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RESEARCH ARTICLE

Implementation of Geometry Multimedia Based on Van Hiele's Thinking Theory for Enhancing Critical Thinking Ability for Grade V Students

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ABSTRACT

This study is a advances study of the development of geometry multimedia based on Van Hiele's thinking theory with the aim of for enhancing critical thinking ability using the ADDIE development model. In this study, a difference test was conducted to determine the effect of using geometry multimedia on students' critical thinking abilities. This experiment was conducted at SDN Mojoroto 1 and SDN Mojoroto 6 Kota Kediri. The results of the t-test analysis show that there are significant differences between the critical thinking abilities of students who use geometry multimedia based on Van Hiele's thinking theory and those who do not use geometry multimedia based on Van Hiele's Thinking Theory.

1. INTRODUCTION

In mathematics, a problem needs to be resolved structurally and systematically to find the right answer. In addition to a structured and systematic mindset, learning mathematics correctly can also improve students' critical thinking skills. Critical thinking ability is a high-level thinking ability that students must possess. As expressed by As'ari (2016) who said that the important thing students must have in facing this 21st century is 4Cs, namely Critical Thinking, Creative Thinking, Collaboration, and Communication Skill.

In general, critical thinking is the ability of reflective thinking which is fundamental to determine whether or not to believe something (Ennis, 1987). Specifically, Facione (2009) states that critical thinking skills consist of two components, namely cognitive skills and critical thinking dispositions. The definition of cognitive skills is a person's tendency to think critically (Tyaningsih & Primasatya, 2016). While critical thinking in learning mathematics is a cognitive process in an effort to obtain mathematical knowledge based on mathematical reasoning (Syahbana, 2012).

The importance of fostering critical thinking skills from an early age is less realized by teachers, especially at the elementary school level. The teacher emphasizes more so that students can memorize the formula and when to use it. Like the initial observations made by researchers about the matter of flat building. When students are asked what is the broad formula of a rectangle, all students can answer. However, when asked why the formula used was more than 70% students could not answer correctly. This indicates a lack of students' ability to think critically, so they only receive information without further analysis.

The low level of critical thinking skills of students in various levels of education has also been studied. As was done by Syahbana (2012) who said that few schools train their students to think critically. In addition, from the results of a study conducted by Suarsana (2013), Sya'afi (2014), Amir (2015) and Judges (2018) it was found that more than 60% of students who were the subjects of their research were in the low category.

In order to improve the ability to think critically for students, it is necessary to develop a learning that allows students to explore in order to find a particular concept. Students need to be trained not only to receive information, but also need to criticize various things related to that information. For example, in student learning not only is given the formula area and circumference of the circle, but also why the formula is like that.

In order to facilitate students to be able to think critically, using the right learning media. The media is not only a means of providing information, but also can make students think more about that information. The media must also be "current" so that students are enthusiastic to learn it. From the criteria mentioned, the use of multimedia is the right choice, because it is "current" and can also be designed so students can explore knowledge through these media. Media used in this research is multimedia geography, which is a development of previous research. Multimedia is said because the media used involves all the senses in the learning process (Personal, 2017).

Multimedia used in this study focused on broad material and circumference of the circle. In multimedia, the material is not only presented, but there is a process of students interacting with the media so as to enable students to interact to explore to find concepts. The learning steps contained in the multimedia have also been adjusted to van Hiele's level of thinking.

Van Hiele's thinking theory is a of thought that examines the process of development that connects between topics and

geometric concepts (Primasatya, 2017). In particular this theory associates mathematical material, especially geometry, with the level of thinking of students. There are 5 levels of thinking proposed by van Hiele, namely: 1) Visualization, 2) Analysis, 3) Informal Deduction, 4) Deduction, and 5) Rigor. Various studies have been conducted related to van Hiele's theory of thinking including Tieng (2015), Primasatya (2017), McIntyre (2017), and Solaiman (2017).

From the various studies, it can be concluded that van Hiele's thinking theory is relevant if applied to mathematics learning, and can improve students' critical thinking skills.

In van Hiele's thinking theory there are stages that need to be passed so that students can increase their level of thinking. The following is a description of the 5 stages along with the learning activities that students go through.

