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PROCEEDING

ICMETA

International Conference on Mathematics: Education, Theory, and Application

December, 6-7th 2016

Department of Mathematics
Faculty of Mathematics and Natural Sciences
Universitas Sebelas Maret

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Mathematics in the Science and Art

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PREFACE

This proceeding contains papers collected from event of The International Conference on Mathematics: Education, Theory, and Application (ICMETA). Some papers presented in ICMETA were published in Journal of Physics: Proceeding Series and others were published in this proceeding.

The ICMETA is conference that was first accomplished by Department of Mathematics, Universitas Sebelas Maret and is planned to be held biennially. This conference is an organization of scientific meetings among mathematicians, students, teachers, researchers, and practitioners from various colleges and related institutions. The goals of the conference are

(a) to increase the role of mathematics, statistics, mathematics education, and computer science in an effort to overcome various problems;
(b) to disseminate, discuss, and communicate the results of research in the fields of mathematics, statistics, mathematics education and computer sciences;
(c) to facilitate communication and discussion related to the problems and current issues of education, sciences, and technology.

As a scientific meeting event we invited experts from 6 different countries including Indonesia, Australia, the Netherlands, Malaysia, Japan, and France as keynote speakers. They were

1. Prof. Dr. Edy Tri Baskoro, M.Sc. (Department of Mathematics, Faculty of Mathematics and Natural Sciences, Bandung Institute of Technology, Indonesia),
2. Dr. Darfiana Nur, M.Sc. (Statistical Science in the School of Computer Science, Engineering and Mathematics, Flinders University, Australia),
3. Dr. G.R. (Ruud) Pellikaan (Department of Mathematics and Computer Science, Technische Universiteit Eindhoven, Netherlands),
4. Prof. Dr. Mohd Bin Omar (Institute of Mathematical Sciences, Faculty of Science, University of Malaya, Malaysia),
5. Prof. Dr. Kenjiro T. Miura (Realistic Modeling Laboratory, Department of Mechanical Engineering, Shizuoka University, Japan),
6. Dr. Sutanto, DEA (Department of Mathematics, Faculty of Mathematics and Natural Sciences, March Eleven University, Indonesia),
7. Dr. Hanna Arini Parhusip (Department of Mathematics, Faculty of Science and Mathematics, SWCU, Salatiga Indonesia), and
8. Dr. Benoît Liquet (Laboratory of Mathematics and Their Applications, Université de Pau et des Pays de l'Adou, France).

Call for Papers for this conference has been notified to several academic and professional associations (IndoMS) since April until October 2016 to be able to muster 53 colleges and polytechnics as well as related agencies including the National Institute of Aeronautics and Space (LAPAN). Attending

participants and keynote speakers were from Australia, Europe and Asia. Additionally, Indonesian participants were from various provinces such as: DKI Jakarta, West Java, Yogyakarta, Central Java, East Java, Bali, Southeast Sulawesi, West Sumatra, Riau Islands, and South Sulawesi. During the two days conference, the researchers presented the most lectured discoveries in Mathematics and Statistics as well as established network for possible joint researches and collaborations among the participants. The conference is consisting parallel sessions and plenary sessions from invited speakers with various interesting topics which held in two days.

We are grateful to all the members of the program committee who contributed for the success in framing the program. We also thank all the delegates who contributed to the success of this conference by accepting our invitation and submitting articles for presentation in the scientific program. We wish for all of us a grand success in our scientific life and we do hope that the coming conferences will pick up similar success, and even better.

Finally, we wish that proceeding will be useful for readers and researchers who want to look for materials in order to support their study.

Chair of ICMETA 2016

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Geometry High School Students Thinking Ability Based On level van Hiele

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Abstract: The purpose of this research is to obtain a description of the knowledge of high school students in solving mathematical problems seen from the ability to think geometry is based on van Hiele level. This study used a qualitative method with descriptive qualitative approach .. The results showed that: (1) the subject using geometric thinking skills, and (2) found a subject that there is a level between levels 1 and 2 on the van Hiele. The results of subsequent studies showed that knowledge of a subject that is at the level between 1 and 2 at the level of the van Hiele in thinking geometry to resolve the issue as follows: (1) at the initial stage of the subject using drawing techniques, (2) and the subject to identify and explain the geometry drawn, (3) the subject can further explain the definition of a wake-drawn, (4) the subject of finding answers requested of the matter.

