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The Enhancement of Students' Mathematics Critical Thinking Ability Through Videoscribe Learning Multimedia

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Abstract

The background of this study is based on the fact that the achievement of high order thinking skills (HOTS)of students in Indonesia is still low. The aim of this study was to determine whether the use of videoscribe learning multimedia can improve the mathematics critical thinking abiliy of 11th grade of Vocational High School students in the City of Bogor. Type of This research is the research & development (R&D). This research uses two stages, namely limited research and development. The instrument used in this study was a test of critical thinking ability in the form of essays. At the limited research stage, it is known that the increase in mathematics critical thinking ability of students who use videoscribe learning multimedia is significantly better than students who use power point media. At the development stage, it was found that the increase in mathematics critical thinking ability is 32.3%. Based on the results of observations note that students are more concentrated and excited in following the lessons using videoscribe learning multimedia.

Keywords: Multimedia Videoscribe, High Order Thinking Skills, Mathematical Critical Thinking Ability

1. Introduction

Mathematics is a very important subject because every type of science subject uses mathematical concepts in it [1]. However, the facts show that the ability of Indonesian students is still low. Based on the results of the TIMSS survey in mathematics, Indonesia was ranked 45th out of 50 countries. The score obtained by Indonesian students is 397, still far from the standard score used by TIMSS which is 500 [2]–[4]. In addition, the PISA survey score in 2006 showed that the mathematical ability of Indonesian students is 391 or 2015 obtained scores of 397, 386, and 403 for literacy skills in reading, mathematics, and science [3], [5]. In the survey, cognitive indicators that are assessed are knowing, applying, and reasoning. To solve application problems, problem solving skills are needed [6]–[11]. From these data it can be seen that the mathematical problem solving ability of Indonesian students is low. Problem solving ability is one indicator of critical thinking skills.

Mathematical thinking is defined as a mental activity in carrying out mathematical processes (doing math) or mathematical tasks [12]–[14]. Judging from the depth or complexity of the mathematical activities involved, mathematical thinking can be classified in low-order mathematical thinking and high-order mathematical thinking [11].

Low-level mathematical thinking includes thinking skills: knowledge (C1 in Bloom's taxonomy) and low-level understanding (C2 in Bloom's taxonomy), such as knowing and memorizing formulas and using formulas in routine calculations. Some experts give different terms for low-level understanding, such as mechanical understanding, computational understanding, instrumental understanding, knowing how to. High-

level mathematical thinking includes: rational understanding, relational understanding, functional understanding, knowing understanding, mathematical critical thinking, mathematical creative, metacognitive and intuitive. This statement shows that mathematical critical thinking includes higher order thinking skills [11], [15].

Mathematics critical thinking is a concept that has evolved a long time, but only began to be deepened at the end of the 20th century [16]. Critical thinking becomes an important and vital topic in modern education. All educators are interested in teaching critical thinking to their students [17]–[20].

The understanding of mathematics critical thinking was proposed by Scriven & Paul as an active and expert intellectual discipline process in understanding concepts, applying, analyzing and synthesizing, evaluating information obtained from observation, experience, reflection, reasoning, or communication, as a guide for believing and act. In line with this opinion, Schafersman provides a definition of critical thinking as a way of thinking correctly to obtain relevant and reliable knowledge. Critical thinking is a way of thinking by reasonable, reflective, responsible, and expert [21]–[25].

Critically thinking in mathematics is to test, question, connect, evaluate, all aspects that exist in a situation or a problem [26]. This understanding of critical thinking is consistent with the stages in the scientific method. Ennis defines critical thinking as a thought process that has the purpose of making responsible decisions about what will be believed and what will be done. This means that someone who thinks critically is able to make decisions about what will be believed and what will be done based on reliable information and understanding of the topic at hand.

The definition of critical thinking in this research is a way of thinking using scientific methods as a basis for thinking. Critical thinking consists of abilities, namely: identifying problems, analyzing problems, compiling problem solving, solving problems, evaluating the results of problem solving, and drawing conclusions [11].

The development of information and communication technology at this time has touched various fields of life. No exception in the field of education. As developments in the field of ICT, the presence of smartphones at this time has changed the paradigm, mobile phones are not only used as a communication tool, but as a medium for obtaining information, social media, business, games and so forth. The existence of a game on a cell phone or cellphone can make people watch for hours and play the game so often they do not care about the surrounding environment. Many students currently only spend time playing games and watching videos on YouTube compared to doing learning activities, reading books, and interacting with the surrounding environment.

