2 d}{N\,(N-1)}}}$$

With:

Md = Mean of differences with the pre test post test

Xd = Deviation of each subject (D - Md.)

$\sum X^2 d$ = Sum of squared deviations

N = Subjects in the sample

d.b = Determined by N – 1

F. Statistical hypothesis

A statistical hypothesis is formulas to test the hypothesis. Researcher will conduct research on “The Influence of the application of the mathematic

learning technique based on The David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students" with triangles and quadrilaterals material in VII grade students at *SMP* Syarif Hidayatullah, then the statistical hypothesis is as follows:

$H_{0:}$ $\beta_0 = 0$; (no influence of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students)

Ha: $\beta_0 > 0$; (there is influence of the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students)

CHAPTER IV

RESULTS AND DISCUSSION

A. Description of The Data

1. Description of The Mathematic Learning Technique based on The David Tall's Three Worlds Mathematics Theory

To find out how far the student's response to mathematics learning techniques based on the David Tall's Three Worlds Mathematics Theory, the researcher uses the student response scale totaling 20 point statement. The scale was disseminated to 32 students in the experimental class at VII-A Syarif Hidayatullah Junior High School Cirebon.

The results of the students' response to the scale of the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory in the experimental class is described in the table below:

Table 4.1
Score of Scale Mathematics Learning Technique
Based on the David Tall's Three Worlds Mathematics Theory

No	Respondent	Total Point	No	Respondent	Total Point
1	R1	69	17	R17	86
2	R2	76	18	R18	81
3	R3	87	19	R19	73
4	R4	71	20	R20	74
5	R5	81	21	R21	80
6	R6	88	22	R22	76
7	R7	75	23	R23	79
8	R8	76	24	R24	81
9	R9	87	25	R25	73
10	R10	79	26	R26	79
11	R11	84	27	R27	85
12	R12	73	28	R28	80
13	R13	85	29	R29	81
14	R14	81	30	R30	87
15	R15	87	31	R31	89
16	R16	83	32	R32	79

Viewing Table 4.1 it is safe to say that to determine the percentage of students' response to the learning process of mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can be made as a percentage of the classification table of the student's responses below:

Table 4.2
Percentage of Student Response Classification

Classification	Category	Frequency	Percentage (%)
80-100	Very Positive	18	56,25%
60-79	Positive	14	43,75%
40-59	Negative	0	0
20-39	Very Negative	0	0
Total		32	100%

(Riduwan, 2008: 121)

Table 4.2 shows that the application of the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is good enough. There are 18 students gave very positive responses with the percentage of 56.25%, 14 students of 18.75% gave positive respond. This shows that most students respond well to the application of learning by using the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory.

For more details, the following is the percentage of student's response to the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory in accordance with each indicator. Each indicator shows the students' response to the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory.

a. Embodiment world

1) The Indicator is Able to Understand the Materials based on The Object Perception.

This indicator aims to determine the understanding of the material based on an object perception that can affect algebraic thinking skills of students. There is one number (number 1) which is a positive statement and two numbers (number 4 & 14) which are

negative statements. Number 1 statement states that "*Pemberian contoh bangun datar oleh guru membuat saya lebih memahami materi*". Number 4 statement states "*Pintu, jendela, layang-layang dapat memudahkan saya memahami materi segi empat*." and the number 14 statement states "*Saya tidak dapat membedakan belah ketupat dan layang-layang*".

All answers from students are listed in the table below.

Table 4.3
Students Understand the Material Based On the Perception of Object

No. Item	Score	Freq.	Total point	Percentage (%)
1,4, and 14	1	0	0	0.0 %
	2	0	0	0.0 %
	3	25	75	26 %
	4	51	204	53.2 %
	5	20	100	20.8 %
Total		96	379	100 %
Max score		480		
Percentage		80 %		

Based on the table above, the response of students stating that the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to understand the material based on the perception of object is high.

2) The Indicator is Able to Understand the Material based On the Reflection Properties of an Object

This indicator aims to determine the understanding of the material based on the reflection object properties that can affect algebraic thinking skills of students. In this indicator, there are 2 items. The statement no. 3 (positive statement) says that "*Saya dapat menyebutkan sifat-sifat segi empat dari sebuah gambar*". The statement no. 19 (positive statement) says that "*Saya memahami*

dengan baik bahwa layang-layang terbentuk dari dua buah segitiga yang memiliki alas sama panjang". Scores obtained by students are:

Table 4.4
Students' Responses in Understanding The Materials Based On The Reflection On The Object Properties

No. Item	Score	Freq	Total Point	Percentage (%)
3 and 19	1	0	0	0.0 %
	2	0	0	0.0 %
	3	11	33	17.2 %
	4	37	148	57.8 %
	5	16	80	25 %
Total		64	261	100 %
Max Score		320		
Percentage		81.6 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to better understand the material based on the reflection on the object properties is high.

b. Symbolic World

1) The Indicator Is Able To Perform Actions of Objects

This indicator aims to determine the understanding to take action of the object that can affect algebraic thinking skills of students. In this indicator, there are 2 items. The statement number 8 (positive statement) says that "*Saya dapat menentukan keliling sebuah kolam*". Statement Number 20 (positive statement) states that "*Saya kesulitan menggambarkan garis tinggi, garis bagi, garis berat, dan garis sumbu pada segitiga*". The scores that student obtained are as follows:

Table 4.5
Students' Response to Take Actions the Object

No. Item	Score	Freq.	Total Point	Percentage (%)
8 and 20	1	0	0	0.0 %
	2	0	0	0.0 %
	3	11	33	17.2 %
	4	41	164	64 %
	5	12	60	18.8 %
Total		64	257	100 %
Max Score		320		
Percentage		80.3 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to be able to take action the object is high.

2) The Indicators Capable Symbolize the Object to Concept

This sub-indicator aims to determine the ability to symbolize the objects in an object that can affect algebraic thinking skills of students. This indicator consists of 5 items, 3 items positive statements and 2 items negative statements. Statement number 2 states that "*Saya mampu memberikan simbol huruf untuk panjang persegi panjang*". Statement No. 16 states that "*Saya mampu menuliskan rumus L = a x t untuk luas jajar genjang*". And the statement number 17 states that "*Simbol-simbol dalam matematika memudahkan saya untuk memahami materi*". For the negative statement (number 5) states that "*Saya kesulitan menggambarkan sebuah bangun datar yang sifat-sifatnya diketahui*". And the statement of the number 12 states that "*Saya kesulitan menentukan keliling segitiga yang panjang sisi-sisinya diperbesar*". The students obtained score are as follows:

Table 4.6
Students' Response Symbolize the Object to Concept

No. Item	Score	Freq.	Total Point	Percentage (%)
2, 5, 12, 16 and 17	1	0	0	0.0 %
	2	0	0	0.0 %
	3	33	99	20.6 %
	4	95	380	59.4 %
	5	32	160	20 %
Total		160	639	100 %
Max Score		800		
Percentage		79.9 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to be able to symbolize the object to concept is high.

c. Formal World

1) The Indicator To Understand the Material Based On Formal Theory and Proof

This indicator aims to determine the understanding the material based on formal theory and proof. In this indicator there are 3 items. 2 positive statements i.e. numbers 9 and 15 and a negative statement i.e. number 13. Statement number 9 states that "*Saya dapat menjelaskan belah ketupat berdasarkan rumus mencari luasnya*". Statement No. 15 states that "*Rumus dalam matematika membuat materi mudah dipahami*". And the statement number 13 states that "*Saya tidak dapat menuliskan panjang diagonal layang-layang yang diketahui pada soal*". The scores of students are as follows:

Table 4.7
Students' Response Understand the Material Based On Formal Theory and Proof

No. Item	Score	Freq.	Total point	Percentage (%)
9,13, and 15	1	0	0	0.0 %
	2	0	0	0.0 %
	3	17	51	17.7 %
	4	55	220	57.3 %
	5	24	120	25 %
Total		96	391	100 %
Max score		480		
Percentage		81.5 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to be able to understand the material based on formal theory and proof is high.

2) The Indicator Constructing an Understanding of Object Based On Formal Concept

This indicator aims to determine the Constructing an Understanding of Object based on Formal Concept**.** In this indicator there are 3 items. A positive statement i.e. number 11 and 2 negative statements i.e. number 7 and 20. Statement number 11 states that "*Saya bisa menentukan salah satu besar sudut dalam segitiga*". Statement No. 7 states that "*Menyelesaikan soal matematika dengan urutan cara terbalik itu sulit*". And the statement number 20 states that "*Saya kesulitan menggambarkan garis tinggi, garis bagi, garis berat, dan garis sumbu pada segitiga*". The scores of students are as follows:

Table 4.8
Students' Response Constructing an Understanding of Object Based On Formal Concept

No. Item	Score	Freq.	Total point	Percentage (%)
7,11, and 20	1	0	0	0.0 %
	2	0	0	0.0 %
	3	15	45	15.6 %
	4	60	240	62.5 %
	5	21	105	21.9 %
Total		96	390	100 %
Max score		480		
Percentage		81.3 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to be able to constructing an understanding of object based on formal concept is high.

3) The Indicator Associating the Definition of the Concept of an Object That Related With the Object

This indicator aims to determine associating the definition of the concept of an object that related with the object**.** In this indicator there are 3 items. A positive statement i.e. number 18 and 2 negative statements i.e. number 6 and 10. Statement number 18 states that "*Saya mampu mengaitkan hubungan luas jajar genjang dengan luas segitiga*". Statement No. 6 states that "*Saya kesulitan membuktikan bahwa jumlah sudut dalam segitiga adalah* 180^0". And the statement number 10 states that "*Saya kesulitan mencari alas sebuah segitiga yang luas dan tingginya sudah diketahui*". The scores of students are as follows:

Table 4.9
Students' Response Associating the Definition of the Concept of an Object That Related With the Object

No. Item	Score	Freq.	Total point	Percentage (%)
6, 10, and 18	1	0	0	0.0 %
	2	0	0	0.0 %
	3	14	42	14.6 %
	4	67	268	69.8 %
	5	15	75	15.6 %
Total		96	385	100 %
Max score		480		
Percentage		80.2 %		

Based on the table above, the response of students declaring that mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory can support students to be able associating the definition of the concept of an object that related with the object is high.

2. **Description of Algebraic Thinking Skills of Students**

Algebraic thinking skills of students after get the application of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory measured by tests in essay form. The test was disseminated to 32 in the experimental class at VII A Syarif Hidayatullah Junior High School Cirebon. Description of the results of the test Algebraic Thinking in class VII A was described in the table below:

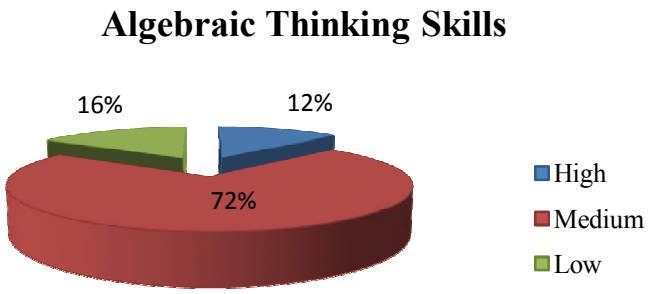


Figure 4.1

By using SPSS 19 statistical description of the data obtained as follows:

Table 4.10

Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
Algebraic thinking skills	32	.08	.75	.4606	.17371
Valid N (listwise)	32				

From the data the mean of the gain value of the algebraic thinking skills of students is 0.4606 due to which it is considered into medium category.

a) Generalizing the problem

1) The Indicator is Determine the Rules or Patterns

This indicator has a description about the 1 item number, which is about the number 3. Once analyzed, the matter produce alternative answers as follows:

Table 4.11
Description of The Item 3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	3.1	3.1	3.1
	2	8	25.0	25.0	28.1
	3	23	71.9	71.9	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 3.1% or a student who get score 1. While, 25% or 8 students who gets score 2 and 71.9% or 23 students who gets score 3.

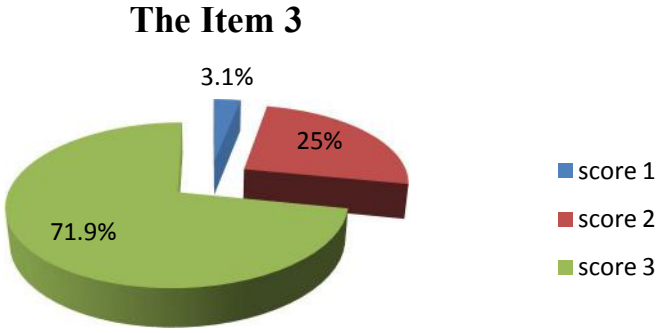


Figure 4.2

b) Reasoning about mathematics

1) The Indicators is able to solve a math problem using its reasoning

This indicator has a description about the 2 item number, number 5 and 7. Produce alternative answers that question as follows:

Table 4.12
Description of The Item 5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	3.1	3.1	3.1
	2	10	31.3	31.3	34.4
	3	5	15.6	15.6	50.0
	4	16	50.0	50.0	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 3.1% cannot answer the item 5. While, 31.3% or 10 students who gets score 2, 15.6% or 5 students who gets score 3 and 50% or 16 students who gets score 4.

The Item 5

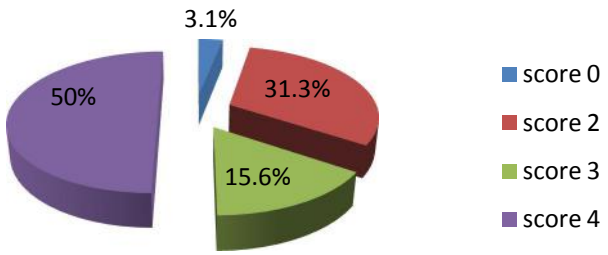


Figure 4.3

Question 7 to produce alternative answers as follows:

Table 4.13
Description of The Item 7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2	6.3	6.3	6.3
	2	14	43.8	43.8	50.0
	3	3	9.4	9.4	59.4
	4	13	40.6	40.6	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 6.3% or 2 students cannot answer the item 7. While, 43.8% or 14 students who gets score 2, 9.4% or 3 students who gets score 3 and 40.6% or 13 students who gets score 4.