Table 1. Stages in Van Hiele's Thinking Theory and Implementation in Learning

Stages in Van Hiele's Thinking Theory	Implementation in Learning
Stages 1 : Inquiry / Information	Through multimedia students recall the definition and characteristics of the circle
Stages 2 : Directional Orientation / Direct Orientation	Through multimedia students find value π (pi) Through multimedia students discover concepts around the circle and their formulas Through multimedia students discover the concept of the circle area and its formula
Stages 3 : Description / explanation	Through multimedia students look for differences in the concept of circumference and area of circle
Stages 4 : Free Orientation	Through multimedia students are given the task in the form of problem solving exercises Through problem solving questions students can distinguish problems around and the area of a circle
Stages 5 : Integration	In multimedia, students write summaries or conclusions from the material and experiments they did on multimedia.

Furthermore, to measure students 'thinking skills need to be set indicators so that students' critical thinking skills can be clearly measured. Many experts set indicators of critical thinking. In this study, the indicators of critical thinking ability adapted the opinions of Hakim & Fatmaryanti (2018) by eliminating the components of expressing opinions and evaluating arguments. This is done by considering the emergence of these indicators at the level of thinking of students according to Van Hiele's theory of thinking. The critical thinking indicators determined in this study are as follows:

Table 2. Indicators of Critical Thinking Ability

No.	Components of Critical Thinking	Indicators
1	Identify problems	Students are able to identify questions
2	Collections relevant informations	Students are able to find material related to the problem
3	Arrange alternative solutions to problems	Students are able to provide alternative solutions
4	Make conclusions	Students are able to make conclusions

(Adaptation of Hakim & Fatmaryanti, 2018)

2. RESEARCH METHODS

In this study, used multimedia geometry products based on van Hiele's thinking theory. The product is the result of development from previous research which stopped at the limited test stage. As a continuation of the research, experiments were carried out as an effort to implement the products that had been developed. This implementation aims to determine the difference between students' critical thinking skills using multimedia geometry based on Van Hiele's theory of thinking with students who do not use multimedia. In accordance with its purpose, the type of research used is a type of quasi-experimental research with a post-test control group design.

The population used in this study were students of Elementary School (SD), that is SDN Mojoroto I, SDN Mojoroto III, and SDN Mojoroto VI Kota Kediri. In terms of location, the three schools are in the same location (one complex) and have the same capabilities. This is evidenced by the test of the similarity of the average of the fifth-grade students in the three schools taken from the pre-test data. Furthermore, randomly selected fifth-grade students in SDN Mojoroto VI and SDN Mojoroto 3 Kota Kediri were the subjects of the study. In this study, the experimental class is a class that uses geometry multimedia based on Van Hiele's thinking theory, namely 33 grade V students of SDN Mojoroto VI in Kediri City. While the control class is a class that does not use geometry multimedia based on Van Hiele's thinking theory, namely 34 students of SDN Mojoroto 1 Kota Kediri. The following is the design of this study:

Table 3. Design of Research

Groups	Treatment	Post-Test
Experiment Class	X	O_x
Control Class	-	O_y

Descripsions:

X : Giving geometry multimedia based on van Hiele's thinking theory

O_x : Value of *post test* of Experiment Group

O_y : Value of *post test* Control Group

The main instruments used in this study were test questions (pre-test and post-test). The test questions used to refer to students' critical thinking abilities as described in the previous section. As support, other instruments are also used such as the Learning Implementation Plan (RPP), Observation Sheet, and Student Response Questionnaire.

Before being tested on research subjects, before the test questions will be tested outside the research subjects to determine the validity and reliability of the question. The trial was carried out for fifth-grade students of SDN Mojoroto III in Kediri City. From the results of these trials, 5 valid and reliable questions were obtained.

As a prerequisite test, the pre-test and post-test data were tested for normality and homogeneity first. If the data is normal and homogeneous, then the data will be analyzed using the independent sample t-test. The analysis was carried out using the help of SPSS 21.0 software. The significance level used is 5%. The hypothesis used to test the data is as follows:

H_0: There was no significant difference in students' critical thinking abilities using multimedia geometry based on van Hiele's thinking theory with students who did not use multimedia geometry based on van Hiele's thinking theory.

H_1: There is a significant difference in students' critical thinking abilities using multimedia geometry based on van Hiele's thinking theory with students who do not use multimedia geometry based on van Hiele's thinking theory.