The habit of playing games and watching videos among students reflects the culture of watching that exists in Indonesian society. As a result of a 2015 Central Statistics Agency (BPS), viewing habits among Indonesians ranks highest compared to radio listening and reading. The habit of watching in Indonesian society is one of the most important consideration factors in the selection of instructional media that can be used in schools. A learning media is needed that can accommodate viewing habits so that students have a strong interest in learning. One of the learning media that uses video is videoscribe.

Videoscribe is software that can be used to create white screen animated designs very easily (automatically). This software was developed in 2012 by Sparkol (a company in the UK). Videoscribe was developed in Adobe Flash and produces Quicktime films and flash videos. Video files can be exported to Quicktime Video Flash videos, or image sequences (JPEG and PNG). Videoscribe won the Best Mobile/Tablet B2S App at the 2013 MOMA Awards [27].

Every teaching material has benefits in accordance with the characteristics of the teaching media. Likewise, the learning video has the following benefits: Overcoming distance and time; Being able to describe past events realistically in a short time; Can be repeated if necessary to increase clarity; The message is fast and easy to remember; Developing students' thoughts and opinions; Develop imagination; Generating motivation and stimulating children to learn [27].

In this study, learning proces is done using multimedia videoscribe. Multimedia videoscribe used by the teacher when explaining learning ahead using the LCD, then students can use smart phone to relearn the material that has been delivered by the teacher.

2. Method

This research is a type of research & development (R&D) research. There are two stages of research, namely the limited research stage and the development

stage. The limited research phase is carried out to determine whether or not there is a difference in the increase in mathematical critical thinking ability between students who obtain learning using videoscribe media and students who use power point media. The development stage is carried out to find out the increase in critical thinking ability between pretest and posttest for all 11th grade students.

At the limited research stage, the quasi-experimental method was used with the pretest-posttes control group design. Table 1 shows the research design at the limited research stage.

Table 1. Pretest Posttest Control Group Design

Class		Pretest	Treatment	Postest
Experiment	R	O_1	X_1	O_2
Control	R	O_1	-	O_2

Information:
R : Class random sampling
O1: Pretest
O2: Posttes
X1: Treatment using multimedia videoscribe

The development phase is carried out to find out how much the increase in critical thinking skills in all 11th grade students in vocational schools in the City of Bogor. The population in this study were 180 vocational high school students in Bogor. While the sample used in the limited research stage was 60 people divided into two classes. The experimental class was 30 students and the control class was 30 students.

The instrument used in this study was the essay critical thinking ability test. Before being used in research, the instrument trial was conducted to determine the validity and reliability of the instrument. Validity used includes content validity and external validity. Content validity is done by consulting a mathematician, while external validity is done by comparing the test with other tests that have been standardized. The correlation coefficient is calculated using the Pearson product moment correlation. Test reliability is calculated with the principle of internal determination, which is done by correlating the answers to an item number with the rest of the answers in another number of the questions. The test is only done once. The formula used is Cronbach Alpha [28].

3. Result and Discussion

3.1. The Results of the Limited Research Stage

Descriptive statistics of the pre-test scores on critical thinking skills at the limited research stage are shown in Table 2.

Table 2. Descriptive Statistics Of Pretest Value

Class	N	Min	Max	Mean	Stand. Dev.	Variance
Experiment	30	12.00	36.00	24.400	6.755	45.628
Control	30	12.00	36.00	24.133	6.927	47.982

In Table 2, the mean value of the pretest scores in the experimental and control groups had almost the same values of 24,400 and 24,133. To test whether there are differences in the mean value of the pretest between the experimental group and the control group, then the mean value of the difference test on the pretest value is performed. Based on data analysis on the pretest value using the Kolmogorov-Smirnov test, the Experiment Group obtained a significance value of 0.00 <0.05, while the Control Group obtained a significance value of 0.007 <0.05. According to the testing criteria, then Ho was rejected in both groups. This means that the two sample groups come from populations that are not normally distributed. To compare the mean values between the two groups the U-Mann Whitney test was used.

