Profile Of Understanding The Concept Of Students Rectangular Based On The Theory Of Pirie-Kieren Reviewed From Different Types

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Abstract- Mathematics is a science that plays an important role in human life which is also a basic science taught from the most basic level or elementary school to varsity level. In addition, mathematics is also a continuous science in which there are basic material (prerequisite material) that must be mastered by students by understanding the problems in the material before entering into higher material. Every student has different ways of understanding a problem. One of them is the way of male students and female students intellection. This is caused by the slow pace of students in receiving and processing information to understand problem. The Importance of Understanding in Mathematical Learning Becomes the Basics of Pirie-Kieren developed a Theory of Understanding. Pirie and Kieren's theory states that the development of mathematical understanding is formed based on the initial understanding and the form of repetition of understanding to the outermost understanding that when in the learning process students return to the previous level of understanding and then progress to the next level of understanding. In the development of one's understanding there are 8 levels namely *Primitive Knowing, Image Having, Image Making, Property Noticing, Formalising, Observing, Structuring* and *Inventising*. This research is a descriptive study with a qualitative approach that aims to describe students' understanding of concepts according to Pirie Kieren's theory based on gender differences.. The selection of research subjects was determined based on gender differences, namely men and women. The research subjects chosen were 1 male student and 1 female student. Data collection techniques were carried out by giving TPKS and the results of student interviews. Research data in the form of TPKS results and interview results. Based on the results of the study, the male subject (ANY) shows that at the *primitive knowing* level, **he** knows the sides and the angles and define them. Measuring angles with a protractor, recognize rectangles according to their characteristics, in *image making* level, can develop ideas from previous knowledge that able to classify and mention the forms of flat facets, and able to measure the lengths of the sides and angles of the rectangles. At image having level, he have done mental activities namely with the existence of ANY media can identify two-dimentional figure of rectangular, and then explain the activities that are in his mind when using the media**.** At the level of *property noticing*, suspect the existence of a relationship between flat shapes or differences between flat quadrilateral , then ANY TPKS complete accord with surprise, and On *formalising* level, can determine the circumference and area flat segiemapat, and can be explained that the steps undertaken in determining the circumference and area can be used. While the female subject (TFH) shows that at the *primitive knowing* level , it can know the sides and angles and define them. Measuring angles with protractor, recognizing rectangles according to their characteristics , at level l *image making* , can develop ideas from previous knowledge that is able to classify and mention the forms of flat, fixed shapes, and can measure the length of the sides and quadrilateral angles . At the level of having image, it has done mental activity namely in the presence of TFH media can identify flat earthquake construction and then describes the activities he has in mind when using media At the property noticing level, suspect the existence of a relationship between the flat shape of the view or the difference

between the rectangular flat building, then TFH completes the TPKS according to the expectations. At level *formalising*, can determine the rectangle circumference and area, you cannot explain that the steps taken in determining the circumference and area can be used.

Keywords : Pirie- Kieren Theory , Concept Understanding, Quadrangle, Gender

I. Introduction

One of the basic knowledge taught in elementary school is mathematics. Mathematics is one in among the subjects which emphasizes a lot on deep understanding of solving a problem. Every day without realizing it or not, humans will face a problem. Problems faced by humans are sometimes a matter of mathematical concept. With the emergence of problems, people will definitely try to understand the problem to solve it . The main emphasis of good mathematics learning is how to better understand mathematical concepts. In order for students to be able to understand mathematical concepts, mathematics learning must be able to provide students the opportunity to construct mathematical concepts, so that students are not only crammed with abstract mathematical material that makes it difficult for students to understand mathematics. The link between the information contained in the concept and the net structure of cognition (schema) that has been owned by someone (Hiebert & Carpenter, 2007, p.42). This can be identified through two things, namely: 1) through the number of network linkages between elements / attributes (information) that build a concept with the knowledge scheme that the individual has; and 2) through the strong functional relationships of the linking networks formed.

Understanding comes from the word "understand". According to KBBI (2015), understanding means understanding, which can be interpreted as a learning process that follows learning outcomes in accordance with learning objectives. In addition, the term *understanding* was also described by Hiebert and Carpenter (in Styliandes, 2008) as " *a mathematical idea or procedure or fact is a part of an internal network. More specifically, the mathematics is a mental representation of a network of representations "* . Based on the above opinion, a mathematical idea or procedure or fact is said to be understood if this becomes part of the internal network. More specifically understanding in mathematics can be interpreted as a *mathematical* idea (*procedure* or *facts) that understood* if *the* mental *representation* is an *element* of *the* representation *network* . It means that the relationship ethics between internal representations of constructive ideas, then there is formed a network of knowledge. Therefore a mathematical idea, procedure, or fact is perfectly understood if it is strongly interwoven with existing networks and has more connections. In other words, mathematics will be understood if the mental picture thought by students can be clearly related to the representation it has.

NCTM (2000, p. 11) mentions " *Student must learn mathematics with understanding actively building new knowledge from experience and previous knowledge"*. Learning with understanding is building a new knowledge gained and associating with various kinds of knowledge that have been previously owned by students that must be able to learn mathematics with understanding, by actively building a new knowledge from experience and initial knowledge that has been previously owned .

Understanding is one of the things that must be considered in the learning process. Every student is expected to understand what is and has been learned. Students' understanding is one indicator of achieving learning goals. Gragae (2001, p. 232) states " *The importance of understanding is crucial by the entire world. To the teacher, students' understanding of mathematics is a sign of achievement having met the goal of teaching* . For educators, student understanding is a sign of achievement in learning.