Based on the results of the analysis of the independent sample t-test, if the significance value is more than or equal to 5% then H_0 is accepted and H_1 is rejected. Conversely, if the significance value is less than 5% then H_0 is rejected and H_1 is accepted.

3. RESULTS AND DISCUSSION

The data obtained in this study is data from the results of tests of critical thinking ability adjusted to indicators of critical thinking. Before a discussion of hypothesis testing is carried out, the following will be explained in advance regarding the prerequisite test, namely the test for normality and homogeneity. The normality test used in this study used the Kolmogorov Smirnov test while the homogeneity test used the Levene Statistic test with the help of SPSS 21.0. The results of the normality test of the experimental class and control class are as follows:

Table 4. Results of the Normality Test of Experimental and Control Class Post-Test

Groups	Kolmogorov-Smirnov		
	Statistics	Df	Sig.
Experiment Class	0,135	33	0,133
Control Class	0,132	34	0,139

Based on these data, the significance values of the experimental and control classes were more than 0.05 (0.133> 0.05 and 0.139> 0.05) then the two classes, both the experimental class and the control class, were normally distributed. Whereas the homogeneity test results are presented as follows:

Table 5. Results of Homogeneity Test of Experimental and Control Class Post-Test

Levene Statistics (Based on Mean)	df1	df2	Sig
2,832	1	65	0,97

Based on these data, because the significance value of 0.97 is more than 0.05 (0.97> 0.05), it can be concluded that the data of the two classes are homogeneous. After the data of the two classes were declared normal and homogeneous, the next step was to examine the differences in the critical thinking skills of the two classes using the independent sample t-test. The results of the analysis with SPSS 21.0 are as follows:

Table 6. Results of T-test of Experimental and Control Class Post-Test

	t-Score	Sig
Results of T-test between Experimental and Control Class	5,807	0,00

Based on Table 6, it is known that the significance value is less than 0.05 (0.00 < 0.05) so it is concluded that H_0 is rejected and H_1 is accepted. So, it can be concluded that there are significant differences in students' critical thinking abilities using multimedia geometry based on Van Hiele's thinking theory with students who do not use geometry multimedia based on Van Hiele's thinking theory.

After finding out the differences in the critical thinking skills of the two classes, through the average value of the two classes, it can be seen which class has higher critical thinking skills.The average results of students' critical thinking skills are presented as follows:

Table 7. Results of Average of Experimental and Control Class Post-Test

Groups	Average	Minimun Value	Maximum Value
Experiment Class	79	68	90
Control Class	65	38	88

Based on these data, its can be seen that the average experimental class is higher than of the control class. So, it can be said that students' critical thinking abilities using geometry multimedia based on Van Hiele's thinking theory are higher more than those of critical thinking skills of students who do not use multimedia geometry based on Van Hiele's thinking theory.

4. CONCLUSIONS

Based on the results of the trial using geometry multimedia based on Van Hiele's thinking theory, conclusions were obtained: 1) there were differences in critical thinking skills between students using geometry multimedia based on Van Hiele's thinking theory and students who did not use geometry multimedia based on Van Hiele's thinking theory 2) Critical thinking ability of students using multimedia geometry based on Van Hiele's thinking theory is better than critical thinking skills of students who do not use multimedia geometry based on Van Hiele's thinking theory.

REFERENCES

Amir, Mohammad. (2015). *Proses Berpikir Kritis Siswa Sekolah Dasar dalam Memecahkan Masalah Berbentuk Soal Cerita Berdasarkan Gaya Belajar.* Jurnal Mat Educator Nusantara, 1(2) : 159 – 170.

As'ari, AR. (2016). *Tantangan Pengembangan Profesionalisme Guru dalam Rangka Membelajarkan Matematika di Abad ke-21 dan Membangun Karakter Peserta Didik.* Naskah Publikasi, (Online), Tersedia di http://www.researchgate.net/publication/311067194, diunduh 1 Juni 2018.

Creswell, John W. (2012). *Research Design Pendekatan Kualitatif, Kuantitatif dan Mixed*. Yogyakarta: Pustaka Pelajar.

Ennis, Robert H. (1987). *Taxonomy of Critical Thinking Dispositions and Abilities.Teaching Thinking Skill*.New York : Freeman.