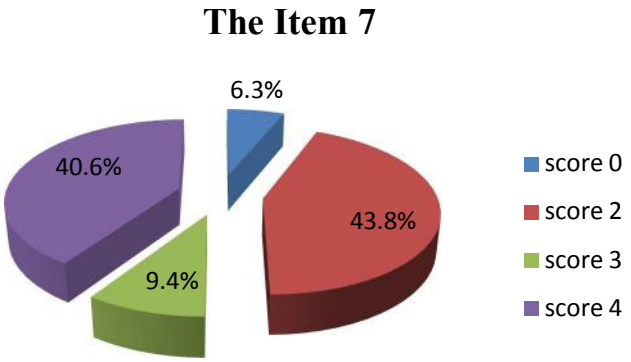


Figure 4.4

c) Exploring the concepts

1) The Indicators are able to prove an equation

This indicator has 1 item description test that item is number 1. Produce alternative answers that question as follows:

Table 4.14
Description of The Item 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	9.4	9.4	9.4
	1	7	21.9	21.9	31.3
	2	7	21.9	21.9	53.1
	3	5	15.6	15.6	68.8
	4	10	31.3	31.3	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 9.4% or 3 students cannot answer the item 1. While, 21.9% or 7 students who gets score 1, 21.9% or 7 students who gets score 2, 15.6% or 5 students and 31.3% or 10 students who gets score 4.

The Item 1

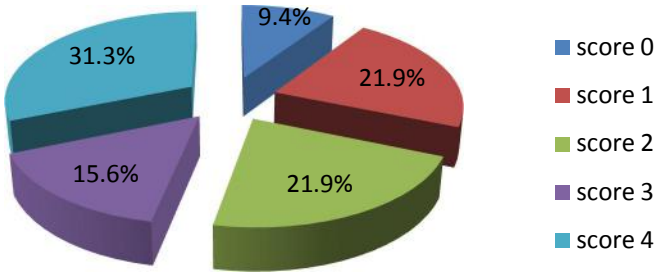


Figure 4.5

2) The Indicators are able to predict and describe planes

This indicator has a description about the 1 item number that is number 8. Produce alternative answers that question as follows:

Table 4.15
Description of The Item 8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	9.4	9.4	9.4
	2	16	50.0	50.0	59.4
	3	2	6.3	6.3	65.6
	4	6	18.8	18.8	84.4
	5	5	15.6	15.6	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 9.4% or 3 students cannot answer the item 8. While, 50% or 16 students who gets score 2, 6.3% or 2 students who get score 3, 18.8% or 6 students who gets score 4 and 15.6% or 5 students who gets score 5.

The Item 8

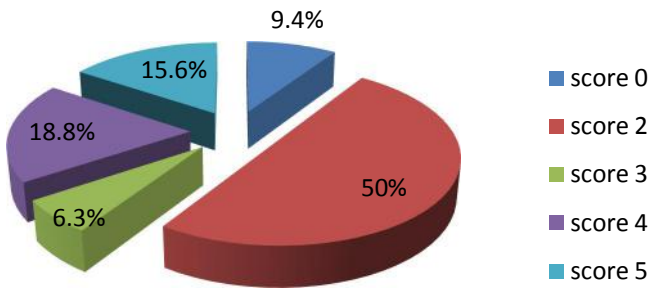


Figure 4.6

d) Constructing ideas

1) The Indicators are able to make the analysis of a math problem

This indicator has 2 item description tests, number 2 and 9. For question number 2 produce alternative answers as follow:

Table 4.16
Description of The Item 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	7	21.9	21.9	21.9
	2	25	78.1	78.1	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 21.9% or 7 students cannot answer the item 2 and 78.1% or 25 students who get score 2.

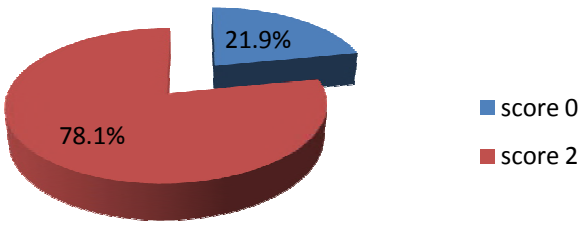


Figure 4.7

As for question number 9 generate alternative answers as follows:

Table 4.17
Description of The Item 9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	18.8	18.8	18.8
	3	17	53.1	53.1	71.9
	4	3	9.4	9.4	81.3
	5	6	18.8	18.8	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 18.8% cannot answer the item 9. While, 53.1% or 17 students who gets score 3, 9.4% or 3 students who gets score 4 and 18.8% or 6 students who gets score 5.

The Item 9

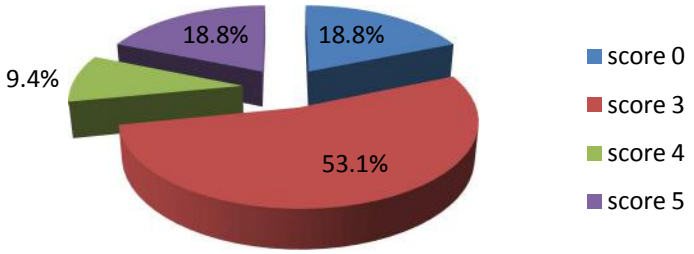


Figure 4.8

e) Solving the problem

1) The Indicators are Able to Solve a Math Problem That's Presented In Telling Story

This indicator has a description about the 2 item number, number 4 and 10. For question number 4 generating alternative answers as follows:

Table 4.18
Description of The Item 4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2	6.3	6.3	6.3
	2	9	28.1	28.1	34.4
	3	8	25.0	25.0	59.4
	4	13	40.6	40.6	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 6.3% or 2 students cannot answer the item 4. While, 28.1% or 9 students who gets score 2, 25% or 8 students who gets score 3 and 40.6% or 13 students who gets score 4.

The Item 4

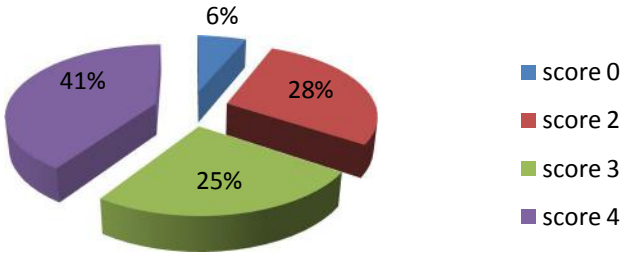


Figure 4.9

As for question number 10 produce alternative answers as follows:

Table 4.19
Description of The Item 10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	18.8	18.8	18.8
	2	7	21.9	21.9	40.6
	3	6	18.8	18.8	59.4
	4	6	18.8	18.8	78.1
	5	7	21.9	21.9	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 18.8% or 6 students cannot answer the item 10. While, 21.9% or 7 students who gets score 2, 18.8% or 6 students who gets score 3, 18.8% or 6 students who gets score4 and 21.9% or 16 students who gets score 5.

The Item 10

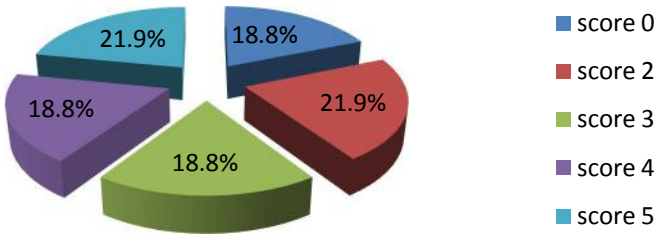


Figure 4.10

2) The Indicators Are Able To Find and Express Operations by Using Symbolic Algebra and Determine the Solution

This indicator has a description about the 1 item number, number 6. For question number 6 is generating alternative answers as follows:

Table 4.20
Description of The Item 6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	14	43.8	43.8	43.8
	3	7	21.9	21.9	65.6
	4	11	34.4	34.4	100.0
	Total	32	100.0	100.0	

From 32 students who took the test, 43.8% or 14 students cannot answer the item 6. While, 21.9% or 7 students who gets score 3 and 34.4% or 11 students who gets score 4.

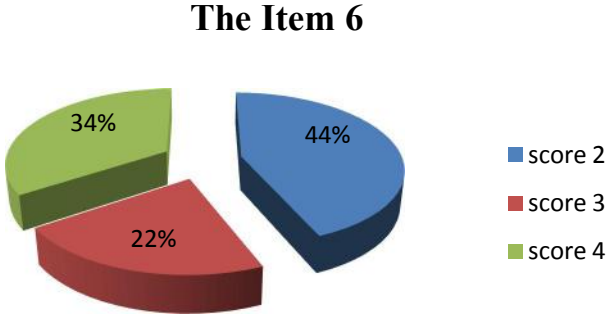


Figure 4.11

B. Data Analysis

1. The Residual Normality Test

The calculation of the normality test is done by SPSS. The results can be seen in the table below:

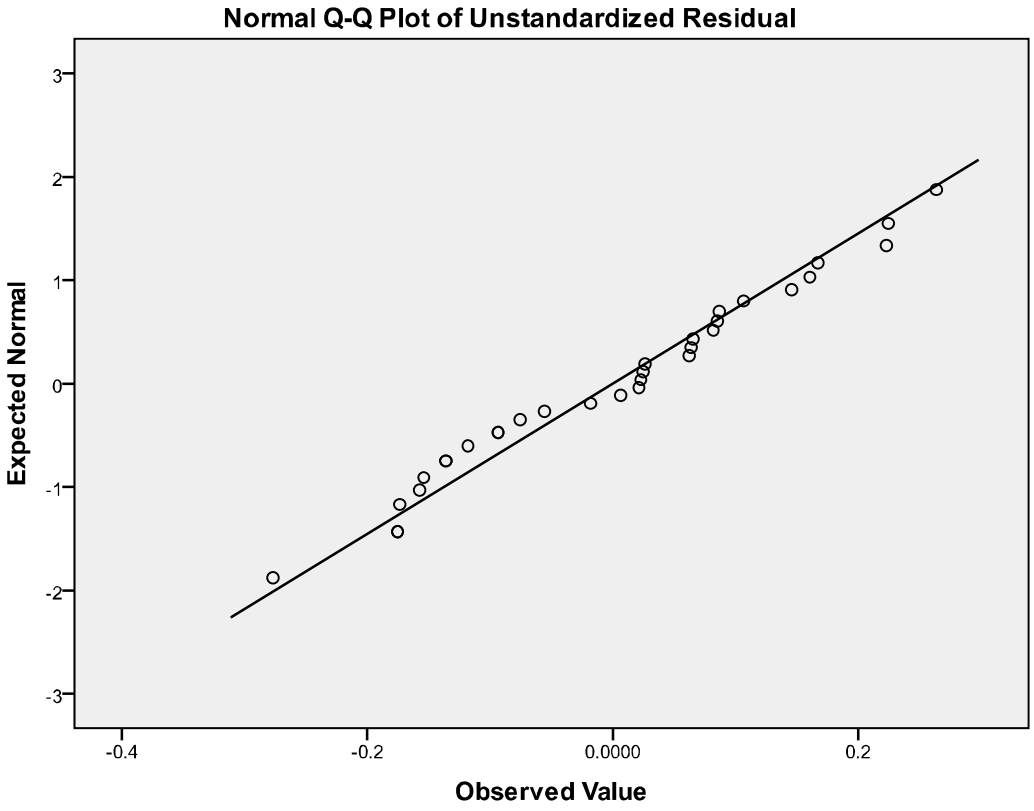
Table 4.21
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.095	32	.200*	.970	32	.509

a. Lilliefors Significance Correction
*. This is a lower bound of the true significance.

Based on the results of table 4.21 for testing normality with Kolmogorov-Smirnov Method the significance value is 0.200. Residual unstandardized data show that significant value is greater than 0.05, thus the data were all normally distributed.

Figure 4.12



Output interpretation of test of normality with Normal QQ plot of unstandardized residual explained that the diagonal line in the graph

describes the ideal state of the data that follow a normal distribution. The points around the line is state's the test of data. If most of the points are very close to the line or even attached to a line, then we can conclude that our data follow a normal distribution. The straight line that ran from the bottom left corner to the upper right to form a diagonal direction can be referred to as the reference line of normality.

Based on Figure 4.12, it is seen that the points are scattered close to a straight line. Thus, based on the results of testing normality with QQ Normal Plot of unstandardized residual, proved that the data are normally distributed.

2. The Homogeneity Test

Table 4.22

Test of Homogeneity of Variances

Y

Levene Statistic	df1	df2	Sig.
.945	6	16	.491

Based on the table 4.22 homogeneity test results it can be seen that the significance value of sample is 0.491 and greater than 0.05. It can be concluded that the data distribution is homogeneous.

3. The Linearity Regression Testing

Calculations were performed using SPSS data obtained by the following calculation

Table 4.23

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Y * X	Between Groups	(Combined)	.494	15	.033	1.142	.396
		Linearity	.368	1	.368	12.772	.003
		Deviation from Linearity	.126	14	.009	.312	.983
	Within Groups		.461	16	.029		
	Total		.955	31			

Based on the table 4.23 the linearity test results can be seen in table ANOVA output. The significant value on the line Linearity is 0.003. Because the significance value is less than 0.05, it can be concluded that the variable mathematic learning techniques based on David Tall's Three Worlds Mathematic Theory with variable algebraic thinking skills of students there is a linear relationship.

4. The Regression Equation

Regression equations used to predict how high the value of the dependent variable based on the value of the independent variable. By using SPSS version 19.0 obtained:

Table 4.24

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.118	.365		-3.061	.005
X	.020	.005	.621	4.338	.000

a. Dependent Variable: Y

Based on Table 4.24 shows the significant value of the constant is 0.005 < 0.05 and its significance value of the variable X of 0.000 < 0.05. Thus the regression equations for the two variables are:

$\hat{Y}$ = a + bX

$\hat{Y}$ = - 1.118 + 0.20X

$\hat{Y}$ = Algebraic thinking skills of students

X = Mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory

From the equation above, can be explained if without the application of mathematic learning techniques based on David Tall's Three Worlds of Mathematics Theory the algebraic thinking skills of student's is equal to -1.118.

To determine whether the regression equation can be used as a predictor, then the F test by compare the F_{test} with F_{table}.

Table 4.25

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.368	1	.368	18.817	.000[a]
	Residual	.587	30	.020		
	Total	.955	31			

a. Predictors: (Constant), X
b. Dependent Variable: Y

Because F_{test} value is 18.817 and the value of $F_{0.5}(1;30)$ is 4.17. Then $F_{test} > F_{table}$ then the regression equation can be used for predictors.

5. The Applicable of The Model Test

The applicable of the model or the coefficient of determination test is used to determine the percentage effect of the application of mathematics learning techniques based on David Tall's Three Worlds of Mathematics Theory to algebraic thinking skills of students. Before obtaining the coefficient of determination, first find out the R value (correlation). By using SPSS 19 Regression coefficients are presented in the following output:

Table 4.26

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.621[a]	.385	.365	.13987

a. Predictors: (Constant), X
b. Dependent Variable: Y

Having known the value of R = 0.621 coefficient of determination subsequent test or kindness following models:

$$KM = R^2 \times 100\%$$
$$= (0.621)^2 \times 100\%$$
$$= 0.385 \times 100\%$$
$$= 38.5\%$$

KM value of the test results by 38.5%, it means that the variable math learning technique based on the David Tall's Three Worlds Mathematics Theory contribute in improving students' algebraic thinking skills in mathematics learning in particular subject triangles and quadrilaterals is 38.5% and the remaining 61.5% determined by other variables.