Piaget (Mousley, 2004, p. 378) states that " *understanding as constructed, developed and organized as a result of cognitive interaction between sensory experience and existing and existing schema* ". According to Piaget, understanding is built, developed and organized as a result of cognitive interactions between existing sensory experiences and schemes. This shows that there is a process of constructing knowledge actively from students, so that students not only receive knowledge from passive teachers.

In accordance with constructivism theory, educating is not the process of transferring information to students and learning is also not a passive activity in absorbing information from teachers or books. But in educating teachers it should help students in constructing their own ideas using the knowledge they have had before. There are three

factors that can be used to develop classroom learning, namely: 1) conditioning students' reflective thinking, 2) creating social interactions between students and student-teachers, and 3) using models or tools for learning.

In reality, the teacher is currently carrying out learning with the stages of presenting definitions and then giving examples and finally giving the task to be done at home. In this way the students learning tends to be as a listener and recipient information, and then students work on assignments as s u dah modeled by teachers. Students work procedurally and understand mathematics without reasoning, so understanding mathematics is not meaningful.

As a result of the process students are only limited to "imitating" procedures (steps of completion) that have been done by the teacher. Even students often "do not know" why they should use such a procedure, which is important for students is "already" using the procedure exemplified by the teacher and obtaining answers that are in accordance with what is desired by the teacher. In this case students do not need to think of alternatives (other ways), which may be more efficient and effective.

One of the things that is more supportive of this "imitation process" is the desire of educators to be faster in evaluating. In this case the evaluation will be easy to do, if the way done by students is uniform. Therefore the emphasis on procedures (how to answer) becomes dominant in learning. As a result the learning process does not develop an understanding of concepts that are not well constructed.

Brown and Cocking (NCTM, 2000, p. 20) suggest that conceptual understanding is an important part of knowledge that is needed to solve a problem. This also relates to the opinion expressed by Djaramah (2008, p. 152) that procedural knowledge and conceptual understanding are equally important for building skills in mathematics, learning with understanding will make the next learning process easier.

The concept is one mathematical object. According to Soedjadi (2000) "In mathematics the object being studied is a basic object consisting of 1) facts, 2) Concepts, 3) Relations or rules and (4) Principles".

According to Budiarto (2016) students can be said to understand a concept or understand the concepts given in the learning process when he is able to express or re-explain the concept by using his own words and not just memorizing. In addition, it can also find and explain the relationship between concepts and other concepts that have been studied first. Therefore, students must be accustomed to bring up new ideas, solve problems, and find something that can be used for their needs, and familiarize students to construct their own knowledge. To ascertain whether or not students understand mathematics or not is to identify how that understanding occurs (Gulkilik et al., 2016). A theory from Pirie and Kieren (1994) describes the process of mathematical understanding such as the statement *"It is a theory of the growth of mathematical understanding as a whole, dynamic, leveled but nonlinear, transcendental recursive process"* (p. 166). Pirie and Kieren (1994) see understanding as a whole process of growth.

According to Pirie (1992), understanding is the ability to explain a situation or an action. From this understanding, understanding is *ability* someone to search for, choose and create an active learning *situation* to capture the meaning and meaning of *a* concept.

Pirie and Kieren's theory states that mathematical understanding is formed based on initial understanding and the form of repetition of understanding to the outermost understanding that when in the learning process students return to the previous level of understanding and then progress to the next level of understanding. In the development of one's understanding there are 8 levels namely *Primitive Knowing*, *Image Having*, *Image Making*, *Property Noticing*, *Formalising*, *Observing*, *Structuring* and *Inventising* .

S ISWA often do not understand the concepts in mathematics, and are far from understanding the true meaning of mathematical concepts. Because all mathematical concepts and procedures are built into mind (Steffe, 2001, 2004; Thompson, 2003; von Glasersfeld, 1983), understanding mathematics can be difficult. This is an important problem, and needs to be considered to assess students' understanding of mathematical concepts (Pirie & Kieren, 1989; Skemp, 1976). Assessment of student understanding of mathematical concepts is not an easy task, thus only a limited part of student understanding can be assessed (Sierpinska, 1994).

One concept in mathematics is the concept of geometry. Geometry is a branch of mathematics that does not prioritize relationships between numbers, even though it uses numbers. But geometry studies the relationship between dots, lines, angles, fields and flat and built up spaces (Susanah & Hartono, 2012, p. 1).

Geometry has an important role in mathematics. Walle & John stated several reasons for the importance of studying geometry. 1) Geometry is able to provide more complete knowledge about the world. 2) Exploration of

geometry can develop problem solving abilities. 3) Geometry plays an important role in learning other concepts in mathematics learning. 4) Geometry is used every day by many people. 5) Geometry is a fun lesson.

From the statement, it is expected that geometry material can be mastered and understood by students. But in fact there are still many students who have not mastered and understood geometry, especially in quadrilateral, because quadrilateral is one of the important geometrical material, which is often found in everyday life.

Quadrangle is one of the concepts that forms the basis of geometry. When learning the concept of quadrilateral students construct a quadrilateral concept in an effort to understand the concept. An understanding that has been formed about the concept of quadrilateral will be stored in the long-term memory of students. At certain times the quadrilateral concept is needed again, for example to understand other concepts related to quadrilateral concepts. Because the quadrilateral concept has been stored in the memory of students, then to use the quadrilateral concept in these situations must reconstruct the quadrilateral concept that has been understood before. Because the fourth place is also one of the prerequisite materials in learning to build space in the next class.

