JOURNAL of Mathematics Education
Website: http://usnsj.com/index.php/JME
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ANALYSIS OF THE STUDENTS' GEOMETRIC REASONING ABILITY

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ARTICLE INFO

ISSN: 2528-2026
Vol. 2, No. 1, June 2017
URL:
http://usnsj.com/index.php/JME/article/view/2.1.11-16

Abstract

This research was a descriptive research with quantitative approach that aimed to analyze or describe the geometric reasoning ability of SMA Negeri 1 Wundulako students in solving mathematical problems related to the building of the three dimensions. Indicators used to describe students' geometric reasoning abilities include visualization, analysis, abstraction, and formal deduction. Data collection techniques consisted of interviews to deepen information about students 'geometric reasoning abilities and written tests to get an idea of students' cognitive abilities. Subjects in this study, namely students class XI.IA SMA Negeri 1 Wundulako as many as 40 students who have studied three dimensional materials. Data analysis in this research used descriptive analysis. Based on the data analysis obtained average value of 49.86, median 53.33, mode 66.67. The standard deviation was obtained at 22.39, it showed that there was a considerable difference of value between the students who mean in high ability category with the average of 91,11, medium ability category equal to 66,27, and low ability equal to 31,82 , With minimum value is 3.33 and maximum 93,33. In general, based on descriptive analysis, the geometric reasoning ability of SMA Negeri 1 Wundulako students was still low.

Keywords: *the ability of geometric reasoning, dimension three*

A. Introduction

The development of science and technology is based on mathematics where Mathematics is the science that discusses patterns of order, both patterns in nature as well as in the human mind. The development of mathematics has an impact on the expanding horizon of thinking that requires readiness of educators and students to face the challenges of the globalization era. This is supported by Soehendro's statement (2006: 153) which states that mathematics is a universal science underlying the development of modern technology, and has an important role in various disciplines of science and development of human thinking skills.

Reasoning is one type of thinking skill. Where reasoning in mathematics education plays an important role. This can be seen by maketh reasoning as one of the goals mathematics education in Indonesia contained in Decree No. 22 of 2006 on Content Standards is to use reasoning on patterns and traits, perform mathematical manipulations in generalizing, compiling evidence, or explaining mathematical ideas and statements (Shadiq, 2009: 2).

The reasoning problem is the first thing that needs to be understood in terms of the study of basic concepts of mathematics because reasoning is the basis for learning further mathematical

concepts (Prihandoko, 2005: 7). So to obtain high students' achievement in learning mathematics, it is necessary to emphasize the learning of mathematics directed at development aspect of student reasoning ability. One of the important reasoning abilities in mathematics learning is the ability of geometric reasoning.

Budiarto (2000: 439) states that the purpose of learning geometry is to develop the ability to think logically, develop spatial intuition, instill knowledge to support other materials, and can read and interpret mathematical arguments. The learning of geometry is related to reasoning activity. While Bobango (1993: 148) said that the purpose of learning geometry is that students gain self-confidence about mathematical ability, be a good problem solver, can communicate mathematically, and can reason mathically.

Nizar (2007: 74) states that the mathematical mindset gives a considerable contribution in developing science. Based on the facts, during this mathematics learning, it is more emphasis on aspects of conceptual understanding and problem solving. Problem solving that is not directed to something logically defined does not involve reasoning. Reasoning is often ignored with the assumption that it does not directly impact students. Because during this which became the benchmark of student success is the value obtained by students rather than the ability of students in providing a rational reason for the problems raised mathematics.

Khoiriyyah, et al. (2013: 19) states that the reality on the ground shows that most students still lack the mastery of geometry material, one of which is high school level. In fact, one branch of mathematics is geometry basically has greater opportunities for students to understand compared to other mathematical branches. This is because geometric ideas are known to students earlier before they enter school, such as lines, fields, and spaces (Abdusakkir, 2010).

Low geometry problems have inspired studies based on van Hiele's learning model among those conducted by Atebe and Schafer (2008), Mateya (2008). In addition, van Hiele's theory offers most hope to meet the challenges of various levels of students' reasoning in geometry. Van Hiele's biggest contribution to his theory is that the difference in reasoning levels is under the control of the teacher and can be facilitated with proper instruction expressed by Pusey (2003: 50).

Students need experience to better prepare themselves through continuing practice. As a teacher, it should be necessary to pay attention to the initial conception of students before learning to successfully instill the correct concept and not cause learning difficulties. Because, teaching is not only to pass on the ideas of educators to students, but as a process of changing the conceptions of students who already exist and may be wrong. That is, by designing the learning that can form the students to build their own knowledge by melatihkan multilevel problems to see the level of development of students' reasoning, modify, design the learning so that students can be trained to reason logically with respect to geometric reasoning and encourage student self-confidence that is the role of educators as Facilitators and motivators in overcoming the difficulties of van Hiele's problematic students with problems. Learning is made meaningful to the student's personal, more directed learning encourages students to think. This description is one reason for choosing the geometric reasoning ability of the students to be studied further. The purpose of this research is to know the description of geometric reasoning ability of SMA Negeri 1 Wundulako students in solving mathematical problems related to three-dimensional structure, in order to get the right solution alternative for advanced research.