6. Testing Hypothesis

Hypothesis testing is done to determine whether there is the effect of the application of mathematical learning techniques based on David Tall's Three Worlds of Mathematics Theory to algebraic thinking skills of students. Ho is assumed that there is no influence of mathematics learning technique based on the David Tall's Three Worlds of Mathematics Theory and Ha is a significant influence on mathematics learning technique based on the David Tall's Three Worlds of Mathematics Theory. Using the SPSS output obtained as follows:

Table 4.27

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-1.118	.365		-3.061	.005
X	.020	.005	.621	4.338	.000

a. Dependent Variable: Y

Tabel 4.28

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	posttest	67.0313	32	12.69108	2.24349
	pretest	38.8281	32	15.48913	2.73812

Based on the analysis of SPSS in the Table Coefficients shows t_{table} 4.338 and the significance is 0.000. T_{table} searched for the significant level of 5% with degrees of freedom (df) = N - nr (Sudijono, Anas 2008:194) is 32-2 = 30. With one side testing (significance = 0:05), the obtained t_{table} 1.697. Because t_{test} (4.338) is greater than t_{table} (1.697) then Ho is rejected,

it means that there is significant influence of the mathematic learning technique based on the David Tall's Three Worlds Mathematics Theory (x) on the algebraic thinking skills of students(y). On the Table Paired Samples Statistics looks average for the pretest is 38.8281 and the average posttest was 67.0313. So, it can be concluded that the application of mathematical learning techniques based on David Tall's Three Worlds Mathematics Theory can provide a significant impact on students' ability to think algebraically

C. Discussion

The results of this study indicate that a significant influence of the application of the mathematical learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students.

This is in accordance with the opinion of David Tall stating "The second world is the world of symbols we use for calculation and manipulation in arithmetic, algebra, calculus and so on". World 'symbolic-proceptual', which grew out of the realization of the world through acts (like counting) and is symbolized by the real concept (like numbers) that serve as a process to do and concepts to think (procept) and used in algebra. This is in agreement with the opinion of Herbert and Brown (1997) who state that "Algebraic thinking is using mathematical symbols and tools to analyze different situations by (1) extracting information from the situation... (2) representing that information mathematically in words, diagrams, tables, graphs, and equations; and (3) interpreting and applying mathematical findings, such as solving for unknowns, testing conjectures, and identifying functional relationships".

The Three Worlds Mathematic Theory supports the algebraic thinking skills. Each world helps students to understand the characteristics of the abstract algebra. The embodiment world helps students to imagine symbol, and symbolic world helps students to understand the formal concept.

The results showed that the indicator to understand the material based on the reflection properties of an object to get the highest response from students

that is equal to 81.6%. By getting the highest response from students shows that students can understand the material better when the learning process starts with the embodied world in a world in which the embodiment is formed of a image concept that can be used to describe the cognitive structures associated with a concept, properties and processes associated with the concept.

While the indicators of symbolizing the object to concept of getting the lowest response rate compared with other indicators that is equal to 79.9%. By getting the lowest response from students does show that students still have trouble in understanding the material related to the symbolic world that have abstract property because the cognitive development of seventh grade junior high school age students are still limited to the things that had to do with something concrete.

For algebraic thinking skills, the results of the study showed 78.1% of students can answer questions number 2 properly. The matter is interpreting the indicator able to make the analysis of a math problem. This indicator is used to determine the students' ability to think algebra in formalizing ideas. It shows students are able to manipulate and solve problems based on analysis of algebraic concepts that already exist.

While on the matter of number 8 shows the students find it difficult to answer. Only 15.6% of students who can solve the problems correct. The matter is interpreting the indicators able to predict and make planes. This indicator is one of the indicators used to assess the ability of students to explore algebraic thinking concepts. This shows that students are still difficulties in linking or connecting one concept with other concepts.

From the data the mean of the gain value of the algebraic thinking skills of students is 0.4606 due to which it is considered into medium category. Based on the calculation and linearity regression hypothesis test using SPSS 19, we can conclude that t_{test} (4.338) is greater than t_{table} (1.697) then there is a significant influence.

Regression analysis has value coefficient of determination (R Square) of 0.385 or 38.5%. This means that 38.5% of the dependent variable algebraic thinking skills of students (y) is explained by the independent variables mathematic learning techniques based on the application of David Tall's Three Worlds Mathematics Theory (x), and the remaining 61.5% (100% - 38.5%) is explained by other variables in external variables used. Thus, the results of the data analysis show that a significant difference between the application mathematic learning techniques based David Tall's Three Worlds of Mathematics Theory to algebraic thinking skills of students.

CHAPTER V

CONCLUSIONS & SUGGESTIONS

A. Conclusions

Based on the analysis of data from two variables: the application of the mathematical learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students to solve problems triangles and quadrilaterals that have been described in Chapter IV, it can be concluded that:

1. The application of the mathematical learning technique based on the David Tall's Three Worlds Mathematics Theory especially on the subject of triangles and quadrilaterals in its application 56.25% of students (18 students) gave a very positive response. While the rest (14 students) or 43.75% gave a positive response. This positive response may give a significant influence over the rise of students' ability to think algebraically.
2. The mean of gain value of the algebraic thinking skills of students at Junior High School Syarif Hidayatullah is 0.4606 due to which it is considered into medium category.
3. It is plausible to declare that there is a significant influence of the application of the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory on the algebraic thinking skills of students in learning mathematics. This means that the alternative hypothesis is accepted, as seen from the value of t_{test} (4.338) is greater than t_{table} (1.697). Thus, based on this evidence there is a significant relationship. This positive relationship shows that the higher the level of understanding of learning with the application of the mathematical learning technique based the David Tall's Three Worlds Mathematics Theory the more increasing students' ability to think algebraically.

B. Suggestions

Based on the research, discussion and conclusions above, the author could take some suggestions that may be useful for students, teachers and other researchers:

1. Learning mathematics through with the application of the mathematics learning technique based on the David Tall's Three Worlds Mathematics Theory is one technique for a teacher (facilitator) in teaching mathematics. Teacher is expected to teach mathematics using this technique to train and develop algebraic thinking skills of students in learning mathematics.
2. For further researches, the researcher is expected to well compile a learning design in which the mathematic learning techniques based on the David Tall's Three Worlds Mathematics Theory is applied these technique can improve students' algebraic thinking skills in mathematics learning especially in the fields of objects symbolizing the concept and indicators of ability to make a prediction and planes.

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APPENDIX A

-

DAFTAR NAMA SISWA

SMP SYARIF HIDAYATULLAH

Kelas Experimen : VII A

NO.	NAMA	
1	Abdul Sutedi	L
2	Ahmad Bustomi	L
3	Ardi	L
4	Aris Budiyanto	L
5	Chaerul Abdullah	L
6	Dody Prayogo	L
7	Dimas	L
8	Erwin Susanto	L
9	Fatimahtul Zahro	P
10	Iskandar Ramadhan	L
11	Ita Rosita	P
12	Khofifah	P
13	Linda Dewi	P
14	Melina	P
15	Muhammad Rizki	L
16	Noor Dianti Hakim	P
17	Pridayanti	P
18	Romlah	P
19	Rumani	P
20	Rahmat Juanda	L
21	Siti Dewi Ratna	P
22	Suptiyan Eko Hermawan	L
23	Selvia	P
24	Sivi Azizah	P
25	Tomi Mahendra	L
26	Tri Sari	L
27	Umi Hani	P
28	Yanti	P
29	Yesi	P
30	Yayan Sopyan	L
31	Zaenal Abidin	L
32	Deni Kristanto	L

RENCANA PELAKSANAAN PEMBELAJARAN
(RPP)

Nama Sekolah	:	SMP SYARIF HIDAYATULLAH
Mata Pelajaran	:	Matematika
Kelas	:	VII (Tujuh)
Semester	:	2 (Dua)
Alokasi Waktu	:	2 x 40 menit

STANDAR KOMPETENSI

6. Memahami konsep segi empat dan segitiga serta menentukan ukurannya.

KOMPETENSI DASAR

6.1. Mengidentifikasi sifat-sifat segitiga berdasarkan sisi dan sudutnya.

INDIKATOR

1. Menentukan jenis-jenis segitiga berdasarkan panjang sisinya.
2. Menentukan jenis-jenis segitiga berdasarkan besar sudutnya.
3. Menentukan jenis-jenis segitiga berdasarkan panjang sisi dan besar sudutnya.
4. Menggunakan hubungan sudut dalam dan sudut luar segitiga.

A. TUJUAN PEMBELAJARAN

Setelah melakukan kegiatan ini siswa diharapkan dapat:

1. Menentukan jenis-jenis segitiga berdasarkan panjang sisinya dengan benar.
2. Menentukan jenis-jenis segitiga berdasarkan besar sudutnya dengan benar.
3. Menentukan jenis-jenis segitiga berdasarkan panjang sisi dan besar sudutnya dengan benar.
4. Menggunakan hubungan sudut dalam dan sudut luar segitiga dengan baik.

B. MATERI AJAR

Segitiga dan Segi Empat:

- Menemukan jenis-jenis segitiga.
- Menggunakan hubungan sudut dalam dan sudut luar segitiga.

C. PENDEKATAN DAN METODE PEMBELAJARAN

- Pendekatan : Pembelajaran Langsung
- Model : *Cooperative Learning*
- Metode : Diskusi, penugasan, Kuis

D. LANGKAH PEMBELAJARAN

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Awal	1. Guru memberi salam kepada murid *(Religius)* 2. Guru mengabsen murid-murid dan mencatat siapa saja yang tidak hadir *(Disiplin, Jujur, Tanggungjawab)* 3. Guru bersama-sama mendo'akan murid yang sakit, jika ada *(Religius, Kepedulian)* 4. Guru memberikan sedikit *ice breaking* di awal *(Saling menghargai)*	± 10 menit

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Inti *(Eksplorasi, Elaborasi dan Konfirmasi)*	**Eksplorasi:** 1. Guru mengenalkan materi yang akan disampaikan pada pertemuan kali ini *(Keterbukaan)* 2. Guru menyampaikan tujuan yang ingin dicapai dalam pertemuan kali ini *(Jujur, Terbuka)* 3. Guru menyampaikan materi jenis-jenis segitiga *(Embodied and Symbolic World)* 4. Guru menyampaikan materi hubungan sudut dalam dan sudut luar segitiga *(Symbolic and Formal World)* 5. Guru memberikan contoh soal mengenai jenis-jenis segitiga dan hubungan sudut dalam dan sudut luar segitiga *(Terbuka, Jelas, Lugas) , (Embodied, Symbolic, and Formal World)* 6. Guru bersama-sama dengan murid menyelesaikan contoh soal yang diberikan *(Kerjasama)* 7. Guru memberi kesempatan kepada siswa untuk bertanya mengenai hal yang belum dipahaminya *(Demokratis)* **Elaborasi:** 1. Guru memberi latihan soal kepada siswa 2. Guru meminta setiap siswa mengerjakan latihan soal tersebut *(Tanggungjawab)* 3. Guru memeriksa hasil latihan siswa satu persatu *(Saling mengingatkan)* 4. Guru meminta salah satu siswa untuk menjelaskan jawabannya di depan kelas *(Tanggungjawab, Percaya Diri) , (Embodied, Symbolic, and Formal World)* **Konfirmasi:** 1. Setelah semua siswa selesai mengerjakan latihan soal guru memberikan kesempatan bagi siswa yang ingin bertanya mengenai materi yang belum dipahami *(Rasa Ingin Tahu, Demokratis)*	± 60 menit
Kegiatan Penutup	1. Membuat simpulan pelajaran 2. Guru mengingatkan siswa untuk mempelajari kembali pelajaran yang telah disampaikan *(Saling Mengingatkan)* 3. Guru memberi salam kepada siswa *(Religius)*	± 10 menit

E. ALAT DAN SUMBER BELAJAR

Alat/bahan

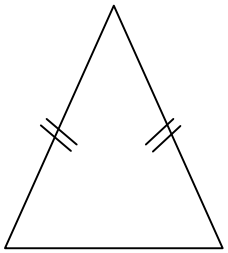
- Alat Tulis (Spidol)
- White Board
- Alat Peraga

Sumber Belajar

Matematika SMP dan MTs ; Untuk kelas VII karangan Tatang Yuli Eko Siswono dan Netti Lastiningsih.

F. PENILAIAN

Instrumen :

Indikator Pencapaian Kopetensi	Penilaian		
	Teknik penilaian	Bentuk instrument	Instrument soal
• Mengetahui jenis-jenis segitiga berdasarkan sisi-sisinya • Mengatahui jenis segitiga berdasarkan besar sudutnya	Tes secara acak	Uraian	1. Disebut segitiga apakah gambar dibawah ini  2. Sebutkan jenis-jenis segitiga yang besar sudutnya a. 50^o ,60^o ,70^o b. 90^o ,45^o ,45^o c. 120^o ,30^o ,30^o

Kunci Jawaban

1. Segitiga sama kaki
2. a . Segitiga lancip
   b . Segitiga Siku-Siku
   c . Segitiga Tumpul

Pedoman Penskoran

Jenis soal	Soal	Skor nilai
Uraian	1	25
	2	75
Jumlah	2	100

Cirebon, 11 April 2013

Mengetahui,
Guru Pamong,

Praktikan,

Syahroni, S.Pd.I

Iis Sugiarti

Pertemuan 2

STANDAR KOMPETENSI

6. Memahami konsep segi empat dan segitiga serta menentukan ukurannya.

KOMPETENSI DASAR

6.2 Mengidentifikasi sifat-sifat persegi panjang, persegi, trapesium, jajargenjang, belah ketupat dan layang-layang.

INDIKATOR

1. Menjelaskan pengertian jajar genjang, persegi, persegi panjang, belah ketupat, trapesium, dan layang-layang menurut sifatnya
2. Menjelaskan sifat-sifat segi empat ditinjau dari sisi, sudut, dan diagonalnya.

A. TUJUAN PEMBELAJARAN

Setelah melakukan kegiatan ini siswa diharapkan dapat:

1. Menjelaskan pengertian jajar genjang, persegi, persegi panjang, belah ketupat, trapezium, dan layang-layang menurut sifatnya dengan baik.
2. Menjelaskan sifat-sifat segi empat ditinjau dari sisi, sudut dan diagonalnya.