But most students still have difficulty when understanding quadrilateral. This difficulty can be seen from many students who experience errors when solving quadrilateral problems (Anzora, 2013). Molle (2000) argues that the errors experienced include quadrilateral concepts, symmetry concepts, mobile concepts and principles and concepts and broad principles of flat building. In accordance with Dian (2014), which revealed that there were several problems that resulted in students tending to make mistakes when solving quadrilateral. In solving contextual problems related to geometry students often experience difficulties, for example making images that correspond to the purpose of the problem and students often find it difficult to connect between a concept and another concept. These errors are thought to be caused by a lack of understanding of students on quadrilateral material.

Researchers choose Elementary School (SD), because elementary school is one form of formal education unit that organizes general education at the basic education level (PP NUMBER 17 OF 2010 Article 1 Paragraph 8). Also because since elementary school lay the foundation or foundations of all scientific disciplines including mathematics. The considerations for the selection of fifth grade elementary school students as research subjects are as follows: (1) According to Havighurts (Sofyan, 2016, p. 12-13) the task of developing children and schoolchildren (6-12 years) is related to attitudes, behavior and skills that should be mastered with the age or phase of development, namely learning basic skills in counting; (2) The age of grade V elementary school students when associated with intellectual stages, Piaget (Omrod, 2008, p. 45) students at ages 6 or 7 years to 11 or 12 years, enter the concrete operational stage. At this stage the child has begun to use clear and logical rules and is characterized by *reversibility* and eternity. Children have logical thinking skills, but only with objects that are protective; (3) when children enter the operational *operation stage (concrete operation stage),* their thinking processes become organized into a larger system of mental processes, for example, *operations* , which make it easier for them to think more logically based on information given to them. Even though students who demonstrate concrete operational thinking have featured many features of logical thinking, their cognitive development is in perfect numbers.

Mulyono (2011) argues that basically every individual is unique. Each individual has distinctive characteristics, which are not shared by other individuals. One of them is the difference in ability possessed by each individual in dealing with mathematical problems. In this regard, mathematics learning in schools must involve male and female students, many opinions suggest that women are not successful enough to learn mathematics compared to men. . This opinion was concluded from the opinion of some experts in the field of psychology, for example (Bratanata in Suprianto, 2017, p. 81) saying that women are generally better in memory and men are better at logical thinking. Likewise, (Katono in Suprianto, 2017, p. 81) argues that however good and brilliant the intelligence of women is, but in essence women almost never have a thorough interest in theoretical questions like men, women are also more close to theoretical life issues, women are also closer to abstract aspects. From the expert's opinions, related to mathematical abilities, it resulted in women being portrayed as being less intelligent in mathematics than men.

Carr and Davis (Casey, 2001. p. 29) shows *"further the first grade boys could use manipulation as well as the girls, but the girls could not use retrieval the facts" as well as boys, even when instructed to retrieve the facts "* . It can be said further that first-class boys can use manipulatives as well as girls, but girls cannot use fact-finding like boys, even when instructed to take facts. In a *longitudinal* study Fennema (in Cesey, 2001, p. 29) also found that in

classes one and two, girls were more likely to use more abstract solution strategies that found conceptual understanding.

Based on the explanation of some of these things, the researcher was interested in conducting a study entitled "Profile of Understanding the Concept of Elementary School Quadrilateral Students According to Pirie and Kieren Theories Viewed from Sex Differences ". This study aims to . 1) Describe the profile of quadrilateral conceptual understanding of female students according to Pirie-Kieren theory, 2) Describe the profile of understanding the quadrilateral concept of male students according to the Pirie-Kieren theory

II. Research Elaborations

The design of this study is included in Qualitative research . This study aims to analyze students' understanding of concepts according to Pirie Kieren's theory based on gender differences then this research is descriptive with a qualitative approach. Qualitative research is research that is used to examine natural conditions. In addition, this study aims to uncover and provide an overview of the object of scientific research. Researchers choose qualitative research because researchers want to reveal and give an idea of the object of scientific research. Researchers chose qualitative research because researchers wanted to reveal and illustrate the profile of understanding the concept of quadrilateral students according to Pirie Cier e n theory based on sex in natural conditions.

This research was carried out at SDN MADANI PALU. The selection of the subject of this study is in accordance with the consideration that the fifth grade elementary school students have studied square, rectangular and parallelogram material in class V. The research subjects selected amounted to two students, consisting of one male and one female student.

Techniques in choosing research subjects in this study are started from Determination of classes then Establish criteria for prospective subjects , Criteria to consider are mathematical abilities. Prospective research subjects must have equivalent mathematical skills. The subject's mathematical abilities are seen from the results of tests of mathematical abilities that have been given by researchers. In addition, the researcher also asked for consideration from the mathematics teacher who knew the ability of prospective research subjects in the field of mathematics , then grouped students by sex , and finally selected one student from each group .

The instruments used in this study are two, namely, the main instrument which is the researchers themselves and supporting instruments, namely the task of understanding quadrilateral concepts (TPKS) and interview guide texts made by researchers based on desired objectives in this study and audiovisual recording tools

an early-stage stage pursued by researchers in conducting this study of merancanag research instruments up to prepare a report of the research is the first planning done at the planning stage are the Develop research proposals, research instruments covering Designing Concept Training Task Quadrilateral (TPKS) , Validating the research instrument , Requesting permission to conduct research from the campus and the school where the data was collected , and visiting the school to conduct research . Both t AHAP implementation conducted at the implementation stage is where the research m elakukan observation, m enentukan subject of study by gender, m emberikan TPKS to the subject of research, m elakukan penelituian interview on the subject, and m arouses transcript of the interview. Third, the data analysis carried out at the stage of analyzing this data is to clarify / categorize data , reduce data , present data , interpret / interpret data , and draw conclusions . And the last stage in the implementation of this research is t AHAP make a research report

III. Results or Finding

Based on the results of research that has been obtained in this study , the level of understanding according to Pirie and Kieren's theory in male students is obtained as follows.