B. Literature Review

Geometric Reasoning

Wing (1985: 6) states that "geometric reasoning is the process of defining and distinguishing the properties of the entity, the relationship with other geometric entities, Geometric (Euclidean) space ", which means that geometric reasoning is the process of defining and deducing the properties of a unified geometry by using the intrinsic nature of the unity, its relation to other geometric entities, and the rules for drawing true conclusions Intertwined among the properties present in the geometry space (Euclid). In other words geometric reasoning encompasses complex aspects namely: (1) defining and deducing geometric properties; (2) linking it to other aspects of geometry; and (3) draw conclusions based on existing rules (postulates). Geometric reasoning according to Napitupulu (2008: 171) can be interpreted as a tool to understand geometry and understanding of geometry is used to solve geometry problems. Furthermore, experience in solving problems in turn strengthens geometric understanding and reasoning which then returns to capital to solve new problems or other problems that are of course more complex.

Geometric reasoning is closely related to the stages of cognitive development in geometry learning proposed by Van Hiele. In addition, he also divides geometric reasoning into five levels where the level or level of thinking that students pass through in a geometrical understanding of visualization, analysis, informal deduction, formal deduction, and the accuracy of Kepner (2006: 7-8). At the high school level, this discussion reaches level 3 (formal deduction).

C. Methodology

This research is descriptive research with quantitative approach. This research was conducted in November 2016 at State Senior High School 1 Wundulako. The techniques used to collect data about students' geometric reasoning abilities are interviews and test provision.

Subjects in this study were students of class XI.IA as many as 40 students. The way of determining the subject of research was by selecting them who had studied the material relating to three dimensional spaces.

Instrument in this research was test instrument that was geometric reasoning ability of student as many as 4 items of question consisting of 4 levels of ability, they were visualization, analysis, abstraction, and formal deduction.

To collect the data in this study used interview techniques to deepen information about students 'geometric reasoning abilities and written tests to get a picture of students' cognitive abilities ie data about students 'cognitive abilities related to students' geometric reasoning. While the data analysis techniques in this study using descriptive analysis.

The students' geometric reasoning abilities were scored according to the level or level of van Hiele. The scoring rubric of geometric reasoning ability, according to Mateya (2008: 56) as follows:

Table 1. Geometric Reasoning Scoring Rubric

Level	Phase	Score
0	Visualisation	1
1	Analysis	2
2	Abstraction	4
3	Formal deduction	8

The distribution of categories for students' geometric reasoning abilities is categorized using criterion standards with the criteria proposed by Kadir (2010: 251) as follows:

Table 2. Categorization of Geometric Reasoning Capabilities

Score	Category
$80 \leq x \leq 100$	High
$60 \leq x < 80$	Average
$0 \leq x < 60$	Low

D. Finding and Discussion

Findings

Data analysis in this research was done to measure geometric ability of class XI.IA students at SMA Negeri 1 Wundulako. The general description of students' geometric reasoning abilities using descriptive analysis is as follows:

Table 3. Results of Students' Descriptive Analysis of Geometric Reasoning Ability

GEOMETRIC REASONING ABILITY	
Number of Respondent	40
Mean	49.87
Median	53.33
Modus	66.67
Standard of Deviation	22.39
Variance	501.56
Minimum score	3.33
Maximum score	93.33
Total score	1994.66

The average comparison of students' geometric reasoning abilities for each category of high, medium, and low group based on the number of students is presented in the bar chart in the following figure 1.

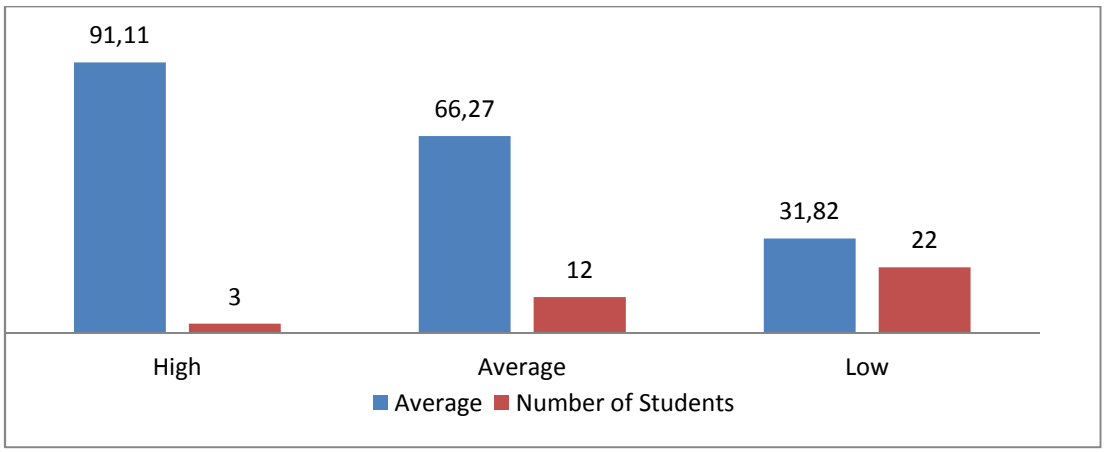

Figure 1: Average of Student Geometric Reasoning Capability for Each Category of High, Medium, and Low