B. MATERI AJAR

Segitiga dan Segi Empat:

a. Mengingat segi empat.
b. Mengidentifikasi sifat-sifat segi empat

C. PENDEKATAN DAN METODE PEMBELAJARAN

- Pendekatan : Pembelajaran Langsung
- Model : *Cooperative Learning*
- Metode : Diskusi, penugasan, Kuis

D. LANGKAH PEMBELAJARAN

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Awal	1. Guru memberi salam kepada murid *(Religius)* 2. Guru mengabsen murid-murid dan mencatat siapa saja yang tidak hadir *(Disiplin, Jujur, Tanggungjawab)* 3. Guru bersama-sama mendo'akan murid yang sakit, jika ada *(Religius, Kepedulian)* 4. Guru memberikan sedikit *ice breaking* di awal *(Saling menghargai)*	± 10 menit

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Inti *(Eksplorasi, Elaborasi dan Konfirmasi)*	**Eksplorasi:** 1. Guru mengenalkan materi yang akan disampaikan pada pertemuan kali ini *(Keterbukaan)* 2. Guru menyampaikan tujuan yang ingin dicapai dalam pertemuan kali ini *(Jujur, Terbuka)* 3. Guru menyampaikan materi pengertian jajar genjang, persegi, persegi panjang, belah ketupat, trapezium, dan layang-layang menurut sifatnya dengan baik *(Embodied and Symbolic world)* 4. Guru menyampaikan materi sifat-sifat segi empat ditinjau dari sisi, sudut dan diagonalnya *(Tanggungjawab), (Symbolic and Formal World)* 5. Guru memberikan contoh soal mengenai segi empat *(Terbuka, Jelas, Lugas), (Embodied, Symbolic, and Formal World)* 6. Guru bersama-sama dengan murid menyelesaikan contoh soal yang diberikan *(Kerjasama), (Embodied, Symbolic, and Formal World)* 7. Guru memberi kesempatan kepada siswa untuk bertanya mengenai hal yang belum dipahaminya *(Demokratis)* **Elaborasi:** 1. Guru memberi latihan soal kepada siswa 2. Guru meminta setiap siswa mengerjakan latihan soal tersebut *(Tanggungjawab)* 3. Guru memeriksa hasil latihan siswa satu persatu *(Saling mengingatkan)* 4. Guru meminta salah satu siswa untuk menjelaskan jawabannya di depan kelas *(Tanggungjawab, Percaya Diri), (Embodied, Symbolic, and Formal World)* **Konfirmasi:** Setelah semua siswa selesai mengerjakan latihan soal guru memberikan kesempatan bagi siswa yang ingin bertanya mengenai materi yang belum dipahami *(Rasa Ingin Tahu, Demokratis)*	± 60 menit
Kegiatan Penutup	1. Membuat simpulan pelajaran 2. Guru mengingatkan siswa untuk mempelajari kembali pelajaran yang telah disampaikan *(Saling Mengingatkan)* 3. Guru memberi salam kepada siswa *(Religius)*	± 10 menit

E. ALAT DAN SUMBER BELAJAR

Alat/bahan

- Alat Tulis (Spidol)
- White Board
- Alat Peraga

Sumber Belajar

Matematika SMP dan MTs ; Untuk kelas VII karangan Tatag Yuli Eko Siswono dan Netti Lastiningsih.

F. PENILAIAN

Instrumen :

Indikator Pencapaian Kompetensi	**Penilaian**		
	Teknik	**Bentuk Instrumen**	**Instrumen/ Soal**
➢ Menjelaskan pengertian jajargenjang, persegi, persegi panjang, belah ketupat, trapesium, dan layang-layang menurut sifatnya. ➢ Menjelaskan sifat-sifat segi empat ditinjau dari sisi, sudut, dan diagonalnya.	Tes tertulis	Tes uraian	1. Persegi merupakan belah ketupat dengan sifat khusus. Berdasarkan pernyataan tersebut, buatlah pengertian persegi. 2. Tulislah nama bangun datar yang sesuai dengan sifat berikut. Jawaban dapat lebih dari satu. a) Sisi yang berhadapan sama panjang. b) Sudut-sudut yang berhadapan tidak sama besar. c) Diagonal-diagonalnya membagi 2 sama panjang.

Pedoman Penskoran

Jenis soal	Soal	Skor nilai
Uraian	1	25
	2	75
Jumlah	2	100

Cirebon, 16 April 2013

Mengetahui,
Guru Pamong,

Praktikan,

Syahroni, S.Pd.I

Iis Sugiarti

Pertemuan 3

STANDAR KOMPETENSI

6. Memahami konsep segi empat dan segitiga serta menentukan ukurannya.

KOMPETENSI DASAR

6.3 Menghitung keliling dan luas bangun segitiga dan segi empat serta menggunakannya dalam pemecahan masalah

INDIKATOR

1. Menurunkan rumus keliling dan luas bangun segitiga dan segi empat.
2. Menyelesaikan masalah yag berkaitan dengan menghitung keliling dan luas bangun pada segitiga dan segi empat.

A. TUJUAN PEMBELAJARAN

Setelah melakukan kegiatan ini siswa diharapkan dapat:

1. Menurunkan rumus keliling dan luas bangun segitiga dan segi empat dengan baik.
2. Menyelesaikan masalah yang berkaitan dengan menghitung keliling dan luas bangun segitiga dan segi empat dengan benar.

B. MATERI AJAR

Segitiga dan Segi Empat:

- Menghitung keliling dan luas segi empat dan menggunakannya dalam pemecahan masalah.
- Menghitung keliling dan luas segitiga dan menggunakannya dalam pemecahan masalah.
- Menghitung keliling dan luas bangun datar dan menggunakannya dalam pemecahan masalah.

C. PENDEKATAN DAN METODE PEMBELAJARAN

- Pendekatan : Pembelajaran Langsung
- Model : *Cooperative Learning*
- Metode : Diskusi, penugasan, kuis

D. LANGKAH PEMBELAJARAN

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Awal	1. Guru memberi salam kepada murid *(Religius)* 2. Guru mengabsen murid-murid dan mencatat siapa saja yang tidak hadir *(Disiplin, Jujur, Tanggungjawab)* 3. Guru bersama-sama mendo'akan murid yang sakit, jika ada *(Religius, Kepedulian)* 4. Guru memberikan sedikit *ice breaking* di awal *(Saling menghargai)*	± 10 menit

TAHAPAN KEGIATAN	KEGIATAN	ALOKASI WAKTU
Kegiatan Inti *(Eksplorasi, Elaborasi dan Konfirmasi)*	**Eksplorasi:** 1. Guru mengenalkan materi yang akan disampaikan pada pertemuan kali ini *(Keterbukaan)* 2. Guru menyampaikan tujuan yang ingin dicapai dalam pertemuan kali ini *(Jujur, Terbuka)* 3. Guru memberikan contoh soal mengenai masalah yang berkaitan dengan menghitung keliling dan luas bangun segitiga dan segi empat *(Terbuka, Jelas, Lugas), (Embodied, Symbolic, and Formal World)* 4. Guru bersama-sama dengan murid menyelesaikan contoh soal yang diberikan *(Kerjasama)* 5. Guru memberi kesempatan kepada siswa untuk bertanya mengenai hal yang belum dipahaminya *(Demokratis)* **Elaborasi:** 1. Guru memberi latihan soal kepada siswa 2. Guru meminta setiap siswa mengerjakan latihan soal tersebut *(Tanggungjawab)* 3. Guru memeriksa hasil latihan siswa satu persatu *(Saling mengingatkan)* 4. Guru meminta salah satu siswa untuk menjelaskan jawabannya di depan kelas *(Tanggungjawab, Percaya Diri), (Embodied, Symbolic, and Formal World)* **Konfirmasi:** Setelah semua siswa selesai mengerjakan latihan soal guru memberikan kesempatan bagi siswa yang ingin bertanya mengenai materi yang belum dipahami *(Rasa Ingin Tahu, Demokratis)*	± 60 menit
Kegiatan Penutup	1. Membuat simpulan pelajaran 2. Guru mengingatkan siswa untuk mempelajari kembali pelajaran yang telah disampaikan *(Saling Mengingatkan)* 3. Guru memberi salam kepada siswa *(Religius)*	± 10 menit

E. ALAT DAN SUMBER BELAJAR

Alat/bahan

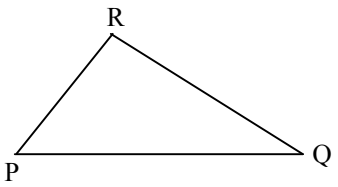
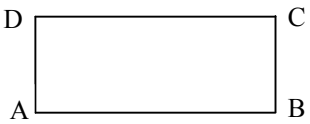
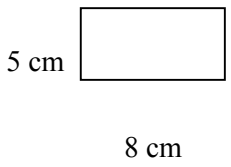
- Alat Tulis (Spidol)
- White Board
- Alat Peraga

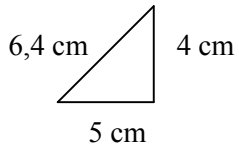
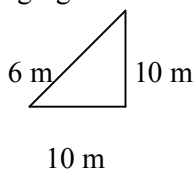
Sumber Belajar

Matematika SMP dan MTs ; Untuk kelas VII karangan Tatag Yuli Eko Siswono dan Netti Lastiningsih.

F. PENILAIAN

Instrumen :

Indikator Pencapaian Kompetensi	Penilaian		
	Teknik	**Bentuk Instrumen**	**Instrumen/ Soal**
• Menurunkan rumus keliling bangun segitiga dan segiempat	Tes tertulis	Isian singkat	
• Menurunkan rumus luas bangun segitiga dan segiempat	Tes tertulis	Isian singkat	Keliling segitiga PQR sama dengan .....
• Menyelesaikan masalah yang berkaitan dengan menghitung keliling dan luas bangun segitiga dan segiempat	Tes tertulis	Uraian	 Luas persegipanjang ABCD adalah ..... Pak Surya mempunyai kebun berbentuk persegipanjang dengan panjang 1 km dan lebar 0,75 km. Kebun tersebut akan ditanami pohon kelapa yang berjarak 10 m satu dengan yang lain. Berapa banyak bibit pohon kelapa yang diperlukan pak Surya? Tentukan luas dan kelilng segi empat berikut.  Tentukan luas dan keliling segitiga berikut.

			 Diagram di bawah ini menunjukkan taman berbentuk segitiga.  Tutik ingin memberi pupuk ke seluruh tanah di tamannya. Satu bungkus pupuk dapat digunakan untuk memupuki 8 m^2. Berapa bungkus pupuk yang akan diperlukan Tutik?

Cirebon, 27 April 2013

Mengetahui,
Guru Pamong,

Praktikan,

Syahroni, S.Pd.I

Iis Sugiarti

-

APPENDIX B

KISI-KISI INSTRUMENT SKALA

PENERAPAN TEKNIK PEMBELAJARAN MATEMATIKA

BERDASARKAN TEORI TIGA DUNIA MATEMATIKA DAVID TALL

Variabel	Definisi Operasional	Dimensi	Indikator	No. Item	
				+	-
Respon siswa terhadap penerapan Teknik Pembelajaran Matematika berdasarkan Teori Tiga Dunia Matematika David Tall	Respon merupakan tanggapan, persepsi atau penilaian resepsional siswa atas penerapan Teknik Pembelajaran Matematika berdasarkan Teori Tiga Dunia Matematika David Tall yang dilakukan oleh guru yang terdiri dari dunia perwujudan, simbolis, dan aksioma.	Perwujudan	➢ Siswa memahami materi berdasarkan persepsi objek. ➢ Siswa memahami materi berdasarkan refleksi pada sifat-sifat objek.	1 4 3 19	14
		Simbol	➢ Siswa melakukan tindakan terhadap objek ➢ Siswa menyimbolkan objek dalam konsep	8 16 2 17	5 12
		Aksioma	➢ Siswa memahami materi berdasarkan teori formal dan bukti ➢ Siswa mengkonstruksi pemahaman tentang objek berdasarkan definisi konsep formal ➢ Siswa mengaitkan definisi konsep suatu objek yang berhubungan dengan objek tersebut	9 15 11 18	13 7 20 6 10

INSTRUMENT SKALA

PENERAPAN TEKNIK PEMBELAJARAN MATEMATIKA

BERDASARKAN TEORI TIGA DUNIA MATEMATIKA DAVID TALL

Nama :

Kelas :

Petunjuk Pengisian

1. Tulislah identitas Anda pada kolom yang telah disediakan
2. Bacalah setiap pernyataan dengan baik dan teliti
3. Isilah pernyataan di bawah ini dengan memberikan tanda checklist (√) pada kolom pernyataan yang sesuai dengan pilihan Anda dan tidak boleh lebih dari satu pilihan.
   Keterangan :
   - Sangat Setuju (SS)
   - Setuju (S)
   - Ragu - Ragu (R)
   - Tidak Setuju (TS)
   - Sangat Tidak Setuju (STS)
4. Mohon untuk diisi tanpa ada yang terlewat

NO	PERNYATAAN	SS	S	R	TS	STS
1.	Pemberian contoh bangun datar oleh guru membuat saya lebih memahami materi.					
2.	Saya mampu memberikan simbol huruf untuk panjang persegi panjang.					
3.	Saya dapat menyebutkan sifat-sifat segi empat dari sebuah gambar.					
4.	Pintu, jendela, layang-layang dapat memudahkan saya memahami materi segi empat.					
5.	Saya kesulitan menggambarkan sebuah bangun datar yang sifat-sifatnya diketahui.					
6.	Saya kesulitan membuktikan bahwa jumlah sudut dalam segitiga adalah 180^0.					
7.	Menyelesaikan soal matematika dengan urutan cara terbalik itu sulit.					
8.	Saya dapat menentukan keliling sebuah kolam.					
9.	Saya dapat menjelaskan belah ketupat berdasarkan rumus mencari luasnya.					
10.	Saya kesulitan mencari alas sebuah segitiga yang luas dan tingginya sudah diketahui.					
11.	Saya bisa menentukan salah satu besar sudut dalam segitiga.					
12.	Saya kesulitan menentukan keliling segitiga yang panjang sisi-sisinya diperbesar.					

13.	Saya tidak dapat menuliskan panjang diagonal layang-layang yang diketahui pada soal.					
14.	Saya tidak dapat membedakan belah ketupat dan layang - layang					
15.	Rumus dalam matematika membuat materi mudah dipahami.					
16.	Saya mampu menuliskan rumus L = a x t untuk luas jajar genjang.					
17.	Simbol-simbol dalam matematika memudahkan saya untuk memahami materi.					
18.	Saya mampu mengaitkan hubungan luas jajar genjang dengan luas segitiga.					
19.	Saya memahami dengan baik bahwa layang-layang terbentuk dari dua buah segitiga yang memiliki alas sama panjang.					
20.	Saya kesulitan menggambarkan garis tinggi, garis bagi, garis berat, dan garis sumbu pada segitiga.					