The level of understanding of the male subject concept (ANY) starts at the *primitive knowing* then moves forward to *doing the image* level and then advances again to *image reviewing* at this level the flow of understanding the ANY subject goes to the level of *predicting* that is aware of the relationship quadrangle building, then back again to level *image seeing* and can explain the activity, namely doing mental activities and explaining what is in his mind, meaning ANY has been at the level of *image saying* , then the subject ANYWAY moves forward to the level

of *property predicting and property recording* ie ANY subject completes the task in accordance with his expectations, in completing the task to go to *formalizing* level , ANY subject moves back again to level *image seeing* , ANY performs mental activity (using media) to help him complete the next task, then moves forward to the level *method* for determine area and twill g waking up in a square, then moving forward to the ANY *justifying method* can explain that the method and steps taken can be used.

At the level of *Primitive knowing* male students, namely ANY, have initial knowledge related to the concept of quadrilateral (jajargenjang, rectangle and square). ANY defines the length, rectangle and square with its own language, besides ANY it can also know the sides and angles and define them. To explain what is meant by the expression expressed, ANY says that the line has a face that is equal to the length, even the square is the same as the number but has a different angle, and for the ANY square it says that all sides of the square are the same. ANY can also define sides and angles with their own language, that is, sides are lines that are interconnected so that they can form a flat shape, whereas for ANY angle it also shows that angles are two lines that meet each other and the meeting point is determined by an angle. The ability of the ANY to define quadrilateral, is needed to understand the properties of a quadrilateral. This is consistent with the statement from Mokwebu (2013, p.8) that *"the Primitive knowing which piece of mathematics starts",* which means that this level indicates the existence of an initial understanding that students have as a basis for growth in understanding mathematics.

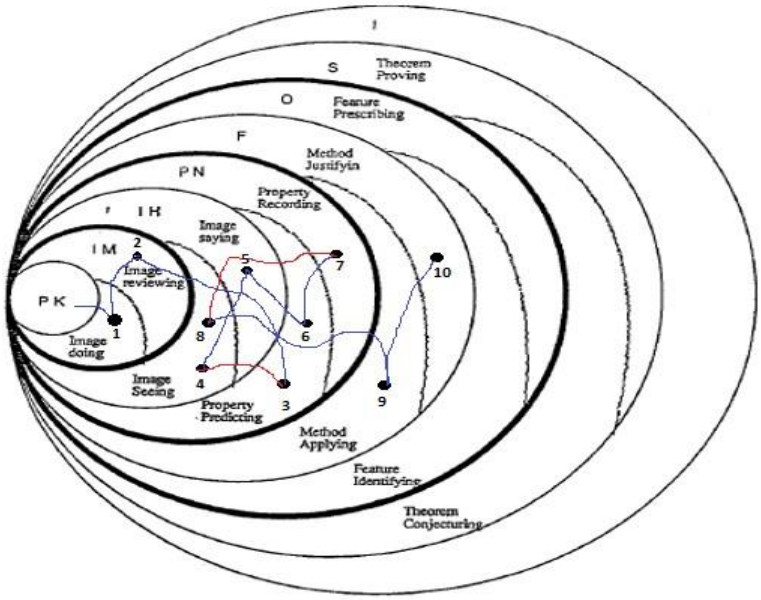
In the *making image* level ANY determines the value of the side length and the size of the angle using the previous knowledge about the background point of view and also the meaning of the sides and angles. ANY measures the sides and angles of each square, but ANY understands that to measure the length of the sides and the width of the sides of the rectangle and the length of the wall can only measure once and to measure the square ANY simply measures the sides and angles once, at this level ANY has taken a mental action, this mental action occurs after ANY doing physical action, that is when playing or moving the media movements provided so realize that there is a relationship between the square and the jargon. Meel (2003, p.144) states *"... The actions at this layer involve the learner doing, either mentally or physically, something to an idea about a concept"* . In accordance with that opinion ANY tries to determine the results of the measurement of the sides and angles of a flat rectangular build ANY has acted either mentally or physically which aims to get an idea of a concept.

At level *image having* , ANY explains again about the solutions that have been previously worked out verbally, that is, determining each result from measuring the sides and angles of a flat, flat angle. Initially ANY measures the edges and angles of angles by measuring each side and angle, but after getting the value of the side and angle of the angle, ANY realizes that to measure the side of the contents and angles one side can be measured and just one corner, so that in performing tasks at this stage ANY can accomplish with a fairly short time, far from the time predicted by the researcher. This is in accordance with the statement of Mokwebu (2013, p. 8) that *"At the level of the learner can use a mental construct about an activity without having to do certain activities which brought it about"*. This means that at this level ANY can use mental construction about an activity without having to do physical activity, ie students also have ideas in their minds. Manu (2005, p. 49) also states *"... A learner demonstrates the use of a mental construct or 'mental plan' about the topic that is able to use that particular image without doing the activity itself ..."* . The statement means that the ANY student has shown how students make mental constructs or (mental plans) of the topic without having to work on examples. Therefore students may replace the picture of knowledge that has been obtained previously and replaced by mental knowledge (Meel, 2003).