Table 3. The Test of Difference Mean Value in Pretest

Statistics	Combined Pretest
Mann-Whitney U	439.500
Wilcoxon W	904.500
Z	-0.159
Asymp. Sig. (2-tailed)	0.874

Data analysis using the Mann Whitney U test with SPSS software showed a significance value of 0.874> 0.05. Based on the hypothesis testing criteria, Ho is accepted. Thus it can be concluded that the mean value of pretest scores in the experimental and control groups were not different.

Table 4. Descriptive Statistics of Post-Test Value

Class	N	Min	Max	Mean	Stand. Dev.	Variance
Experiment	30	60.00	100.00	88.133	9.555	91.292
Control	30	60.00	92.00	77.467	9.187	84.395

Table 4 shows that the mean value of the experimental group (88,133) was higher than the mean value of the control group (77,467). To prove whether there is a difference in the mean value between the post-test scores of the experimental group and the control group, the mean value of difference test is performed.

Based on the Kolmogorov Smirnov test on SPSS software, the significance value obtained by the experimental group was 0.001 <0.05. While in the Control Group 0.082> 0.05. Based on the hypothesis testing criteria, the Experiment Group came from populations that were not normally distributed while the control group came from populations that were normally distributed. To test the difference in the mean value of post-test critical thinking skills used the Mann Whitney U test.

Table 5. The Mean Value Differences For Post-Test

Statistics	Combined Post-test
Mann-Whitney U	168.000
Wilcoxon W	633.000
Z	-4.196
Asymp. Sig. (2-tailed)	0.000

Based on the results of data processing using the Mann Whitney U test with SPSS software, it is known that the significance value obtained is 0,000 <0.05. Thus the mean value of the two groups is different. It can be concluded that there are differences in the mean value of critical thinking ability between groups that get learning using videoscribe and students who use power points. Based on the posttest mean value it is known that the mean value of the experimental group is higher than the control group.

Based on data analysis at the limited research stage, it was found that the increase in the critical mathematics ability of students who use videoscribe were significantly better than students who used power point media.

3.2. The Results at Development Stage

Table 6. Descriptive Statistics of Combined Mean Value

Statistics	Pretes	Postes
N	30	30
Mean	53.267	85.533
Std Deviation	10.872	7.375
Variance	118.202	54.395
Minimum	32	68
Maximum	66	96

At the development stage, learning was carried out on four classes of students using videoribe learning media. Descriptive statistics at the development stage are shown in Table 6.

Based on data analysis on the average value of combined pretest and posttest is known that the data are not normally distributed and are not homogeneous. To compare the average value of combined pretest and posttest combined on critical thinking skills the average difference test was used using the Mann Whitney U test as shown in Table 7.

Table 7. Test of the Mean Value Differences of Combined Mean Value

Test	Combined Mean Value
Mann-Whitney U	0.000
Wilcoxon W	465.000
Z	-6.680
Asymp. Sig. (2-tailed)	0.000

In Table 8 it can be seen that the significance value of the Mann Whitney U test is 0,000. Based on testing criteria using a 5% significance level, it is known that Ho is rejected. It can be concluded that there are differences in the average value between pretest and posttest students' critical thinking skills. Increased students' Critical thinking ability is 32.3%.

Based on the results of the study, the results obtained that the critical thinking ability of students who get learning videoscribe is better than students who use ordinary learning media in the form of power points. These results are in accordance with the advantages possessed by the videoscribe learning media described earlier. The Multimedia videoscribe can be repeated, so students can better understand the learning material delivered by the teacher in class. Presentation using pictures and music in videoscribe makes many students' senses used during the learning process so that it increases the understanding and memory of students. The use of videoscribe multimedia can improve the students motivation to learn and can last longer for learning. Besides that, learning using videoscribe makes the teacher faster in explaining the material, so the teacher can develop learning to improve higher thinking skills such as critical thinking.

4. Conclusions and Suggestions

4.1. Conclusions

The students' mathematics critical thinking ability can be improved through learning using videoscribe multimedia. Videoscribe Multimedia can increase learning motivation, enthusiasm for learning and resistance of students in learning mathematics.

4.2. Suggestion

Mathematics learning is recommended to utilize multimedia videoscribe to improve students' critical thinking. Mathematics learning is recommended to utilize multimedia videoscribe to increase student motivation and learning enthusiasm.

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