KISI-KISI TES KEMAMPUAN BERPIKIR ALJABAR

Variable Penelitian : Kemampuan Berpikir aljabar

No.	Definisi Operasional	Dimensi	Indikator	Batasan	No. Item
1.	Kemampuan dalam melakukan generalisasi dari pengalaman dengan bilangan dan perhitungan, melakukan penalaran terhadap soal-soal matematika, mengeksplorasi konsep-konsep dari pola dan fungsi, dan memformalisasikan ide-ide dengan penggunaan sistem simbol yang berguna untuk memecahkan beragam masalah matematika.	Menggeneralisasi masalah	➢ Siswa mampu menentukan aturan atau pola	Menentukan rumus keliling segitiga dalam bentuk aljabar.	3
		Menalar soal matematika	➢ Siswa mampu menyelesaikan soal matematika dengan menggunakan penalaran yang dimilikinya	Menentukan luas persegi panjang yang tidak diarsir.	5
				Menentukan sisi sebuah persegi, jika diketahui keliling persegi sama dengan keliling persegi panjang	7
		Mengeksplorasi konsep-konsep	➢ Siswa mampu membuktikan sebuah persamaan	Membuktikan persamaan sudut pada segitiga	1
			➢ Siswa mampu memprediksi dan menggambarkan bangun	Menentukan luas maksimal bangun segi empat yang dapat dibentuk dari tali sepanjang 46 m.	8
		Memformalisasikan ide-ide	➢ Siswa mampu membuat analisis dari suatu soal matematika	Menyimpulkan pertidaksamaan dari sisi sisi segitiga	2
				Memperbaiki persamaan tentang sudut sebuah persegi panjang	9

-

-

		Memecahkan masalah	➢ Siswa mampu menyelesaikan soal matematika yang disajikan dalam bentuk soal cerita	Menghitung luas ubin	4
				Menentukan biaya yang diperlukan untuk membeli rumput sebuah taman	10
			➢ Siwa mampu menemukan dan mengekspresikan operasi aljabar dengan menggunakan simbol serta menentukan solusinya	Menentukan panjang sisi sejajar trapesium yang diketahui perbandingannya	6

-

INSTRUMEN PENGUMPULAN DATA

Judul Proposal Penelitian

Pengaruh Penerapan Teknik Pembelajaran Berdasarkan Teori Tiga Dunia Matematika David Tall Terhadap Kemampuan Berpikir Aljabar Siswa Kelas VII Pokok Bahasan Segitiga dan Segi Empat

PROPOSAL SKRIPSI

Diajukan Sebagai Salah Satu Syarat
Untuk Memperoleh Gelar Sarjana Pendidikan Islam (S.Pd.I)
Pada Jurusan Tadris Matematika Fakultas Tarbiyah
Institut Agama Islam Negeri (IAIN) Syekh Nurjati Cirebon

IIS SUGIARTI

NIM : 59450987

KEMENTERIAN AGAMA RI
INSTITUT AGAMA ISLAM NEGERI (IAIN)
SYEKH NURJATI CIREBON FAKULTAS TARBIYAH
2013

Nama :
Kelas :
Sekolah :

INSTRUMEN TES KEMAMPUAN BERPIKIR ALJABAR

Satuan Pendidikan : Sekolah Menengah Pertama
Mata Pelajaran : Matematika
Kelas/Semester : VII/II
Alokasi Waktu : 2 X 40 Menit

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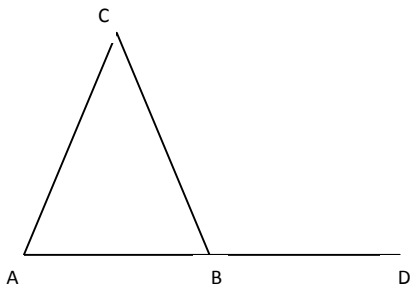
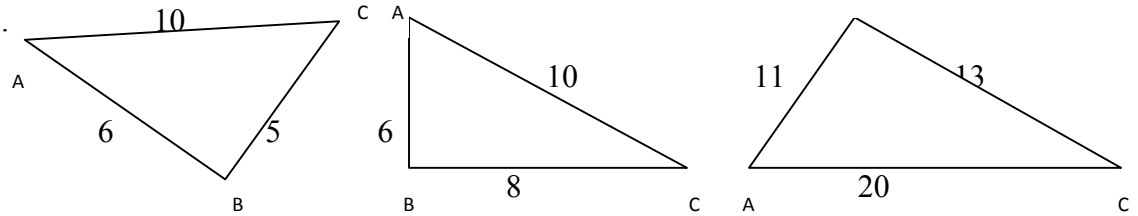
1. 

Buktikan < DBC = < BAC + < ACB

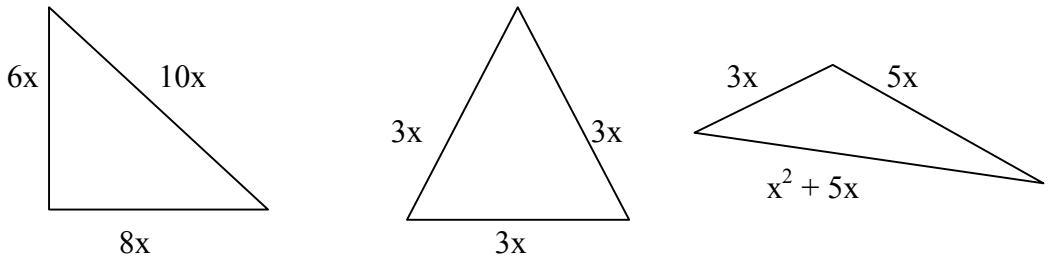
2. 

$10 < 6 + 5$ $10 < 6 + 8$ $20 < 11 + 13$

Perhatikan gambar di atas!

Jika AC = sisi terpanjang

Maka dapat disimpulkan : sisi terpanjang < ..... + ……

3. 

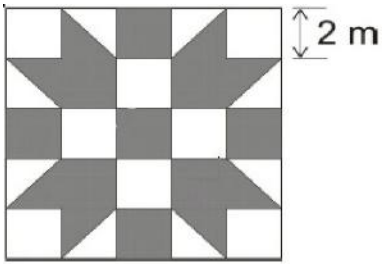
(i) (ii) (iii)

Keliling segitiga (i) = 24x

Keliling segitiga (ii) = 9x

Tentukan keliling segitiga (iii)!

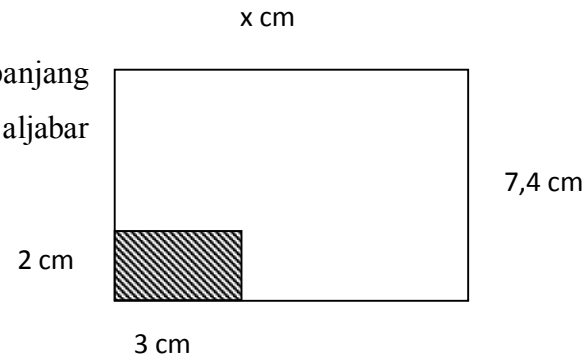
4. Hartono merencanakan memasang ubin untuk lantai kamarnya dengan model seperti pada gambar.



Tersedia ubin dengan warna abu-abu dan putih yang berbentuk persegi dengan panjang sisi 2m.

a. Berapa luas ubin putih yang terpasang pada lantai kamar Hartono tersebut?
b. Berapa luas ubin abu-abu yang terpasang pada lantai kamar Hartono tersebut?

5. Perhatikan gambar di samping. Luas persegi panjang adalah panjang kali lebar. Tulislah bentuk aljabar yang menyatakan luas persegi panjang yang tidak diarsir.

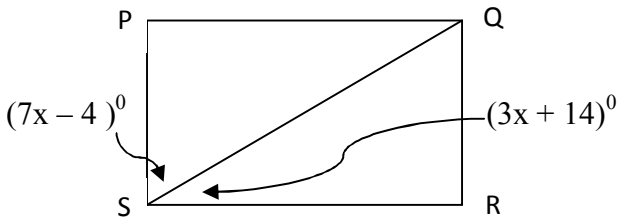


6. Perbandingan panjang sisi-sisi sejajar suatu trapezium adalah 1 : 3. Tinggi trapezium itu 6 cm dan luasnya adalah 48 cm^2. Tulislah persamaan untuk mencari panjang sisi yang sejajar. Selesaikan persamaan itu.

7. Diketahui suatu persegi dengan sisi (x+3) cm dan persegi panjang dengan panjang (2x – 3) cm serta lebar (x + 1) cm. Jika keliling persegi panjang = keliling persegi, tentukan panjang sisi persegi tersebut.

8. Buatlah bangun segi empat dari tali sepanjang 46 m. Bangun segi empat apakah yang dapat dibentuk sehingga luasnya maksimal? Tentukan luas bangun tersebut.

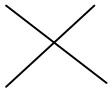
9. Pada sebuah soal tentang persegi panjang, seorang siswa diminta menentukan nilai x. Hasil pekerjaan siswa tampak seperti pada gambar.



$7x - 4 = 3x + 14$

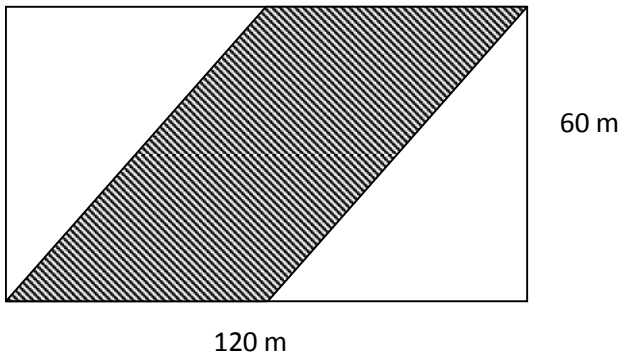
$4x = 18$

$x = 4{,}5$



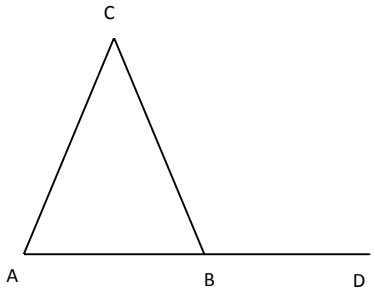
Dimanakah letak kesalahan yang dilakukan? perbaiki jawaban siswa tersebut!

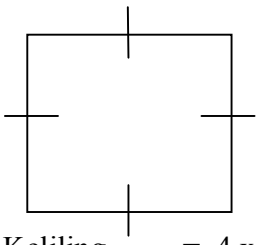
10. Sebuah taman tampak seperti gambar !



Bagian yang diarsir ditanami Rumput Gajah yang tiap kilogramnya dapat menutup daerah seluas 5 m^2. Harga Rumput Gajah adalah Rp. 750,00 per kg. Berapa biaya yang dibutuhkan untuk membeli rumput taman tersebut.

JAWABAN INSTRUMENT KEMAMPUAN BERPIKIR ALJABAR

NO	JAWABAN	SKOR
1.	Buktikan $< DBC = < BAC + < ACB$  $< DBC = 180° - < ABC$ $< ABC = 180° - (< BAC + < ACB)$ $< DBC = 180° - < ABC$ $< DBC = 180° - (180° - (< BAC + < ACB))$ $< DBC = < BAC + < ACB$ TERBUKTI	1 2 3 4
2.	Jika AC = Sisi Terpanjang Maka : AC < AB + BC	2
3.	i. 14x ii. 9x iii. $x^2 + 13x$	1 2 3
4.	Luas ubin putih = Luas 12 persegi = 12 x s x s = 12 x 2 x 2 = 48 m^2 Luas ubin abu-abu = Luas 13 persegi = 13 x s x s = 13 x 2 x 2 = 52 m^2	1 2 3 4
5.	Luas yang tidak diarsir = Luas − Luas = 7,4 x – (2 x 3) = (7,4 x – 6) cm^2	2 3 4
6.	Perbandingan sisi-sisi sejajar trapesium 1 : 3 Misal sisi-sisi sejajar trapesium : a dan 3a Luas Trapesium = $\frac{\text{jumlah sisi sejajar}}{2} \; x \; t$ 48 = $\frac{a+3a}{2} x \; 6$ 48 = $\frac{4a}{2}$ x 6 48 = 12 a	2 3

	a $= \frac{48}{12}$ a $= 4$ 3a $= 12$ Jadi panjang sisi-sisi sejajar trapezium tersebut adalah 4cm dan 12cm	4
7.	Keliling Persegi Panjang = Keliling Persegi 2 (p + l) = 4 s 2 (2x – 3 + x + 1) = 4 (x + 3) 2 (3x – 2) = 4x + 12 6x – 4 = 4x +12 6x – 4x = 12 + 4 2x = 16 x $= \frac{16}{2}$ x = 8 Maka, panjang sisi persegi tersebut adalah 8 + 3 = 11 cm	2 3 4
8.	 Keliling = 4 x s 46 = 4 x s s $= \frac{46}{4}$ s = 11,5 m Luas Persegi = s x s = 11,5 x 11,5 = 132,25 m^2	2 3 4 5
9.	$(7x-4)^o + (3x+14)^o = 90^o$ $7x^o + 3x^o - 4^o + 14^o = 90^o$ $10x^o + 10^o = 90^o$ $10x^o = 90^o - 10^0$ $10x^o = 80^o$ $x^o = \frac{80^o}{10^o}$ $x^o = 8$	3 4 5

10.	Luas yang diarsir = Luas Jajar Genjang = a x t = 60 x 60 = 3600 m^2 Rumput yang dibutuhkan = $\frac{3600}{5}$ = 720 kg Biaya untuk membeli rumput = 720 x Rp.750 = Rp. 540.000 Jadi biaya yang dibutuhkan untuk membeli rumput taman adalah Rp. 540.000	2 3 4 5

LEMBAR VALIDASI BUTIR PERNYATAAN SKALA
PENERAPAN TEKNIK PEMBELAJARAN MATEMATIKA BERDASARKAN TEORI TIGA DUNIA MATEMATIKA DAVID TALL

Sampel : Kelas VII SMP Syarif Hidayatullah, Pasalakan

Pokok Bahasan : Bangun Datar (Segitiga dan Segi Empat)

Berilah tanda ceklis (√) pada kolom yang sesuai.