At the level of *property noticing* , ANY describes the properties of rectangles using their own language and also at this level ANY understand and suspect that there is a relationship between each rectangular flat build. ANY can explain how to measure the lengths of the sides and angles and begin to suspect that there are differences in properties between flat shapes and then do the activity from the guesswork that is only measuring once for the length and width on a rectangle and also just measuring one side to square. Likewise the angle ANY guesses that the four angles in the rectangle and square are the same, so ANY only takes one measurement at the rectangular and square angles. Pirie and Kieren (1994b, p.170) stated that *"A fourth level of understanding can be used to construct context specific, relevant properties"* This statement means that understanding is made when students can manipulate or combine aspects from one mental picture to build a specific context based on the relevant nature of a particular topic. Furthermore Pirie-Kieren states that at the *level of property noticing* students record differences, combinations or relationships between images and determine various details of the image. From these statements, it can be concluded that at the level of the *noticing* ANY *property, you* can associate, combine and differentiate the properties of a concept that has been understood at the previous level to be used on the next relevant topic or material.

On the *formalizing* level ANY applies a quadrilateral flat shape when measuring the circumference and width of a rectangular flat wake. In completing the ANY problem, it has been understood that there is a relationship between flat shapes, it can be seen that when ANY explains to measure long lines and rectangle can use the rectangular area formula. So that it can be concluded that ANY is able to associate the initial knowledge with the knowledge that has just been obtained. Besides that ANY can also provide an explanation or statement that in order to find a wide range of spaces is the same as looking for a rectangular area. This is consistent with the statement of Mokwebu (2013, p. 9) that, *"There is a need for generalizing what is happening and it is not longer needed to relate back to specific mathematical contexts that gave rise to understanding"* . Based on the statement of the second statement that on *the* ANY *formalising level is* able to generalize what he has gained from *property noticing* and does not need to reconnect with certain mathematical contexts to bring out his understanding .

The understanding flow obtained by male students in understanding quadrilateral concepts according to Piere-kieren theory is illustrated in the following graph.



While the results of the research obtained , the level of understanding according to Pirie and Kieren's theory on female subjects was obtained as follows.

The level of understanding of the concept of female subject (TFH) starts from the *primitive knowing* level , then moves forward to the level of *doing image*, namely TFH can measure the length and angle of the quadrangle, then move forward to the level *image reviewing* because TFH can expose steps from the activities he did, then TFH moved forward to the level of *image seeing* as well as *predicting property* because it had identified a flat building in his mind by using media and guessing the existence of links between quadrangular groups, then moving forward to the level *image saying* namely TFH explains what has been known about the media about flat quadrilateral construction. Furthermore, the flow of understanding of the subject of TFH went backwards to the level of *doing image* and moved forward again to the level of *property predicting* and *recording property* that TFH knew and suspected that there was a relationship between each rectangular flat building, ie not measuring the sides repeatedly as before. Next, go again to the *formalizing* level, but at this level TFH only reaches the *aplying method section.* TFH is not up to the level *metho justifying* because it can not explain the steps performed may be used.

At the *primitive* level *of knowing* female students , namely TFH, they have initial knowledge regarding quadrilateral concepts (jajargenjang, rectangle and square). The TFH defines lengths, rectangles and squares with its own language, besides TFH can also know the sides and angles and define them as evenly as they can recognize shapes of rectangular flat shapes by showing a number of available flat shapes around the room. This is in accordance with the statement from Mokwebu (2013, p. 8) that *"the Primitive knowing which piece of mathematics starts"*, which means that this level indicates the initial understanding that students have as a basis for growth in mathematical understanding.

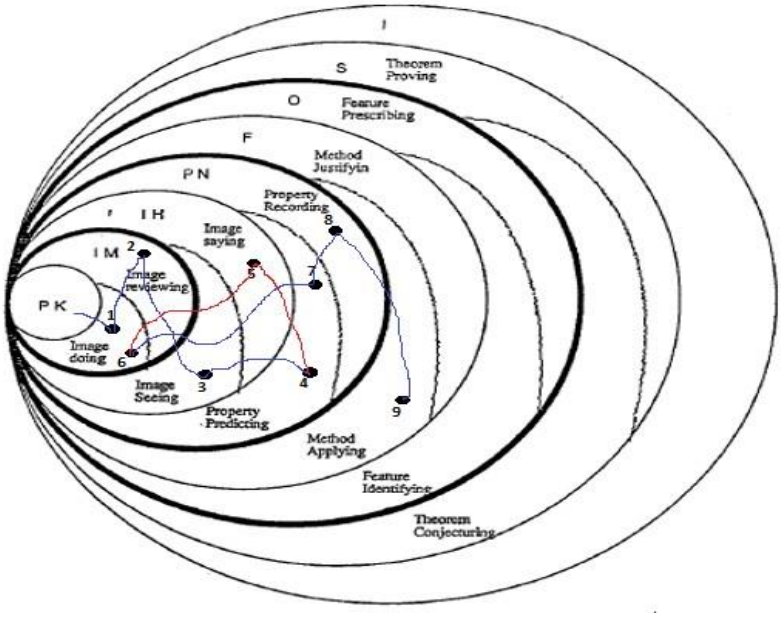
At the level of *image making* TFH determines the value of the side length and the size of the angle by using previous knowledge about rectangular flat shapes and also the meaning of the sides and angles. TFH understands the difference between flat building after measuring the sides and angles of each flat wake. But at this stage TFH in determining its sides and angles TFH takes repeated measurements, so that the TFH takes a long time to complete its task. Meel (2003, p.144) states *"... The actions at this layer involve the learner doing, either mentally or physically, something to an idea about a concept"* . In accordance with this opinion TFH tried to determine the results of measurements of the sides and angles of a rectangular flat build TFH has acted both mentally or physically which aims to get ideas from a concept.

