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Analysis of Van Hiele's Geometry Thinking Ability in the 5E Learning Cycle Model with Ethnomatematics Nuances in terms of Student Self-efficacy

Teguh Ananta✉, Zaenuri Zaenuri, Scolastika Mariani

Universitas Negeri Semarang, Indonesia

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Abstract

The purpose of this study is to describe the ability to think geometry in terms of self-efficacy of class VIII SMPIT Assaidiyyah students in 5E Learning Cycle with ethnomatematics nuances. The method in this study uses mixed methods with a concurrent embedded strategy that supports the data obtained from the primary method. In this research, quantitative research is the primary method while qualitative research is the secondary method. The population in this study are all students of class VIII SMPIT Assaidiyyah. Based on the analysis of the description of Van Hiele's geometric thinking skills in terms of student self-efficacy, it is obtained (a) In the category of high Self-efficacy levels, students' geometric thinking skills are at the visualization level, analysis level, and informal deduction level (b) In the category of moderate level of self-efficacy, the level of students' geometric thinking ability is at the visualization level and the analysis level (c) In the low Self-efficacy level category, the geometric thinking ability of students is at the visualization level.

✉Correspondence Address:
Jl. Kelud Timur II No. 15, Gajah Mungkur, Kota Semarang, Indonesia
E-mail: anantaiyeasu@gmail.com

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INTRODUCTION

Mathematics is a branch of science that is closely related to human life. According to Hudojo (1988), mathematics is a tool for developing a way of thinking, is abstract, reasoning is deductive and deals with structured ideas whose relationships are logically arranged. The 2012 International Survey Program for International Student Assessment (PISA) showed that Indonesia was in the second lowest rank of 65 countries for mathematics (OECD, 2013). Analysis of the 2007 and 2011 TIMSS results in mathematics and science for junior high school students in grade 2 shows that in mathematics more than 95% of Indonesian students are only able to reach the intermediate level, while for example in Taiwan nearly 50% of students are able to reach high and advanced levels.

The results of the 2011 TIMSS review also showed that the achievement score in geometry content for grade 8 in various countries including Indonesia was still low, namely only 39% compared to other mathematics content (Mullis, et al, 2011). This indicator shows that mathematics education is still a serious problem faced by Indonesia. The low achievement is due to several factors including first, a lack of understanding in learning geometry as expressed by Batista & Borrow (1997); Elchuck (1992); Noraini (1999) in Idris (2009) states that many students fail to develop an adequate understanding of geometric concepts, geometric reasoning, and geometric problem solving abilities. Second, the selection of learning strategies is not appropriate and does not pay attention to students' geometric thinking skills (Safrina, Ikhsan, & Ahmad, 2014). Third, students learn to memorize concepts rather than construct their own knowledge (Aydogdu, 2014).

Basically, geometry material has a greater potential for students to understand because students are familiar with the basic ideas of geometry before entering the world of school. However, the level of understanding and solving geometric problems between students at the same level can vary. Van Hiele stated that the increase from one level to the next level depends more on learning than age and biological maturity (Usiskin, 1982) Van Hiele's level of geometric thinking (Usisikin, 1982) consists of five levels, namely level 0 (visualization), level 1 (analysis), level 2 (informal deduction), level 3 (deduction), level 4 (rigor).

Self-efficacy can be grown through cooperative learning. This is supported by the results of research by Nuyami, Suastra, and Sadia (2014) which found that students who learn with cooperative learning models have better self-efficacy than students who learn conventional learning models. This is also consistent with research from Schunk & Hanson (1985) which states that students who observe their friends produce higher self-efficacy than just observing their teachers. McCabe (2003) recommends working with peers as one way of increasing student self-efficacy. Van Dinther (2010) states that mastery experiences are the strongest source to create a strong sense of self-confidence.

According to Shirley as cited by Rizka (2014), the field of ethnomathematics, namely mathematics that arises and develops in society and is in accordance with local culture, is a learning process and learning method. Ethnomatematics has the potential to help students feel accepted, become more accepting of others, and fight racism (Brandit and Chernoff, 2014). Abiam, et al (2016) stated that the ethnomathematics approach is not only more effective and superior to conventional approaches, but can also increase instructional acceptance of elementary school geometry material.

The Learning Cycle model is a series of activity stages organized in such a way that students can master the competencies that must be achieved in learning by playing an active role (Dasna in Widhy, 2012).