Keywords: Thinking Geometry, Van Hiele

1. Background

Stacey (2006) argues that the process of mathematical thinking is a way to think of mathematics. There are four components to think mathematically consisting of *spesialising, generalizing, conjecturing* and *convincing.* Stenberg (2009) revealed that the thinking process consists of understanding, the formation of opinions and forming conclusions. In establishing the terms of analyzing the characteristics of a number of objects, then compared and designated non-essential characteristics. Formation of opinion do to put relations between the two terms. The formation of the final conclusions of the thinking process. In this study involving pokon discussion of geometry and algebra.

With regard to the process of thinking, research on thinking geometry has been studied by experts (Ekanayake, 2003; Patsiomitou, 2008; Meng, 2009; Pittalis, M., Mousalides, N., & Christon, C. 2009). Hollerands (2003) reveals there are three important reasons to learn geometry, which gives an opportunity to the students to think about the important concepts in

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mathematics, provide a context in which students can see mathematics as a discipline are interconnected and provide the opportunity for students to engage in high-level reasoning activities using a variety of representations. Similarly, Guven (2012) found in geometry mempelajari need a lot of exercise and the use of a means of involving students in solving problems. Van de Walle (2001) also revealed the importance of studying the geometry, the geometry is closely related to our daily lives we, the geometry can develop problem solving skills, geometry plays an important role in studying the branches of other mathematical, geometry can be used in everyday life and studying geometry very pleasant. Clements and Battista (1992) suggest that think geometric students developed through use measurement and transformation something objects. NCTM (2000) says that the ability of the geometry must be owned by the students are: (a) analyze the characteristics and character geometric two-dimensional and three dimension and developing argument mathematics about relationships geometric; (b) specify seat and describe spatial relations use coordinate geometry and system of representation other; (c) apply transformation and use symmetry to analyze the situation mathematics; and (D) visualization is used, spatial reasoning, and modeling geometry for solve the problem.

Van Hiele mathematician is someone who gave birth to the stages of child cognitive development in understanding the geometry known as van Hiele theory. According to the theory of van Hiele someone going through five levels of hierarchy in the study of geometry (van Hiele, 1999; van de Walle, 1994; D'Augustine & Smith, 1992; Clements & Battista, 1992; Jones, 1998).

Below these levels on van Hiele

Level 0 Visualization

At the level of visualization in identifying students, call me, compare and operates on geometrical figures. This level is often called the recognition rate. At this level students are familiar geometric shapes.

Level 1 Analysis

At this level students to analyze the images in terms of components and the relationships between components and find properties / empirical rules. This rate is also called the level of description. At this level the children are already familiar with the properties of geometry based on an informal analysis of the parts up and attributes of components. At this rate started a lot of their analysis of the concepts of geometry. Students can recognize and determine the

characteristics of the wake by properties. Through observation, experiment, measurement, drawing, and to model, students can recognize and distinguish the characteristics of a structure. Students see that a structure has certain parts that can be recognized. However, students can not fully explain the relationship between the nature waking up one with nature wake up the others, and the abstract definition has not been or can not be understood. An example, children can not assert that the rectangle is also a parallelogram. In this study, the level of analysis indicated that the students can provide the characteristics of an isosceles triangle that has a pair of sides of the same length

Level 2 Deduction informal

At this level students with the logic of interrelationships found previous properties / rules by giving or following an argument in formal. This level of abstraction is often called the level or degree of sorting. At this level the children can see the relationship between the properties in a single build.

Level 3 Deduction

At this level students think deduction has begun to develop and reasoning deduction as a way to build the structure geometry in an axiomatic system that has been understood. This has been demonstrated by the student to prove a statement about the geometry by using the logical and deductive reason.

Level 4 Rigor

At this level students can work in a variety of axiomatic deductive structure. Students can find the difference dianara two structures. Students understand the difference between Euclidean geometry and non-Euclidean geometry.

2. Research methods

The research is a qualitative research with a qualitative descriptive approach. The instrument used consisted of the main instruments and supporting instruments. The main instrument is the researchers themselves, while other instruments consist of mathematical problems which consists of two problems. The subjects were students of class XI. Selection of research subjects is done by providing a test consisting of two questions. The research subject

selected with *purposive sampling.* The technique used to obtain the data in this study is a written test, interview, and observation.

3. Research Result

The results obtained include the results of tests klasifikasipada van Hiele level students are: (1) students at levels between 1 and 2, (2) to solve the problems subject think geometry seen on:

Classification Test Results At Level van Hiele

Giving van Hiele level classification tests performed on the data obtained 5 students and students who are at level 2 development think Van Hiele according to criteria that have been determined as follows:

Table 1 Categories students according to van Hiele level

No.	Student's name	Category Level
1	DW	2
2	AK	1
3	DRG	2
4	WB	Between 1 and 2
5	FPT	2

The first problem that a given subject is as follows.