At the level of *image having* , TFH can explain what he already knew after using the media, TFH realized that there was a relationship between square and square structures, while square and rhombus. TFH also explained that the relationship between the flat building is located on the side. TFH has been at the level of *having image* because it has identified a flat build in its mind by using media and then explaining what has been understood about the media about rectangular flat builds. This is in accordance with the statement of Mokwebu (2013, p. 8) that *"At the level of the learner can use a mental construct about an activity without having to do certain activities which brought it about"*. This means that at this level TFH can use mental construction about an activity without having to do physical activity, that is, students also have ideas in their minds.

At the level of *property noticing* , TFH describes quadrilateral properties using its own language and also at this level TFH understands and suspects that there is a relationship between each rectangular flat building. TFH can explain how to get a circumference value on a rectangular flat building and has understood that to get the circumference of a flat building that is by adding together its sides. Pirie-Kieren states that at the *level of property noticing* students record differences, combinations or relationships between images and determine various details of the image. From these statements, it was concluded that at the level of *property noticing* TFH has been able to associate, combine, and distinguish the characteristics of a concept that has been understood at the previous level to be used on the topic or subsequent relevant material.

At the TFH *formalizing* level it can complete the task by determining the width of the space according to many tiles. But in completing the task, TFH cannot provide a reason, that is to determine the extent of using a formula. In this case TFH does not reach the *formalizing* level because it contradicts the statement of Mokwebu (2013, p. 9) that, *"The learner is able to generalize what he has seen in property noticing and no longer needs to relate back to specific mathematical contexts that gave rise to hin understanding "* . Based on the statement that TFH has not been able to generalize what he has gained from *property noticing* .

The understanding flow obtained by female students in understanding quadrilateral concepts according to Piere-kieren theory is illustrated in the following graph.



IV. Conclusion

Profile Concept Training Quadrilateral Male students according to the theory of Pirie and Kieren namely (ANY) has a level of understanding of the concept began in the *primitive knowing* then move forward to the level of *image-doing* and then bergrak forward again to *image reviewing* these levels groove understanding of the subject ANY walked to *Property predicting* level that is to realize and suspect that there is a relationship between quadrangle building, then return to level *image seeing* and can explain the activity, namely doing mental activities and explaining what is in his mind, meaning ANY has been at the level *image saying* , then the ANY subject moves forward to the level of *predicting property and property recording,* ie ANY subject completes the task according to his expectations, in completing the task to go to the *formalizing* level , the ANY subject moves back again to level *image seeing* , ANY does mental activity (using media) to help him complete his next assignment, then move forward to the *method* level *apying* to determine the area and circumference of a flat square building, then move forward to the ANY *justifying method* that is able to explain that the method and steps taken can be used

Profile Concept Training Quadrilateral Student woman by theory Pirie and Kieren namely (TFH) has a level of understanding of the concept of starting from a *primitive knowing,* then move forward to the level of *image doing* that TFH can measure the length of the side and a large corner bangundatar quadrilateral, then move forward again to level *image reviewing* because TFH can explain the steps of the activities that it does, then TFH moves forward to the level of *image seeing* and *property predicting* because he had identified a flat building in his mind by using the media and guessing the relationship between the quadrangular groups, then moving forward to the level *image saying* that TFH explained what had been known about the media about quadrilateral flat builds. Furthermore, the flow of understanding of the subject of TFH went backwards to the level of *doing image* and moved forward again to the level of *property predicting* and *recording property* that TFH knew and suspected that there was a relationship between each rectangular flat building, ie not measuring the sides repeatedly as before. Then it goes back to the *formalizing* level but at this level TFH only arrived at the *aplying method section.* TFH does not reach the level of justifying method because it cannot explain the steps taken can be used.

Based on the results of the research and discussion in this study , it can be concluded that male and female students have different mathematical abilities, namely male students can reach the level of formalizing that is up to the *aplying method* and the *Justtifying method* , and female students can reach the *formalizing* level but only reaches the *aplying method* level

V. References

Amir. MZ, & Zubaidah. (2013). *Gender Perspective on mathematics learning* . University of Indonesia education journal Bandung. Vol. XII, No.1

Ausubel, DP, Novak, JD, & Hanesian, H. (1978). Educational Psychology: Cognitive View (2 nd. Ed), New York: Holt, Rinehart and Winston.

Barmby, P., Harres, T., Higgins, S., & Suggate J., (2007). *How can we assess mathematical understanding?* In Procedures of the 31 Conferencing of the International Group for the Psychology of Mathematics Educations, Vol. 2, pp. 41-48. Seoul: PME

Budiarto. (2001). Profile of achievement of thinking stages of middle school students in Malang in learning geometry based on Van Hiele's thinking stage. Malang State University. Not published.

Budiarto, MT (2006). *Abstraction profile of junior high school students in constructing relationships between aspects* . (Unpublished Doctoral Dissertation), Surabaya State University.

Burger, WF & Shaughnessy, JM (1986). Charaterizing the van Hiele levels of development in geometry. *Journal for research in Mathematics Education* , 17, 31-48.

Clements, DH, & Battista, MT (1992). Geometry and spatial reasoning. Issues in Early Childhood, Vol.1, No. 1, 45-46.

de Villiers, M. 1990. The Role and Function of Proof in Mathematics. Pythagoras 24: 17-24

Ekawati, Aminah and Wulandari, Shinta. 2011. "Gender Differences in Students' Ability in Mathematics Subjects (Primary School Case Study)". Sosioscienta Journal. Vol3 (1): p. 19-24.