No Butir	**Pernyataan**	**3**	**2**	**1**	**Saran**
1	Pemberian contoh bangun datar oleh guru membuat saya lebih memahami materi.				
2	Saya mampu memberikan simbol huruf untuk panjang persegi panjang.				
3	Saya dapat menyebutkan sifat-sifat segi empat dari sebuah gambar.				
4	Belajar matematika dengan mengaitkan pada kehidupan sehari-hari itu tidak efektif				
5	Saya kesulitan menggambarkan sebuah bangun datar yang sifat-sifatnya diketahui.				
6	Saya kesulitan membuktikan bahwa jumlah sudut dalam segitiga adalah 180^0.				
7	Menyelesaikan soal matematika dengan urutan cara terbalik itu sulit				
8	Saya dapat menentukan keliling sebuah kolam.				
9	Saya dapat menjelaskan sifat				

	belah ketupat berdasarkan rumus mencari luasnya.				
10	Saya kesulitan mencari alas sebuah segitiga yang luas dan tingginya sudah diketahui.				
11	Saya bisa menentukan salah satu besar sudut dalam segitiga.				
12	Saya sulit menentukan keliling segitiga yang panjang sisi-sisinya menjadi lebih panjang dari semula.				
13	Dalam menyelesaikan soal, saya tidak dapat mengganti symbol dengan angka.				
14	Saya tidak dapat membedakan belah ketupat dan layang – laying				
15	Rumus dalam matematika membuat materi mudah dipahami.				
16	Saya mampu menuliskan rumus L = a x t untuk luas jajar genjang.				
17	Simbol-simbol dalam matematika memudahkan saya untuk memahami materi.				
18	Saya mampu mengaitkan hubungan luas jajar genjang dengan luas segitiga.				
19	Saya memahami dengan baik bahwa layang-layang terbentuk dari dua buah segitiga yang memiliki alas sama panjang.				

20	Saya kesulitan menggambarkan garis tinggi, garis bagi, garis berat, dan garis sumbu pada segitiga.				

Keterangan:

3 : Esensial

2 : Penting tapi tidak esensial

1 : Tidak Penting

Cirebon, ……., 2013

Validator

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LEMBAR VALIDASI BUTIR PERNYATAAN SKALA
PENERAPAN TEKNIK PEMBELAJARAN MATEMATIKA BERDASARKAN
TEORI TIGA DUNIA MATEMATIKA DAVID TALL

Sampel : Kelas VII SMP Syarif Hidayatullah, Sumber-Cirebon

Pokok Bahasan : Bangun Datar (Segitiga dan Segi Empat)

Berilah tanda ceklis (√) pada kolom yang sesuai.

No Butir	**Pernyataan**	**3**	**2**	**1**	**Saran**
1	Pemberian contoh bangun datar oleh guru membuat saya lebih memahami materi.				
2	Saya mampu memberikan simbol huruf untuk panjang persegi panjang.				
3	Saya dapat menyebutkan sifat-sifat segi empat dari sebuah gambar.				
4	Pintu, jendela, layang-layang dapat memudahkan saya memahami materi segi empat.				
5	Saya kesulitan menggambarkan sebuah bangun datar yang sifat-sifatnya diketahui.				
6	Saya kesulitan membuktikan bahwa jumlah sudut dalam segitiga adalah 180^0.				
7	Menyelesaikan soal				

	matematika dengan urutan cara terbalik itu sulit				
8	Saya dapat menentukan keliling sebuah kolam.				
9	Saya dapat menjelaskan sifat belah ketupat berdasarkan rumus mencari luasnya.				
10	Saya kesulitan mencari alas sebuah segitiga yang luas dan tingginya sudah diketahui.				
11	Saya bisa menentukan salah satu besar sudut dalam segitiga.				
12	Saya sulit menentukan keliling segitiga yang panjang sisi-sisinya diperbesar.				
13	Saya tidak dapat menuliskan panjang diagonal layang-layang yang diketahui pada soal.				
14	Saya tidak dapat membedakan belah ketupat dan layang – layang				
15	Rumus dalam matematika membuat materi mudah dipahami.				
16	Saya mampu menuliskan rumus L = a x t untuk luas				

	jajar genjang.				
17	Simbol-simbol dalam matematika memudahkan saya untuk memahami materi.				
18	Saya mampu mengaitkan hubungan luas jajar genjang dengan luas segitiga.				
19	Saya memahami dengan baik bahwa layang-layang terbentuk dari dua buah segitiga yang memiliki alas sama panjang.				
20	Saya kesulitan menggambarkan garis tinggi, garis bagi, garis berat, dan garis sumbu pada segitiga.				

Keterangan:

3 : Esensial

2 : Penting tapi tidak esensial

1 : Tidak Penting

Cirebon, ……., 2013

Validator

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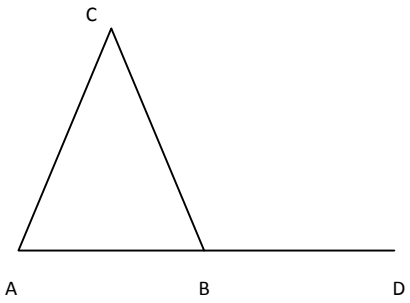
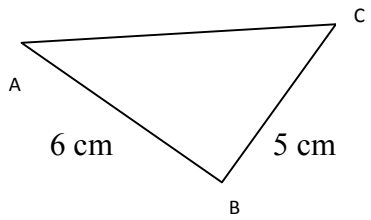
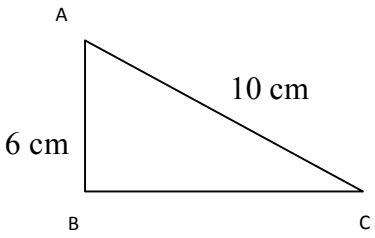
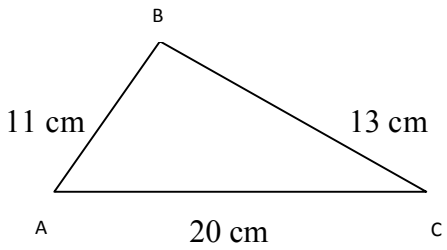
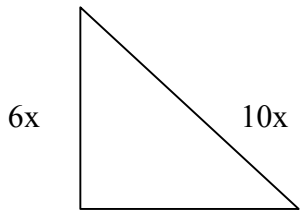
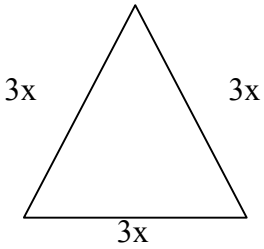
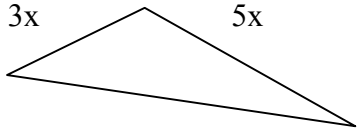
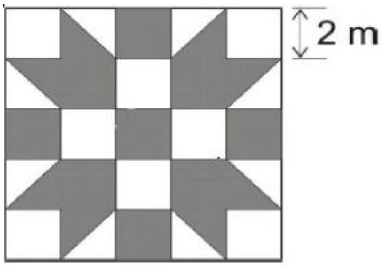
LEMBAR VALIDASI BUTIR SOAL KEMAMPUAN BERPIKIR ALJABAR

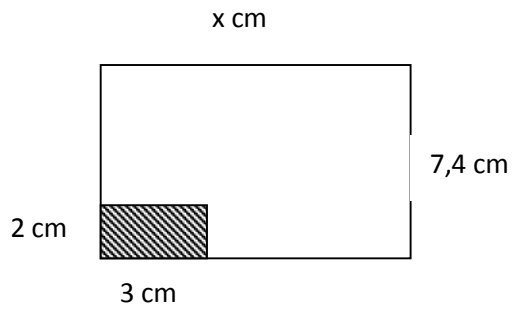
Sampel : Kelas VII SMP Syarif Hidayatullah, Sumber-Cirebon

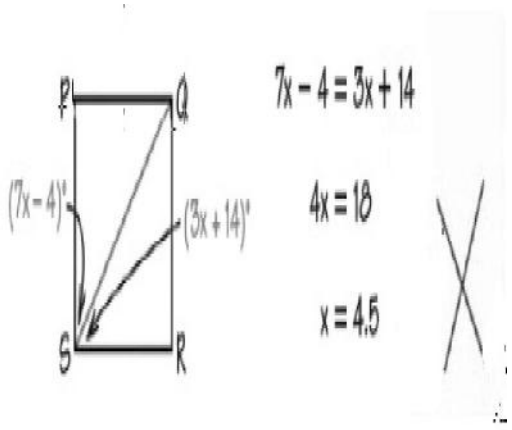
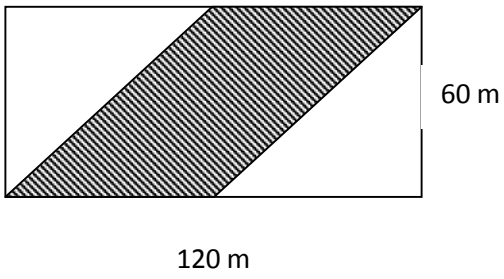
Pokok Bahasan : Bangun datar (Segitiga dan Segiempat)

Berilah tanda ceklis (√) pada kolom yang sesuai.

No Butir	Soal	3	2	1	Saran
1	 Buktikan < DBC = < BAC + < ACB				
2	10 cm   8 cm 				

	Perhatikan gambar di atas! Jika AC = sisi terpanjang Maka dapat disimpulkan : sisi terpanjang < ..... + ……				
3	   $x^2 + 5x$ Tulislah bentuk aljabar yang menyatakan keliling segitiga di atas!				
4	Hartono merencanakan memasang ubin untuk lantai kamarnya dengan model seperti pada gambar.  Tersedia ubin dengan warna abu-abu dan putih yang berbentuk persegi dengan panjang sisi 2m.				

	a. Berapa luas ubin putih yang terpasang pada lantai kamar Hartono tersebut? b. Berapa luas ubin abu-abu yang terpasang pada lantai kamar Hartono tersebut?				
5	 Perhatikan gambar di atas. Luas persegi panjang adalah panjang kali lebar. Tulislah bentuk aljabar yang menyatakan luas peresegi panjang yang tidak diarsir.				
6	Perbandingan panjang sisi-sisi sejajar suatu trapesium adalah 1 : 3. Tinggi trapesium itu 6 cm dan luasnya adalah 48 cm^2. Tulislah persamaan untuk mencari panjang sisi yang sejajar. Selesaikan persamaan itu.				
7	Diketahui suatu persegi dengan sisi (x+3) cm dan persegi panjang dengan panjang (2x – 3) cm serta lebar (x + 1) cm. Jika keliling persegi panjang = keliling persegi, tentukan panjang sisi persegi tersebut.				
8	Buatlah bangun segi empat dari tali sepanjang 46 m. Bangun segi empat apakah yang dapat dibentuk sehingga				

	luasnya maksimal? Tentukan luas bangun tersebut				
9	Pada sebuah soal tentang persegi panjang, seorang siswa diminta menentukan nilai x. Hasil pekerjaan siswa tampak seperti pada gambar.  Dimanakah letak kesalahan yang dilakukan dan perbaiki jawaban siswa tersebut.				
10	Sebuah taman tampak seperti gambar !  Bagian yang diarsir ditanami Rumput Gajah yang tiap kilogramnya dapat menutup daerah seluas 5 m^2. Harga Rumput Gajah adalah Rp. 750,00 per kg. Berapa biaya yang dibutuhkan untuk membeli rumput taman tersebut				

Keterangan:

3 : Esensial

2 : Penting tapi tidak esensial

1 : Tidak Penting

Cirebon, ……., 2013

Validator

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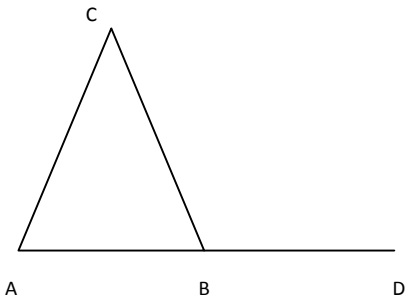
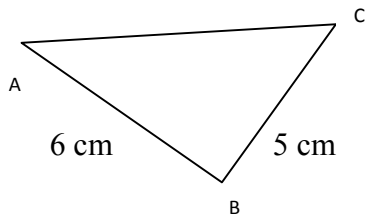
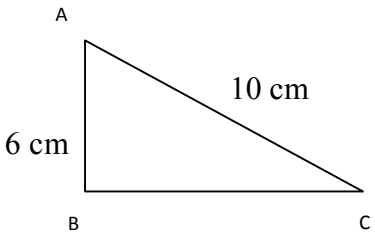
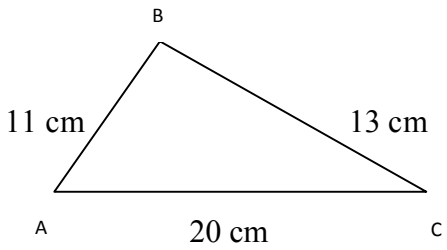
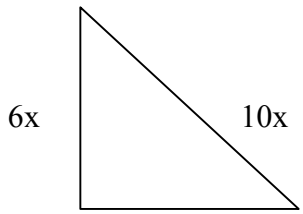
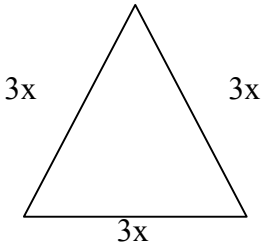
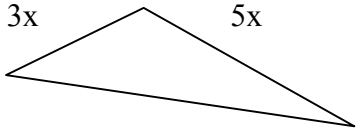
LEMBAR VALIDASI BUTIR SOAL KEMAMPUAN BERPIKIR ALJABAR

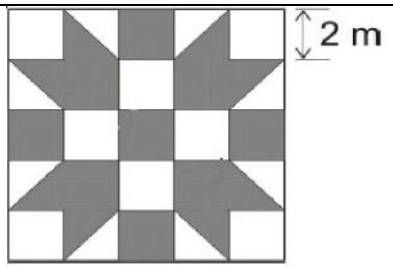
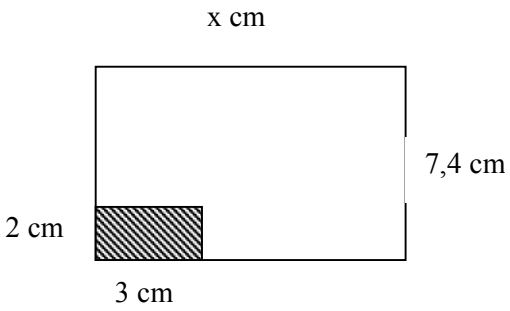
Sampel : Kelas VII SMP Syarif Hidayatullah, Sumber-Cirebon.