Facione, P.A., (2009). *Critical Thinking:What It Is and Why It Count*. The California Academy Press.

Fonna, M., & Mursalin, M. (2018). Pengembangan Modul Geometri Analitik Bidang Berbantuan Wingeom Software untuk Meningkatkan Kemampuan Representasi Matematis Mahasiswa Program Studi Pendidikan Matematika Universitas Malikussaleh. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *6*(3), 391-402.

Hakim, Lukman & Fatmaryanti, Siska Desy. (2018). *Study Pendahuluan Pengembangan Media Pembelajaran Berbasis Booklet Etnosains Fotografi untuk Meningkatkan Kemampuan Berpikir Kritis Siswa.* Repository,(Online), tersedia di http://repository.urecol.org, diunduh 1 Juni 2018.

Imswatama, A & Lukman, H.,S. (2018). The Effectiveness of Mathematics Teaching Material Based on Ethnomathematics*. International Journal of Trends in Mathematics Education Research, 1*(1), 35-38. doi:10.33122/ijtmer.v1i1.11

Putriani, D & Rahayu, C. (2018). The Effect of Discovery Learning Model Using Sunflowers in Circles on Mathematics Learning Outcomes*. International Journal of Trends in Mathematics Education Research, 1*(1), 22-25. doi:10.33122/ijtmer.v1i1.26

Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and Limitations of Qualitative and Quantitative Research Methods. European Journal of Education Studies.

Mclntyre, Richard Nicholas Ian. (2017). *Analyzing Geometry in Classroom Mathematics and Mind Action Series Mathematics Textbook Using van Hiele Levels*. Repository, (Online), http://wiredspace.wits.ac.za, diunduh 1 juni 2018.

Mursalin, M., Nuraini, N. L. S., Purnomo, H., Damayanti, N. W., Kristanti, D., Rohim, A., ... & Fonna, M. (2018, September). The development of algebra teaching materials to foster students' creative thinking skills in higher education. In *Journal of Physics: Conference Series* (Vol. 1088, No. 1, p. 012101). IOP Publishing.

Masitoh, L. F., & Fitriyani, H. (2018). Improving students' mathematics self-efficacy through problem based learning.*Malikussaleh Journal of Mathematics Learning (MJML)*, *1*(1), 26-30.

Pribadi, BA. (2017). *Media dan Teknologi dalam Pembelajaran.* Jakarta : Kencana.

Primasatya, Nurita & Ahdhianto, Erif. (2017). *Pengembangan Modul Geometri Berbasis Teori Berpikir van Hiele Guna Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas V*. Ed-Humanistics, 2(2): 225-231.

Solaiman, Normalah P., Magno, Sonny N., & Aman, Jocelyn P..(2017). *Assessment of The Thirt Year High School Student's van Hiele Levels of Geometric Conceptual Understanding in Selected Secondary Public School in Lanao del Sur*. Journal of Social Sciences, 6(3) : 603-609.

Syahbana, Ali. (2012). *Peningkatan Kemampuan Berpikir kritis Matematis siswa SMP melalui Pendekatan Contextual Teaching And Learning*. Jurnal Edumatica, 2(1) : 45-57.

Tieng, Poh Geik & Eu, Leong Kwan. (2015). *Improving Students van Hiele Level of Geometric Thinking Using Geometer's Sketchpad.* The Malaysian Online Journal of Education Technology, 2(3) : 20-31.

Tyaningsih, Ratna Yulis & Primasatya, Nurita. (2016). *Mengembangakan Disposisi Berpikir Kritis Siswa pada Materi Menggambar Grafil Fungsi Trigonometri Melalui Model Pembelajaran Berbasis Proyek.* Dikma Jurnal Pendidikan Matematika, 4(2): 176-190.

Thahir, M., Roza, Y., & Murni, A. (2018). Validity of learning website of kapita selekta mathematics course at UIN Suska Riau Students. *Malikussaleh Journal of Mathematics Learning (MJML)*, *1*(1), 19-25.

Usmadi & Ergusni (2018). Design of ARCSI Learning Model with Scientific Approach for Teaching Mathematics in School. *International Journal of Trends in Mathematics Education Research, 1*(1), 13-18. doi:10.33122/ijtmer.v1i1.28