Ellis Ormrod, Jeanne, *Educational Psychology Helps Students Grow and Grow* , (Jakarta: Erlangga Publisher, 2008)

Garagae, KG (2001). *"A quest for Understanding In Mathematics Learning Examining Theories of Learning"* . University of Bostwana. http..math.unipa.it / -grim.21_project / 21_Chatlote_Gragae. Downloaded Sept. 12, 2018.

Gokalp, ND & Sharma, MD (2010). A study of addition and subtraction of fractions: The use of Pirie and Kieren models and hands-on activites. *Social and Behavioral Sciences* . 2 (2), Doi: 10.1016 / j. Sbspro.201003.840.

Gudino, JD. (1996). *Mathematical Concepts, Their Meanings, and Understanding. In L.Puig y A. Gutierrez (Eds), Proceedings of XX conference of the international Group for the Psychology of Mathematics Education. (v.2, p. 417-4250* . Universidad de Valencia.

Gulkilik, H., Ugurhu, HH, & Yuruk, N. (2015). Examining Student's Mathematical Understanding of Geometric Transformations Using the Pirie-Kieren Model. *Educational Sciences. Theory & Practice* , 15 (6). Doi:10.12738/estp.2015.6.0056

Haylock. (2008). "Understanding mathematics for young children".

Hiebert J., & Carpenter, TP (1992). *Learning and Teching With Understanding. In: DW Groes (Ed) Hanbook Of Reaserch On Mathematics Teaching And Learning (Hal. 65-97)) National Council of Teacher of Matthematics Resyon, Virginia.*

Indah Wahyu Utami –Abdul Haris Rosyidi, M. Pd, *" Profil Lapisan Pemahaman Propertiy NoticingSiswa pada Materi Logaritma Ditinjau dari Perbedaan Jenis Kelamin"*, MATHEdunesa Jurnal Ilmiah Pendidikan Matematika,1: 5, (2016), 22. .

Jacobs, HR. (1974). *Geometry* . San Francisco: WH Freeman and Company.

John W. Santrock. (1996). Education psychology, edition, Jakarta: Kencana Prenada Media Group

KBBI. (2015). Kamus Besar Bahasa Indonesia [online]. Tersedia http://kbbi.web.id/paham Diunduh 6 februari 2019 .

Kastberg, SE (2002) *Understanding Mathematical Concepts : The case of the logaritma function.* A Dissertation Submitted to the Graduate Faculty of the University of Georgia in Partial Fulfilment of the Requirements of the Degree. Athens, Georgia

Kemp, Jerrold E. Et.all. (2011) *Design Efective Instruction. John Wiley & Sons,* Inc United States of America

Kearsley, Greg, Contructivist Theory, http://www.tip.psychology.org/bruner.html. In unduh pada tanggal 2 Januari 2009

Khoirun Nisa', Tesis: *"Beban Kognitif Siswa padaPembelajaran Matematika dengan Menggunakan Media Power Point Ditinjau dari Kemampuan Matematika"* ,(Surabaya: UNESA, 2014), 28.

Lawan, A. (2011). Growth of Students' Understanding of Part-Whole Sub-Construct of Rational Number on the Layers of Pirie-Kieren Theory. *Proccedings of the Seventeenth National Congress of the Association for Mathematics Education of south Africa (AMESA)* , Vol.1. University of the Witwaterstand Johannesburg.

Manu, SS (2050). Language Switching and Mathematical Understanding In Tongan Clasroom: An Investigation. Journal of Educational Studies Vol. 27, No. 2, 47-70

M. D Villiers. 2009. From the Fermat Point to the De Villiers Points of a Triangle. Proceeding of the 15 th . Annual A MESA. Congress. University of free state

Melfried Olson, et. Al. ((2007), *A study of gender differences in languages used by parents and children working on mathematical taks* . Proceedings of the 31st Conference of the International Group for the Psychology of Mathematics Education, Vol. 4, pp. 49-56. Seoul:PME

Meel, DE (2003). Models and Theories of Mathematical Understanding: Comparing Pirie and Kieren's Model of the Groowth of Mathematical Understanding and APOS Theory. *CBMS Issues in Mathematics Education* 12, 132-181.

Mokwebu, DJ (2013). *An Exploration of the Growth in Mathematical Understanding of Grade 10 Learners.* Polokwane: University of Limpopo.

Mousley, J. *What Does Mathematics Understanding Look Like?* . Melbourn, Deakin University

Morrison, R., Ross, SM, Kalman, HK, & Kemp, JE (2011). *Designing Effectife Instruction. New York: Mic Miian Publisher.*

Mulyono. (2011). "Teori APOS dan Implementasinya dalam Pembelajaran". *JMEE* Volume 1 Nomor 1 Juli 2011.

Muser, GL & Burger, WF (1994). *Mathematics for elementary teachers a contemporary approach; third edition.* New Jersey: Hall

Ngalim Purwanto, Psikologi Pendidikan(Bandung: PT Remaja Rosdakarya, 2007), 102.

National Concil of Teacher of Mathematics (NCTM). (2000). *Principles and Standars for School Mathematics, Reston* , VA:NCTM.