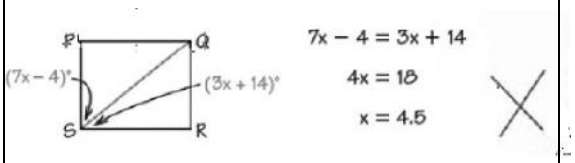
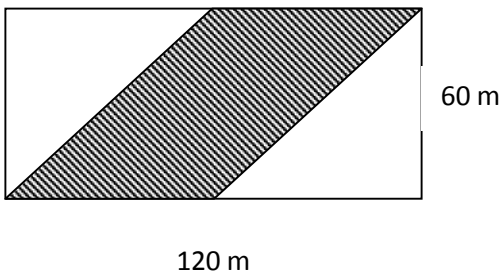
Pokok Bahasan : Bangun Datar (Segitiga dan Segi Empat)

Berilah tanda ceklis (√) pada kolom yang sesuai.

No Butir	Soal	3	2	1	Saran
1	 Buktikan < DBC = < BAC + < ACB				
2	10 cm   8 cm 				

	Perhatikan gambar di atas! Jika AC = sisi terpanjang Maka dapat disimpulkan : sisi terpanjang < ..... + ……				
3	 8x (i)  (ii)  $x^2 + 5x$ (iii) Keliling segitiga (i) = 24x Keliling segitiga (ii) = 9x Tulislah keliling segitiga (iii)!				
4	Hartono merencanakan memasang ubin untuk lantai kamarnya dengan model seperti pada gambar.				

	 Tersedia ubin dengan warna abu-abu dan putih yang berbentuk persegi dengan panjang sisi 2m. a. Berapa luas ubin putih yang terpasang pada lantai kamar Hartono tersebut? b. Berapa luas ubin abu-abu yang terpasang pada lantai kamar Hartono tersebut?				
5	 Perhatikan gambar di atas. Luas persegi panjang adalah panjang kali lebar. Tulislah bentuk aljabar yang menyatakan luas peresegi panjang yang tidak diarsir.				
6	Perbandingan panjang sisi-sisi sejajar suatu trapesium adalah 1 : 3. Tinggi trapesium itu 6 cm dan luasnya adalah 48 cm^2. Tulislah persamaan untuk mencari panjang sisi yang sejajar. Selesaikan persamaan itu.				
7	Diketahui suatu persegi dengan sisi				

	(x+3) cm dan persegi panjang dengan panjang (2x – 3) cm serta lebar (x + 1) cm. Jika keliling persegi panjang = keliling persegi, tentukan panjang sisi persegi tersebut.				
8	Buatlah bangun segi empat dari tali sepanjang 46 m. Bangun segi empat apakah yang dapat dibentuk sehingga luasnya maksimal? Tentukan luas bangun tersebut				
9	Pada sebuah soal tentang persegi panjang, seorang siswa diminta menentukan nilai x. Hasil pekerjaan siswa tampak seperti pada gambar.  Dimanakah letak kesalahan yang dilakukan dan perbaiki jawaban siswa tersebut.				
10	Sebuah taman tampak seperti gambar !  Bagian yang diarsir ditanami Rumput Gajah yang tiap kilogramnya dapat menutup daerah seluas 5 m^2. Harga Rumput Gajah adalah Rp. 750,00 per kg. Berapa biaya yang dibutuhkan untuk membeli rumput taman tersebut				

Keterangan:

3 : Esensial

2 : Penting tapi tidak esensial

1 : Tidak Penting

Cirebon, ……., 2013

Validator

_____

-

APPENDIX C

RELIABILITAS TES
==========

Rata2= 17.69
Simpang Baku= 8.11
KorelasiXY= 0.81
Reliabilitas Tes= 0.90
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

No.Urut	No. Subyek	Kode/Nama Subyek	Skor Ganjil	Skor Genap	Skor Total
1	1	R1	12	11	23
2	2	R2	15	17	32
3	3	R3	9	8	17
4	4	R4	9	8	17
5	5	R5	13	12	25
6	6	R6	7	9	16
7	7	R7	18	17	35
8	8	R8	12	13	25
9	9	R9	5	5	10
10	10	R10	10	8	18
11	11	R11	6	9	15
12	12	R12	8	10	18
13	13	R13	3	3	6
14	14	R14	19	19	38
15	15	R15	12	10	22
16	16	R16	9	6	15
17	17	R17	3	1	4
18	18	R18	11	5	16
19	19	R19	4	4	8
20	20	R20	8	4	12
21	21	R21	7	8	15
22	22	R22	2	1	3
23	23	R23	7	8	15
24	24	R24	7	10	17
25	25	R25	5	8	13
26	26	R26	6	4	10
27	27	R27	14	11	25
28	28	R28	14	9	23
29	29	R29	9	15	24
30	30	R30	8	8	16
31	31	R31	6	10	16
32	32	R32	8	9	17

KELOMPOK UNGGUL & ASOR
==========

Kelompok Unggul
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

					1	2	3	4	5
No Urt					1	2	3	4	5
1	14	R14		38	4	2	2	4	4
2	7	R7		35	4	0	3	4	4
3	2	R2		32	2	2	3	3	2
4	5	R5		25	2	0	3	3	2
5	8	R8		25	0	0	2	4	4
6	27	R27		25	0	0	2	3	4
7	29	R29		24	0	2	0	4	4
8	1	R1		23	2	0	3	4	3
9	28	R28		23	4	0	3	4	4
Rata2 Skor					2.00	0.67	2.33	3.67	3.44
Simpang Baku					1.73	1.00	1.00	0.50	0.88

					6	7	8	9	10
No Urt					6	7	8	9	10
1	14	R14		38	4	4	5	5	4

2	7	R7	35	4	4	4	3	5
3	2	R2	32	4	4	3	4	5
4	5	R5	25	3	2	2	4	4
5	8	R8	25	3	2	3	4	3
6	27	R27	25	3	4	3	4	2
7	29	R29	24	3	3	3	2	3
8	1	R1	23	2	2	3	2	2
9	28	R28	23	2	0	3	3	0
Rata2 Skor				3.11	2.78	3.22	3.44	3.11
Simpang Baku				0.78	1.39	0.83	1.01	1.62

Kelompok Asor
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

				1	2	3	4	5
No Urt				1	2	3	4	5
1	23	R23	15	2	0	3	3	0
2	25	R25	13	0	0	3	3	0
3	20	R20	12	2	0	1	2	1
4	9	R9	10	1	0	1	1	1
5	26	R26	10	1	0	0	2	1
6	19	R19	8	0	0	0	0	0
7	13	R13	6	0	0	0	0	0
8	17	R17	4	2	0	1	0	0
9	22	R22	3	1	0	0	0	0
Rata2 Skor				1.00	0.00	1.00	1.22	0.33
Simpang Baku				0.87	0.00	1.22	1.30	0.50

				6	7	8	9	10
No Urt				6	7	8	9	10
1	23	R23	15	3	0	2	2	0
2	25	R25	13	3	0	2	2	0
3	20	R20	12	0	1	0	3	2
4	9	R9	10	3	0	1	2	0
5	26	R26	10	0	1	0	3	2
6	19	R19	8	1	3	1	1	2
7	13	R13	6	1	2	1	1	1
8	17	R17	4	0	0	0	0	1
9	22	R22	3	0	0	1	1	0
Rata2 Skor				1.22	0.78	0.89	1.67	0.89
Simpang Baku				1.39	1.09	0.78	1.00	0.93

DAYA PEMBEDA
==========

Jumlah Subyek= 32
Klp atas/bawah(n)= 9
Butir Soal= 10
Un: Unggul; AS: Asor; SB: Simpang Baku
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

No	No Btr Asli	Rata2Un	Rata2As	Beda	SB Un	SB As	SB Gab	t	DP(%)
1	1	2.00	1.00	1.00	1.73	0.87	0.65	1.55	25.00
2	2	0.67	0.00	0.67	1.00	0.00	0.33	2.00	33.33
3	3	2.33	1.00	1.33	1.00	1.22	0.53	2.53	44.44
4	4	3.67	1.22	2.44	0.50	1.30	0.46	5.26	61.11
5	5	3.44	0.33	3.11	0.88	0.50	0.34	9.21	77.78
6	6	3.11	1.22	1.89	0.78	1.39	0.53	3.54	47.22
7	7	2.78	0.78	2.00	1.39	1.09	0.59	3.39	50.00
8	8	3.22	0.89	2.33	0.83	0.78	0.38	6.13	46.67
9	9	3.44	1.67	1.78	1.01	1.00	0.47	3.75	35.56
10	10	3.11	0.89	2.22	1.62	0.93	0.62	3.58	44.44

TINGKAT KESUKARAN
==========

Jumlah Subyek= 32
Butir Soal= 10
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

No Butir Baru	No Butir Asli	Tkt. Kesukaran(%)	Tafsiran
1	1	37.50	Sedang
2	2	16.67	Sukar
3	3	55.56	Sedang
4	4	61.11	Sedang
5	5	47.22	Sedang
6	6	54.17	Sedang
7	7	44.44	Sedang
8	8	41.11	Sedang
9	9	51.11	Sedang
10	10	40.00	Sedang

KORELASI SKOR BUTIR DG SKOR TOTAL
==========

Jumlah Subyek= 32
Butir Soal= 10
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

No Butir Baru	No Butir Asli	Korelasi	Signifikansi
1	1	0.442	-
2	2	0.343	-
3	3	0.535	-
4	4	0.745	Sangat Signifikan
5	5	0.673	Signifikan
6	6	0.689	Signifikan
7	7	0.591	Signifikan
8	8	0.775	Sangat Signifikan
9	9	0.657	Signifikan
10	10	0.641	Signifikan

Catatan: Batas signifikansi koefisien korelasi sebagaai berikut:

df (N-2)	P=0,05	P=0,01	df (N-2)	P=0,05	P=0,01
10	0,576	0,708	60	0,250	0,325
15	0,482	0,606	70	0,233	0,302
20	0,423	0,549	80	0,217	0,283
25	0,381	0,496	90	0,205	0,267
30	0,349	0,449	100	0,195	0,254
40	0,304	0,393	125	0,174	0,228
50	0,273	0,354	>150	0,159	0,208

Bila koefisien = 0,000 berarti tidak dapat dihitung.

REKAP ANALISIS BUTIR
==========

Rata2= 17.69
Simpang Baku= 8.11
KorelasiXY= 0.81
Reliabilitas Tes= 0.90
Butir Soal= 10
Jumlah Subyek= 32
Nama berkas: C:\USERS\WINDOW~1\DOCUME~1\POSTTE~1.AUR

No	No Btr Asli	T	DP(%)	T. Kesukaran	Korelasi	Sign. Korelasi

1	1	1.55	25.00	Sedang	0.442	-
2	2	2.00	33.33	Sukar	0.343	-
3	3	2.53	44.44	Sedang	0.535	-
4	4	5.26	61.11	Sedang	0.745	Sangat Signifikan
5	5	9.21	77.78	Sedang	0.673	Signifikan
6	6	3.54	47.22	Sedang	0.689	Signifikan
7	7	3.39	50.00	Sedang	0.591	Signifikan
8	8	6.13	46.67	Sedang	0.775	Sangat Signifikan
9	9	3.75	35.56	Sedang	0.657	Signifikan
10	10	3.58	44.44	Sedang	0.641	Signifikan

VALIDITAS ISI BERDASARKAN EXPERT JUDGEMENT

Tahap I

Dalam penelitian ini validitas yang digunakan adalah validitas isi berdasarkan expert judgement. Dimana soal yang telah dibuat oleh peneliti diajukan kepada beberapa validator untuk dimintai pendapatnya mengenai kesesuaian antara butir soal dengan indikator yang telah dibuat oleh peneliti. Peneliti mengajukan validasi isi kepada dua orang validator, validator tersebut diminta untuk memberi penilaian dengan memberikan nilai "1" jika butir dinilai tidak diperlukan, nilai "2" jika butir penting namun kurang sesuai dengan indikator, dan nilai "3" jika butir sudah sesuai dengan indikator. Hasil penilaian dua orang validator tersebut selanjutnya diolah dengan menggunakan pendekatan kuantitatif untuk mengestimasi validitas isi setiap butir soal dengan menggunakan *Content Validity Ratio* (CVR) sebagaimana yang ditulis oleh Lawshe (1975), dengan rumus sebagai berikut:

$$CVR = (ne - \frac{N}{2})/(\frac{N}{2})$$

Atau bisa juga ditulis dalam bentuk

$$CVR = \frac{2ne}{N} - 1$$

Dengan N adalah banyaknya validator dan ne adalah banyaknya validator yang menyatakan sudah sesuai dengan indikator.

Hasil perhitungan CVR untuk setiap butir peneliti sajikan dalam tabel berikut:

Tabel Perhitungan CVR untuk Setiap Butir Pertanyaan Kemampuan Berpikir Aljabar Siswa

No Butir	Pernyataan Validator		ne	CVR	Keterangan
	Validator 1	Validator 2			
1	3	3	2	1	Butir soal mempunyai validitas isi yang baik
2	3	3	2	1	Butir soal mempunyai validitas isi yang baik
3	2	2	0	0	Butir soal mempunyai validitas isi yang kurang baik
4	3	3	2	1	Butir soal mempunyai validitas isi yang baik
5	3	3	2	1	Butir soal mempunyai validitas isi yang baik

6	3	3	2	1	Butir soal mempunyai validitas isi yang baik
7	3	3	2	1	Butir soal mempunyai validitas isi yang baik
8	3	3	2	1	Butir soal mempunyai validitas isi yang baik
9	3	3	2	1	Butir soal mempunyai validitas isi yang baik
10	3	3	2	1	Butir soal mempunyai validitas isi yang baik

Tabel perhitungan CVR untuk setiap butir pernyataan skala teknik pembelajaran matematika berdasarkan Teori Tiga Dunia Matematika David Tall

No Butir	Pernyataan Validator		ne	CVR	Keterangan
	Validator 1	Validator 2			
1	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
2	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
3	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
4	2	3	1	0	Butir pernyataan mempunyai validitas isi yang kurang baik
5	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
6	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
7	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
8	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
9	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
10	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
11	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
12	2	3	1	0	Butir pernyataan mempunyai validitas isi yang kurang baik
13	1	2	0	0	Butir pernyataan mempunyai validitas isi yang kurang baik
14	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
15	3	3	2	1	Butir pernyataan mempunyai

					validitas isi yang baik
16	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
17	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
18	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
19	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
20	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik

Keterangan

Kode penilaian:

3 = jika validator menyatakan butir pernyataan sudah sesuai dengan indikator

2 = jika validator menyatakan butir pernyataan penting namun kurang sesuai dengan indikator

1 = jika validator menyatakan butir pernyataan tidak diperlukan atau tidak penting

ne = jumlah validator yang menyatakan butir soal sudah sesuai dengan indikator

Hasil diatas dapat digunakan untuk criteria pemilihan butir, dimana butir dengan CVR rendah harus dibuang dan atau diperbaiki. Berdasarkan Lawshe (1975), nilai minimum CVR sedemikian hingga masih dinyatakan baik disajikan dalam tabel berikut:

Tabel nilai minimum CVR berdasarkan Lawshe

Banyaknya validator	Nilai CVR minimum
5	0,99
6	0,99
7	0,99
8	0,75
9	0,78
10	0,62
11	0,59
12	0,56

13	0,54
14	0,51
15	0,49
20	0,42
25	0,37
30	0,33
35	0,31
40	0,29

Karena dalam penelitian ini hanya menggunakan dua orang validator, maka batasan minimum CVR haruslah 1. Tampak bahwa nilai CVR pada soal kemampuan berpikir aljabar nomer 1, 2, 4, 5, 6, 7, 8, 9 dan 10 adalah 1 yang artinya soal dapat dinyatakan memiliki validitas yang baik. Kemudian nilai CVR pada nomer 3 adalah 0 yang artinya butir soal nomer 3 haruslah diperbaiki atau diganti.