In the 5E Learning Cycle, there are five phases (Eisenkraft, 2003), namely Engage, Explore, Explain, Elaborate, and Evaluate. Aktas, Bilgin, and Coskun (2013) state that students who learn using the 5E Learning Cycle model learn more meaningfully and are connected than those who learn using traditional learning methods.

Based on the facts as mentioned above, it encourages researchers to examine more deeply Van Hiele's thinking skills in terms of student self-efficacy.

METHOD

The method used in this research is mixed methods. The research design used in this study is concurrent embedded. According to Sugiyono (2015a), the combined research method of the concurrent embedded model is a research method that combines the use of quantitative and qualitative research methods simultaneously (or vice versa), but

the weight of the method is different. In this research, quantitative research is the primary method while qualitative research is the secondary method.

Researchers treat the experimental class with experiential learning and discovery learning in the control class. In this study, the independent variable (X) is self-efficacy and the dependent variable (Y) is mathematical literacy ability.

The first stage of research to determine the initial conditions used questionnaire and observation methods to obtain student self-efficacy data. Furthermore, qualitative data analysis was carried out so that the subject grouping was obtained into 3 groups, namely: Upper Group Students, Middle Group Students, and Lower Group Students.

Qualitative data analysis was carried out to obtain Van Hiele's mathematical thinking skills and self-efficacy through observation and interview methods for 6 selected students. Meanwhile, quantitative data analysis was carried out to test the effectiveness of learning. Furthermore, the overall interpretation of the data analysis is carried out to get a conclusion and suggestions.

RESULTS AND DISCUSSION

Based on the self-efficacy scale, the questionnaire can be grouped into 3, namely the upper, middle and lower groups using the standard deviation method, namely limiting the group by standard deviation. Of the 28 students, it was found that the group division was in table 1.

Table 1. Results of Student Self-Efficacy Grouping

No	Group	Number of students	Score
1	High	5	76-88
2	Moderate	8	59-75
3	Low	5	48-56

The final data descriptive statistics of students' Van Hiele's geometry thinking ability can be seen in table 2.

Table 2. Descriptive statistics of Van Hiele's geometric thinking ability

Descriptive Statistics	Experiment	Control
Mean	77.1	73.3
Variance	53.8	30.1
Standard Deviation	7.3	5.7

Based on the results of the calculation of learning completeness in the class with Leraning Cycle 5E learning with ethnomathematics nuances, it was obtained $z_{count} = 2.22$ and $z_{table} = 1.64$. Because $z_{count} > z_{table}$, then h_0 is rejected, so it can be concluded that the class Van Hiele's geometric thinking ability by 5E learning cycle with ethnomathematics nuances achieves the minimum completeness criteria of 70 reaching more than 75%.

In the results of the average difference test, the Van Hiele geoemetric thinking ability test obtained $t_{count} = 2.707$, while at $\alpha = 5\%$ with $dk = 28 + 36 - 2 = 62$ obtained $t_{table} = 1.998$ So it can be concluded that $t_{count} > -t_{table}$. So, it can be concluded that the average Van Hiele geometric thinking ability of class students taught with the 5E Learning Cycle with ethnomathematics nuances is higher than class students taught using the expository model.

Based on the summary ofVan Hiele's geometric thinking skills in terms of students' self-efficacy, a comparison of Van Hiele's geometric thinking skills can be presented as a comparison of students with high self-efficacy, moderate self-efficacy, low self-efficacy characteristics in table 3.

Table 3. Van Hiele's geometric thinking ability in terms of student self-efficacy.

Aspect	Self-efficacy		
	High	Moderate	Low
Van Hiele's geometric thinking skills	In the high self-efficacy group, there have been good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism. high self-efficacy groups have achieved good achievements at level 2 (informal deduction / abstraction)	In the moderate self-efficacy group, there have been good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism.	The low self-efficacy group has achieved good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism.

Based on the table, students with low self-efficacy do not understand the elements of the prism. The following is one of the results of student work with low self-efficacy in Figure 1.