North Central Educational Laboratory, Vigotsky, Piaget dan Bruner. Http://www.ncri.org.sdrs.areas/issues/methods/instrenta/in5lk2.html di download pada tanggal 25 Februari 2009

Omrod, JE (2008). *Psikologi pendidikan membantu siswa tumbuh dan berkembang* . Jakarta: Erlangga

Pratama, NAE, Sa'dijah, C., & Subanji. 2016. Teori Pirie-Kieren dalam Mendiskripsikan Perkembangan Pemahaman Matematis Siswa. *Prosiding Seminar Nasional Pendidikan Dasar 2016 (Peningkatan Kualitas Pendidikan Dasar dalam Menghadapi Daya Saing Regional (ASEAN)*

Prameswaran, R. (2010). Expert Mathematicians' Approach to Understanding Definitions, 20 (1), 43-51

Prie, S., & kieren, T. (1994). A Resurcursive Theory of Mathematical Understanding. *For the learning of mathematics* . 9 (3)

Prie, S., & kieren, T. (1994a). Beyond Metapor : Formalising in Mtehematical Understanding within Constructivist Environments . *For the Learning of Mathematics Vol.14, No. 1, 39-43*

Prie, S., & kieren, T. (1994b). *Growh in mathematical understanding: How can we charecterize it and can we represent it? Educational studies in mathematics* , 26, 165-190.

Pirie, S., & Martin, L. (2000). The Role of Collecting in the Growth of Mathematical Understanding. *Mathematics Education Reserch Journal Vol.12, No. 2, 127-146.*

Ruseffendi, ET 2006. *Pengantar Kepada Membantu Guru Mengembangkan Kompetensinya dalam Pengajaran Matematikauntuk Meningkatkan CBSA* . Bandung: Tarsito

Sa'dijah, C. 2016. *Pembelajaran Matematika Secara Konstruktivis* . Pidato Pengukuhan Jabatan Guru Besar dalam Bidang Ilmu Pendidikan Matematika pada Fakultas Matematika dan Ilmu Pengetahuan Alam. Malang: Universitas Negeri Malang.

Sagala, Viktor. (2016). *Profil Lapisan Pemahaman Konsep Turunan Fungsi dan Bentuk Folding Back Mahasiswa Calon Guru Berkemampuan Matematika Tinggi Berdasarkan Gender* . Jurnal Pendidikan Matematika, Sains, dan Teknologi. 4 (1), 47-61

Sierpinska, A. (1994). *Understanding in mathematics* . London: The Falmer Press.

Skemp, RR (1987) *Psychology of Learning Mathematics* . Expanded American edition Lawrence Erlbaum Associates, publishers Hilsdale, New Jersey. Hove an London

Slavin, RE (2011) *Psikologi Pendidikan: Teori dan Praktik* . Indeks Permata Puri media. Jakarta

Soejadi, Dasar-dasar pendidikan Matematika, (Surabaya: IKIP Surabaya, 2000)

Steffe, LP (2001). *On mathematical learning and understanding: A constructivist's perspective* . Discussion Paper, University of Georgia.

Subanji & Nusantara, T., 2016. *Thinking Process of Pseudo Construction in Mathematics Concepts.* International Education Studies; Vol. 9, No. 2; 2016, pp. 17 – 31

Subanji, 2016. *Teori Defragmentasi Struktur Berpikir dalam Mengonstruksi dan Memecahkan Masalah Matematika* . UM Press. Malang

Sugiono. (2010). Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R & D. Bandung: Alfabet bandung

Susan EB Pirie –Thomas E. Kieren, *"Beyond Metaphor:Formalising in Mathematical Understanding ithin Constructivist Environments"* . For the Learning of Mathematics, 14: 1, (February, 1994), 39-40.

Syaiful Bahri Djamarah. 2008. Psikologi Belajar. Jakarta: Rineka Cipta.

Syafiqoh N. (2018). *Level pemahamn siswa menurut teori Pirie-Kieren dalam Merekonstruksi Konsep Perpangkatan ditinjau dari Perbedaan Gender.* (tesis yang tidak dipublikasikan). Universitas Negeri Surabaya, Surabaya.

UNESA. 2000. *Pedoman Penulisan Artikel Jurnal,* Surabaya: Lembaga Penelitian Universitas Negeri Surabaya.

Usiskin, Z., (1982). Van Hiele levels and achievement in secondary school geometry (final report of the cognitive development and achievement insecondary school geometry project). Chicago : University of Chicago, Departement of education. (ERIC Document Reproduction Survice No. D220 .

Viktor Sagala, *"Profil Lapisan Pemahaman Konsep Turunan Fungsi dan Bentuk Folding BackMahasiswa Calon Guru Berkemampuan Tinggi Berdasarkan Gender"* . MATHEdunesa Jurnal Ilmiah Pendidikan Matematika, 4: 1, (Juni, 2016), 41.

Viktor Sagala, Op. Cit., hal 51.

Van de Walle, J. (2008). Metematika sekolah dasar dan menengah jilid 2. Erlangga. Jakarta.

Walle, JAV, Karp, KS, Williams, JM B (2013). *Elementary and Middle School Mathematics Teaching Developmentally.* Howard County Public Schools .

Warner, L., & Schoor, RY (2004). From Pritive Knowing to Formalising: the Role of Student Questioning in the Development of Mathematical Understanding. Traversing the Pirie-Kieren Model for Growth of Matehmatical Understanding. *Procceding of the International Group for Psichology of Mathematics Education* , 2 : 429-437 .

West, C & Zimmerman, DH (2007). *Doing Gender* . Gender and society. Vol. 1, No. 2 .

Wong, M., Evans, D, (2007) *Students' Conseptual Understanding of Equivalent Fractions. Proceedings of the 30 th annual conference ogf the Mathematics Education Research Group of Australia* . Mathematics: Essensial Reserch, essensial Practice- Volume 2 (p.824-833).