Sekarang kita lihat nilai CVR pada pernyataan skala teknik pembelajaran matematika berdasarkan Teori Tiga Dunia Matematika David Tall. Tampak bahwa nilai CVR untuk nomer 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19 dan 20 adalah 1 yang artinya pernyataan dapat dinyatakan memiliki validitas yang baik. Kemudian nilai CVR pada nomer 4, 12 dan 13 adalah 0 yang artinya butir soal 4, 12 dan 13 haruslah diperbaiki atau diganti.

Tahap II

Validitas isi tahap II dilakukan karena terdapat beberapa butir soal dan butir pernyataan yang direvisi ataupun diganti. Berikut adalah hasil perhitungan CVR setelah dilakukan revisi pada beberapa butir soal atau butir pernyataan.

Tabel perhitungan CVR untuk setiap butir pertanyaan kemampuan berpikir aljabar siswa

No Butir	Pernyataan Validator		ne	CVR	Keterangan
	Validator 1	Validator 2			
1	3	3	2	1	Butir soal mempunyai validitas isi yang baik
2	3	3	2	1	Butir soal mempunyai validitas isi yang baik
3	3	3	2	1	Butir soal mempunyai validitas isi yang baik
4	3	3	2	1	Butir soal mempunyai validitas isi yang baik

5	3	3	2	1	Butir soal mempunyai validitas isi yang baik
6	3	3	2	1	Butir soal mempunyai validitas isi yang baik
7	3	3	2	1	Butir soal mempunyai validitas isi yang baik
8	3	3	2	1	Butir soal mempunyai validitas isi yang baik
9	3	3	2	1	Butir soal mempunyai validitas isi yang baik
10	3	3	2	1	Butir soal mempunyai validitas isi yang baik

Tabel perhitungan CVR untuk setiap butir pernyataan skala teknik pembelajaran matematika berdasarkan Teori Tiga Dunia Matematika David Tall

No Butir	Pernyataan Validator		ne	CVR	Keterangan
	Validator 1	Validator 2			
1	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
2	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
3	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
4	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
5	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
6	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
7	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
8	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
9	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
10	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
11	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
12	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
13	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
14	3	3	2	1	Butir pernyataan mempunyai

					validitas isi yang baik
15	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
16	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
17	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
18	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
19	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik
20	3	3	2	1	Butir pernyataan mempunyai validitas isi yang baik

Dari table di atas, hasil validitas isi berdasarkan expert judgment pada tahap II ini sudah baik. Hal ini terlihat dari nilai CVR pada setiap butir soal ataupun butir pernyataan bernilai 1 yang artinya setiap butir soal ataupun butir pernyataan mempunyai validitas isi yang baik.

-

APPENDIX D

HASIL POST-TEST KEMAMPUAN BERPIKIR ALJABAR SISWA

RESPONDEN	NO SOAL										SKOR TOTAL	NILAI
	1	2	3	4	5	6	7	8	9	10		
R1	3	0	2	2	2	2	2	2	3	0	18	45
R2	4	2	2	2	2	2	2	5	0	5	26	65
R3	2	2	2	2	2	4	4	2	3	5	28	70
R4	2	2	2	4	4	4	0	0	0	0	18	45
R5	2	2	3	4	4	2	2	2	3	2	26	65
R6	1	2	3	4	4	4	4	4	4	4	34	85
R7	0	0	3	4	2	4	4	2	0	2	21	52.5
R8	3	2	2	0	2	2	2	0	3	2	18	45
R9	4	0	3	4	4	4	4	2	3	4	32	80
R10	1	2	3	2	0	2	2	2	3	3	20	50
R11	3	2	3	3	3	2	4	3	3	2	28	70
R12	1	0	2	4	4	2	2	2	5	0	22	55
R13	4	2	3	2	3	2	4	2	5	5	32	80
R14	0	2	3	3	3	3	2	2	3	3	24	60
R15	4	2	3	3	4	2	2	4	4	4	32	80
R16	3	2	2	3	4	4	2	2	3	3	28	70
R17	4	2	3	2	2	4	4	5	3	3	32	80
R18	2	2	3	2	2	2	2	4	3	4	26	65
R19	1	0	3	4	4	4	4	4	0	0	24	60
R20	1	2	3	3	4	3	3	2	3	2	26	65
R21	4	2	3	4	4	4	4	3	0	0	28	70
R22	1	2	3	4	4	4	4	0	0	0	22	55
R23	4	2	3	4	4	3	3	2	3	3	31	77.5
R24	0	0	3	2	4	4	4	5	5	5	32	80
R25	2	2	3	3	3	2	0	2	3	4	24	60
R26	1	2	3	4	4	2	4	2	5	5	32	80
R27	2	2	2	3	3	3	3	4	3	4	29	72.5
R28	4	2	3	0	2	2	2	4	4	3	26	65
R29	3	0	1	4	4	3	2	2	3	2	24	60
R30	4	2	3	3	2	3	2	5	5	5	34	85
R31	4	2	3	2	4	3	4	5	5	5	37	92.5
R32	2	2	3	4	2	2	2	2	3	2	24	60

TABEL KEMAMPUAN BERPIKIR ALJABAR SISWA

No.	Respondent	Value			Interpretation
		Pre-test	Post-test	N-Gain	
1	R1	5	45	0.42	Medium
2	R2	20	65	0.56	Medium
3	R3	35	70	0.54	Medium
4	R4	20	45	0.31	Medium
5	R5	40	65	0.42	Medium
6	R6	50	85	0.7	High
7	R7	40	52.5	0.21	Low
8	R8	40	45	0.08	Low
9	R9	60	80	0.5	Medium
10	R10	25	50	0.33	Medium
11	R11	20	70	0.63	Medium
12	R12	20	55	0.44	Medium
13	R13	30	80	0.71	High
14	R14	25	60	0.47	Medium
15	R15	47.5	80	0.62	Medium
16	R16	32.5	70	0.56	Medium
17	R17	65	80	0.43	Medium
18	R18	52.5	65	0.26	Low
19	R19	40	60	0.33	Medium
20	R20	45	65	0.36	Medium
21	R21	20	70	0.63	Medium
22	R22	20	55	0.44	Medium
23	R23	35	77.5	0.65	Medium
24	R24	37.5	80	0.68	Medium
25	R25	52.5	60	0.16	Low
26	R26	60	80	0.5	Medium
27	R27	55	72.5	0.39	Medium
28	R28	45	65	0.36	Medium
29	R29	45	60	0.27	Low
30	R30	50	85	0.7	High
31	R31	70	92.5	0.75	High
32	R32	40	60	0.33	Medium

HASIL SKALA TEKNIK PEMBELAJARAN MATEMATIKA BERDASARKAN TEORI TIGA DUNIA MATEMATIKA

DAVID TALL

RESPONDEN	NO ITEM																				Skor Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
R1	3	4	3	3	4	3	3	4	3	4	3	3	3	3	4	4	3	4	4	4	69
R2	4	4	4	3	5	3	4	4	3	4	4	4	3	3	4	4	3	4	4	5	76
R3	4	5	5	4	4	4	4	4	5	4	4	4	4	5	5	5	4	5	4	4	87
R4	3	4	3	3	5	3	3	4	3	4	3	4	3	3	4	4	3	4	4	4	71
R5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	81
R6	4	4	5	5	4	5	5	3	5	4	4	4	5	5	4	5	4	4	5	4	88
R7	3	4	4	3	5	3	4	4	3	4	4	4	3	3	4	4	3	4	4	5	75
R8	5	4	4	4	5	3	4	4	3	4	4	4	3	3	4	4	3	4	4	3	76
R9	4	4	5	4	5	4	4	3	4	4	4	4	4	5	5	5	4	5	5	5	87
R10	3	4	4	4	3	4	4	4	4	4	4	4	4	5	5	5	4	4	3	3	79
R11	4	4	4	4	4	4	4	4	4	4	5	5	4	5	4	5	4	4	4	4	84
R12	3	3	4	4	3	4	5	4	3	3	4	3	3	3	4	4	3	4	4	5	73
R13	4	4	3	4	4	4	4	3	4	5	4	4	4	5	5	5	4	5	5	5	85
R14	4	4	4	4	5	5	5	4	4	4	4	4	4	4	4	3	4	4	4	3	81
R15	5	5	4	5	4	5	5	4	5	4	5	4	4	4	4	4	4	4	4	4	87
R16	5	4	5	4	4	4	5	5	4	4	4	5	4	3	4	4	4	4	3	4	83
R17	4	4	5	5	5	4	4	4	5	5	5	4	4	4	4	4	4	4	4	4	86
R18	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	3	3	3	5	4	81
R19	4	4	4	3	5	4	3	3	5	4	4	3	4	4	3	3	3	3	4	3	73
R20	4	4	3	4	4	3	3	4	4	4	3	3	3	4	5	4	4	4	3	4	74

R21	3	5	3	4	5	5	4	5	5	4	5	4	4	5	4	4	5	4	4	4	86
R22	4	4	5	3	3	4	4	4	3	4	4	4	5	4	3	3	3	4	4	4	76
R23	4	5	4	3	4	4	5	4	4	3	4	4	4	4	4	3	4	4	4	4	79
R24	5	3	4	4	4	4	4	3	4	3	3	5	5	3	4	4	4	5	5	5	81
R25	3	3	3	3	3	3	3	3	4	5	4	5	4	3	5	4	3	3	4	5	73
R26	4	4	4	4	3	4	4	4	4	4	3	4	4	5	4	4	3	5	4	4	79
R27	4	5	3	4	4	4	4	5	5	4	5	4	4	4	5	4	5	4	4	4	85
R28	4	4	4	4	4	4	5	4	4	3	4	4	4	4	4	5	3	4	5	3	80
R29	5	3	5	4	3	5	4	4	4	4	4	3	4	4	5	4	4	4	4	4	81
R30	4	5	5	4	5	5	4	4	4	4	4	4	5	4	4	4	5	4	5	4	87
R31	5	5	4	4	4	4	5	4	5	4	4	4	5	5	4	4	4	5	5	5	89
R32	4	4	4	3	5	4	4	5	4	4	4	4	4	5	3	4	3	4	3	4	79

Tabel Uji Normalitas

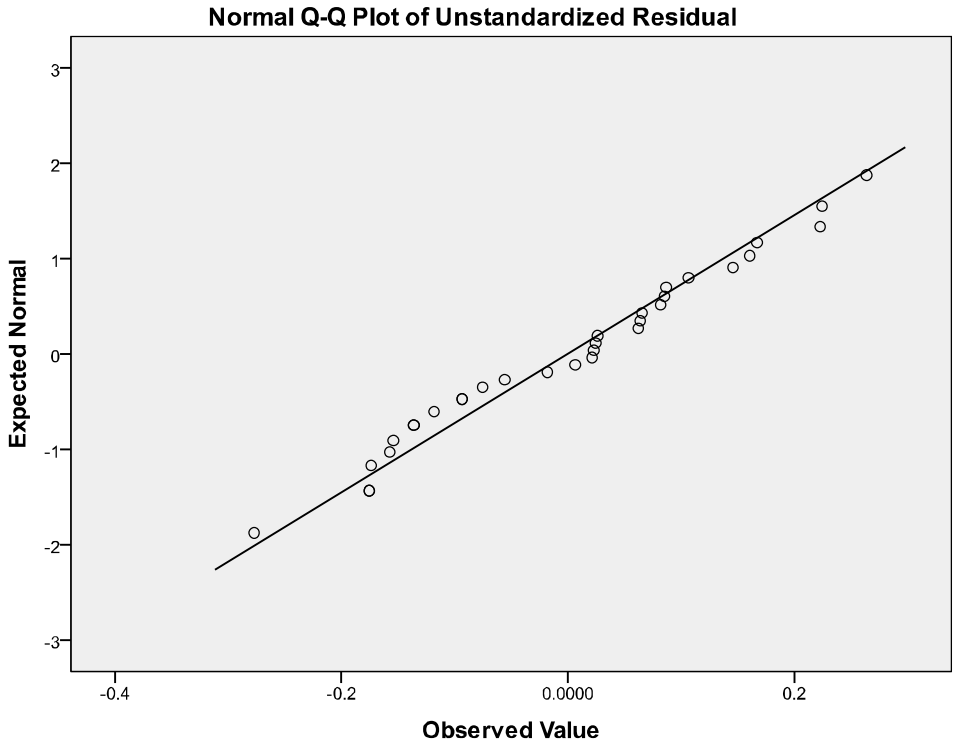
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.095	32	.200*	.970	32	.509

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Diagram QQ Plot



Tabel Uji Homogenitas

Test of Homogeneity of Variances

Y

Levene Statistic	df1	df2	Sig.
.945	6	16	.491

Tabel Uji Kelinieran Regresi

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Y * X	Between Groups	(Combined)	.494	15	.033	1.142	.396
		Linearity	.368	1	.368	12.772	.003
		Deviation from Linearity	.126	14	.009	.312	.983
	Within Groups		.461	16	.029		
	Total		.955	31			

Tabel Persamaan Regresi

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.118	.365		-3.061	.005
X	.020	.005	.621	4.338	.000

a. Dependent Variable: Y

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.368	1	.368	18.817	.000[a]
	Residual	.587	30	.020		
	Total	.955	31			

a. Predictors: (Constant), X
b. Dependent Variable: Y

Tabel Uji Kebaikan Model

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.621[a]	.385	.365	.13987

a. Predictors: (Constant), X
b. Dependent Variable: Y

Tabel Uji Hipotesis

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-1.118	.365		-3.061	.005
X	.020	.005	.621	4.338	.000

a. Dependent Variable: Y

Tabel Perbandingan Pre test dan Post test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	posttest	67.0313	32	12.69108	2.24349
	pretest	38.8281	32	15.48913	2.73812