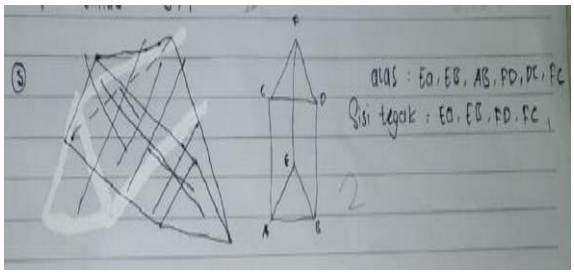

Figure 1. Student work with low self-efficacy

In Figure 1. It shows that E-12 students do not understand the prism elements, this shows that the prism material of E-12 students has not mastered level 1 (analysis). This is in accordance with (Lestari D. I. et al, 2020) which states that students who have low and high category of self-efficacy both have good abilities in the communication component, but are still lacking in other components including mathematising. The statement is in accordance with (Nugroho, et al. 2017) which states that students with low self-efficacy are unable to achieve good indicators of mathematical literacy, such as communication, mathematics, representation, developing strategies to solve problems and using mathematical tools.

Students with moderate self-efficacy levels have reached level 0 and level 1.The following is one of the results of student work with moderate self-efficacy in Figure 2.

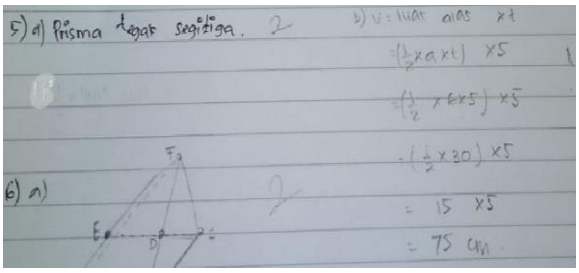

Figure 2. Student work with moderate self-efficacy

Figure 2 shows that students E-11 know that the shape in question is a triangular vertical prism. Subject E-11 already knows the formula for determining the volume of the prism. The disadvantage of E-11 students is that they are unable to determine a strategy to determine the height of the triangle from the base of the prism in question. This happens because E-11 students do not understand the elements of the prism. This is in accordance with (Cahyani, 2020) which states that students with the self-efficacy category are still making several mistakes at the reading, understanding, transformation, processing, and coding stages, with the highest percentage of errors at the understanding stage.

Students with high self-efficacy have reached level 0 and level 1. The following is one of the results of student work with high self-efficacy.

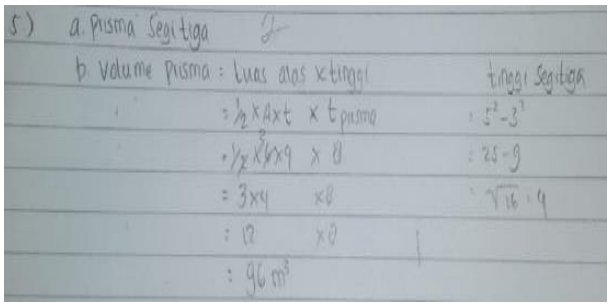

Figure 3. Student work with high self-efficacy

Figure 3 shows that students E-22 know that the shape in question is a triangular vertical prism. This is in accordance with Muhassanah's (2014) statement quoted by Widiyaningsih (2019) which states that students who reach level 1 (analysis) are able to draw geometric objects when given elements of a shape. This is also in accordance with (Ulya. Et al, 2016) which states that students with high self-efficacy are able to understand problems, plan problem solving, implement problem-solving plans, and check back correctly and completely. In line with (Fajariyah, et al, 2017) students with high self-efficacy have been able to achieve all four aspects of problem-solving abilities, namely problems, namely understanding problems, compiling problem-solving plans, implementing problem-solving plans, and re-examining work results. This statement is also supported by Van De Walle's opinion which states that most SMP / MTs students are between level 0 (visualization) to level 2 (informal deduction) (Mujib, 2017).

CONCLUSION

Based on the analysis and discussion above, it can be concluded that the learning quality of the 5E Learning Cycle model with ethnomathematics nuances is quantitatively in the good category.

The low self-efficacy group has achieved good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism. In the moderate self-efficacy group, there have been good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism. In the high self-efficacy group, there have been good achievements at level 0 (visualization) and level 1 (analysis) but there are still deficiencies in understanding the elements of the prism. the high self-efficacy group has had good achievements at level 2 (informal deduction / abstraction). In this study, although in the Pyramid and Prism material, the Van Hiele geometry thinking level was at level 0 (visualization) to level 1 (analysis). There are differences in the achievement of Van Hiele's geometric thinking ability indicators in the Pyramid and Prism material. Van Hiele's geometric thinking ability indicators are mostly achieved in Pyramid material.

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