There are 8 bars sticks (4 sticks consist of the same length and 4 sticks the size of half of the stem of the first rib, from 8 sticks please you create 3 square.

The matter is a matter of geometry. Answers to the subject, found that subjects solve the problem geometrically. Subject to think geometrically in clearing this permasahan. Knowledge geoemtri resolve the subject is needed in this matter.

In geometry students to draw in advance to get the right answer. Figure 1 shows selesaian given subject.

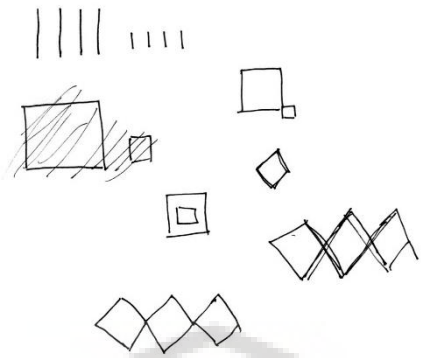

Figure 1. The students' answers to the problems I

The second problem is given subject are as follows.

A wealthy merchant will change the tile floor in the warehouse. He wanted to put a square tile without cutting the tiles. Floor gudan g 36 m long and 12 m wide. How long is the side of the tile (in meters)?

The issue is a problem that can give an answer that is more than one answer. In this case the subject of the first things to do is also to draw first and then merencamnkan awaban desired. In sii ability dipeerlukan geometry is also subject to menyeesaikan this problem. Figure 2 shows selesaian given subject.

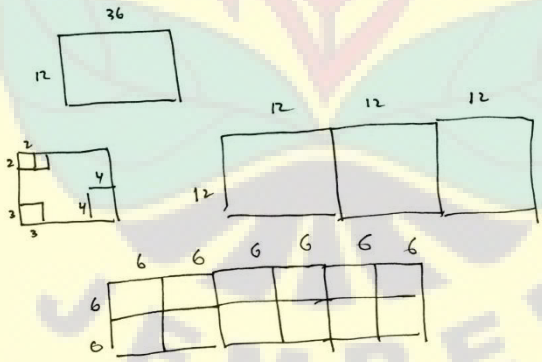

Figure 2. The students' answers to the problem 2

4. Discussion

This section will discuss the results of the study of geometry thinking skills of students in solving mathematical problems that obtained the subject at level anatara level 1 and level 2 van Hiele. Subject obtained, at 0 and 1 are met all the indicators. While on level two only partially achieved. The results are summarized in the following table.

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Table 2. Ability to think geometry resolve the problems of students in mathematics

level	problems I	problems II
1	Subject identify shapes square	Subject identify the shapes square and rectangular
	Subject flipping through square wake-up position	Subject position the square wake
	Subject to make a square image	Subject to make a square image within the rectangle
	Subject marks the square shape with numbers	Subject marks the size of the rectangle with numbers and square shape with numbers
	Subject shows each square the same size	Subject shows each square the same size
	Subjects described the square as a rectangle	Subjects described the square closes all the rectangles
	Subject try to find three square congruent	Subject try to find the square size in question
	Subject identify overall section on the square pond.	Subject identify the overall portion of ponds in square and rectangular
	Subjects that do not measure the same length side square sutu	Subjects did not measure that the sides of a square of the same length
	Subjects did not use the word "all" such as when mention of the square	Subjects did not use the word "all" such as when mention of the square
2	Subject Marks square has four sides of equal length	Subject Marks square has four sides of equal length
	Subject indicates that the opposite side of the square of the same length	Subject indicates that the opposite side of the square of the same length
	Subject to compare the two square konruen	Subject to compare the two square konruen
	Students indicate that the square has four sides and all sides are equal in length.	Students indicate that the square has four sides and all sides are equal in length.
	Subject square describes the same size the same extent.	Subject square describes the same size the same extent.
	Subject explain square has four sides of	Subject explain square has four sides of

3	equal length, a square has four right angles. Solve problems with alignment and upright nature. Which may explain the subject is not a square. Subjects can be explained that the square has the same large area. Subject lines can explain ketegaklurusan By using alignment and ketegaklurusan, the subject can solve the problem.	equal length, a square has four right angles. Subject menjelasakn bring the four corners of square and rectangular are elbow-to-elbow Solve the problem by the nature of the square. Which may explain the subject is not a square. Subjects can be explained that the square has the same large area. Can explain the subject area that cover the rectangular square By using the area and a number of factors subject can solve the problem.

5. Conclusion

Based on the results of research and discussion, we can conclude that the subjects in menyelasikan math problems are as follows: (1) the subject using geometric thinking skills, and (2) found a subject that there is a level between levels 1 and 2 on the van Hiele.

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