Based on table 3 and figure 1 obtained the number of values of 1994.66 with an average value of 49.86, median equal to 53.33, the mode equal to 66.67. The standard deviation is obtained at 22.39, it shows that there is a considerable difference of value between the students who mean in high ability category with average of 91.11, medium ability category equal to 66.27, and low ability equal to 31,82 , With a maximum value of 3.33 and a maximum of 93.33. In general, based on descriptive analysis, the geometric reasoning ability of SMA Negeri 1 Wundulako students is still low.

The results of descriptive analysis of students' geometric reasoning abilities for each level consisting of visualization, analysis, abstraction, and formal deduction are presented in the following table 4.

Table 4. Average of Students' Geometric Reasoning Capability for Each Level

Item	Visualisation	Analysis	Abstraction	Formal deduction
Mean	0.630	0.625	3.050	3.175

Based on the test results, for the four levels of geometric reasoning abilities are visualization, analysis, abstraction, and formal deduction of students seen in all levels still not achieved optimally level 0 (visualization) maximum score 2 while the average obtained 0.630, level 1 (analysis) A maximum score of 4 on average earns a value of 0.625, level 2 (abstraction) a maximum score of 6 earns an average yield of 3.050, and for level 3 (formal deduction) get score of 3.175 in average.

Discussion

Based on the result of the research, it is found that by descriptive geometric reasoning ability of grade XI.IA students of SMA Negeri 1 Wundulako obtained an average of 49.87. This shows that students' geometric reasoning ability is still low.

From the four levels of geometric reasoning abilities namely visualization, abstraction analysis, and formal deduction, students experiencing a degree of visualization and visualization of this matter in accordance with the lowest average results obtained by students of 0.630 and 0.625. Students experiencing difficulty at the beginning will also find it difficult to answer the questions at the next level. As a result students have problems reaching the level or levels 2 and 3 at the Van Hiele level of the tested problem with the subject of the third dimension because there is no habituation of the learning done.

Based on the analysis at the time of the test and interview, there are various factors that affect the students' geometric reasoning abilities on the third dimensional geometry material is low. This is due to the learning process in the classroom, where the teacher is central to the learning process and makes the students less active. As a result students become less interested in the material being taught, does not cultivate the students' curiosity about the material being studied, the students quickly feel bored and hope the learning process soon ends so that it is less able to understand and develop the ability of mathematics. This is in line with the opinion of

Saragih (2011: 5) revealed that the low ability of students in geometry, especially related to the spaces can not be separated from the learning process. As a fact, it generally shows that math teachers are more emphasis on waking up space on aspects of memory. Although teachers have used props to cultivate students' reasoning about the concepts of waking up, teachers often rush to direct students to understand the waking of the space through images in two dimensions.

Therefore, in the process of learning mathematics is very important to train students in developing their thinking skills, not only provide routine questions that are based on the package book but also in the learning process teachers need to tackle the problems that represent the levels of van Hiele that will give the teacher an idea of the student's ability. Teachers also need to provide learning with attention to the level of development of students' knowledge and not impose the knowledge of students who are still in the low level because although it is forced, students can only accept knowledge through memorization not understanding. Designing learning in terms of teaching materials, student worksheets to facilitate students' success in geometry learning so that the four levels of van Hiele at high school level ie visualization, analysis, abstraction, and deduction can be achieved in geometry learning. It is in the opinion of Khotimah (2013: 10) that in order for the four levels of geometric reasoning at the high school level to be achieved, one way is to apply the five phases namely; Information, direct orientation, explanation, free orientation, and integration. In addition, Van de Walle (2006: 151) states that each level describes how we think and what kind of geometry ideas we think, rather than how much knowledge we have. Significant differences from one level to the next are mind objects that are what we can think geometrically.

E. Conclusion

Based on the results of the analysis and discussion, it can be concluded that geometric reasoning ability of grade XI.IA students of SMA Negeri 1 Wundulako is still low both at the level of visualization, analysis, abstraction, and formal induction. Based on the data analysis, discussion, and conclusion then the suggestion given is the research about geometric reasoning ability can be continued by applying some model of learning one of van Hiele learning model and developing learning device in accordance with geometric reasoning ability.

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