

## The Effect of The Geogebra-Assisted Problem Based Learning Model on Problem Solving Ability and Critical Thinking Ability for Class X Students of SMA Negeri I Petang

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### Abstract

*This study aimed to know the differences and to describe the ability of problem solving and critical thinking skills of students who engaged in Problem Based Learning with geogebra with students who took conventional learning. This research was a quasi-experimental study using post-test only control group design. The population of this research is the tenth grade students of SMA Negeri I Petang academic year of 2019/2020. There were 366 students in class X of SMA Negeri I Petang and were divided into eleven classes. In this study, the sample used were 65 students who were divided into two classes (experimental and control classes). The sample was determined by cluster random sampling technique. The research instruments were in the form of problem solving skills and mathematical critical thinking tests. The data obtained were analyzed using MANOVA test. The results of the analysis showed that the students' ability in solving problems and thinking critically using Problem Based Learning model assisted with geogebra was better than those who took conventional learning ( $F = 1917,095$  and  $Sig. = 0,000$ ;  $q < 0.05$ )*

**Keywords:** Problem Based Learning Model, problem solving ability, critical thinking ability..

## INTRODUCTION

In facing future life, education plays an important role in preparing human resources. Through the time, education in Indonesia has experienced the development and progress of various things such as improvements in facilities and infrastructure, more complete learning media as well as educational support technology and professional teaching staff. In the development of science, mathematics is one of the basic science that is important and useful. A strong mastery of mathematics from an early age is very important to be able to balance the development of science and technology. Therefore, good mathematics learning is needed. Mathematical learning is the process of providing learning experiences to students through a series of planned activities so that students gain competence about the mathematical material being studied (Muhsetyo, 2008: 1.26).

In order to achieve the learning objectives, a learning model is needed. "The learning model is a plan or a pattern that is used as a guide in planning learning in class. The learning model refers to the learning approach that will be used, including teaching objectives, stages in learning activities, learning environment, and classroom management (Arends in Trianto, 2010: 51). There are various kinds of learning models that are recommended and effective to be applied, one of them is the Problem Based Learning model. Several studies that are international scale and relevant to PBL are: (1) Hung (2016) An important part of PBL implementation is the problem. (2) Siswono et al (2018) Based on the results of the study, it can be concluded that PBL is effective in statistical learning. These findings indicate that students are enthusiastic in working on a given project and are actively discussing with other students

in the class. (3) Costas S. Constantinou 1 & Stella A. Nicolaou 2 (2018) PBL are known for improving students' problem solving skills and teamwork.

The importance of problem solving ability was stated by Aljaberi & Gheith (2016) that problem solving is one of the most important cognitive activities and can be used by people in a variety of contexts, especially with regard to the revolution in information technology and in accelerating changes in aspects of life. Polya (1985) defines problem solving as an attempt to find a way out of a difficulty in order to achieve a goal that cannot be achieved immediately. The ability of problem solving will be juxtaposed with the ability to think critically in this study. According to (Ennis, 1996) critical thinking is rational and reflective thinking focused on focusing on what must be believed or done. According to Van Gelder & Willingham (in Eggen & Kauchak, 2012: 111), critical thinking can be defined in various ways, but the essence of the definition includes a person's ability and tendency to make and conduct an assessment towards conclusions based on evidence, so critical thinking is very important because it is used to make decisions with the right reasons.

The importance of practicing critical thinking was caused by the reason that critical thinking is a basic process that allows students to cope with and reduce uncertainty in the future. Critical thinking skills which possessed by students are very helpful for students in determining important information that is obtained, changed or transformed and maintained. Meaningful experiences that involve critical thinking can help students: 1) to make decisions based on evaluating the components involved, 2) to determine the validity of conclusions, beliefs and opinions expressed by others, 3) to see their own beliefs, feelings, attitudes and thoughts related to the existing situation, and 4) to allow students to strengthen ideas and beliefs and to determine their own values that will be appreciated. In this study, the researcher refers to the idea of Eggen and Kauchak because they were considered to be very close to the Problem Based Learning process which will be juxtaposed with critical thinking itself in which geogebra as software can facilitate it. Geogebra is a computer software that has interesting features related to mathematics. Integration of technology in learning and learning mathematics is what is offered by geogebra software. The strength of geogebra is that it is able to explain concepts and the interaction between teachers and students in the teaching and learning process when trying to understand the materials being taught. The use of geogebra provides an immediate response to students. This media is seen as a stimulus. Any changes when students use this media will be responded quickly by the computer. In mathematics, it is important to understand the material by mastering the concepts, theorems, and mathematical principles holistically so it is important that problem solving can be found. Related to this, geogebra can construct knowledge and problem solving. Some research results showed that it can improve students' procedural and conceptual mathematics even in abstract form (Zulnaldi and Zamri, 2016; Caglayan, G, 2015, Suriadi, et al, 2014). Besides, geogebra also has a positive effect on students achievement in a lot of material in mathematics. According to Lavieza (in Aryasuta, 2014) a number of studies have shown that geogebra can drive the process of discovery and investigation in class.

Reviewing the appearance, this software is intended for the benefit of learning mathematics. The appearance maximally accommodates the representation of mathematical concepts in multimode or multirepresentation (suweken, 2011). Geogebra is expected to reduce student learning difficulties because of the reasons stated above. Based on the background, the problem can be formulated, it is to find out and describe whether students' problem solving and critical thinking ability who take Problem Based Learning assisted by geogebra are better than students who take conventional learning?

## **RESEARCH METHOD**

This research is quasi-experimental because it uses all subjects in the study group to be treated, not using subjects taken randomly. In this study, the population was all students of class X in SMAN I Petang academic year of 2019/2020 consisting of science and social science classes. The population in this study is 11 classes. This research used cluster random sampling technique to determine two classes as the control class and the experimental class.

In this study there are 2 variables, namely the independent variable and the dependent variable. The independent variable in this study is the Geogebra-assisted Problem Based Learning model. The

dependent variable in this study is the ability of problem solving and critical thinking skills of students in learning mathematics. The research design used in this study was the post-test only control group design, where the control class with conventional learning models and the experimental class with Problem Based Learning models assisted with geogebra.

With a design like this, it is possible not to randomize individuals in a group placement. The advantage of this research design is the use of whole groups (classes) so that the research subjects are not very aware of the experiments conducted. In this study, the research steps conducted as follows:

1. 1. Determine research samples in the form of classes of populations that have been determined and have been tested for equality, using random sampling techniques.
2. 2. The research sample obtained will be drawn again to determine the experimental class and the control class.
3. 3. Determine the subject matter and prepare the completeness of learning that will be used during learning. Arrange lesson plans and worksheets for the experimental class and consult the lesson plans and worksheets with the lecturer.
4. 4. Develop research instruments in the form of tests to measure students' problem solving abilities and critical thinking skills.
5. 5. Conducting trial research instruments to determine the validity and reliability of the contents.
6. 6. Applying Problem Based Learning assisted with geogebra to the experimental class while conventional learning models to the control class.
7. 7. Provide post-test for both sample classes.
8. 8. Analyzing research data to test the proposed hypothesis.
9. 9. Prepare research reports

Research instruments are tools used by researchers to collect data (Suharsimi Arikunto, 2002b). The type of instrument used in this study is a test consisting of quantitative data instruments. The test that will be used in this study is a description test from consisting of 5 items with a specified grid and scoring rubric. Each test item description about concept understanding ability gets a score of 0 to 2 so that the maximum score is ideally 10. The data analysis technique of this study was conducted with several tests namely content validity test by experts, construct validity testing and reliability testing. After that, it is followed by hypothesis prerequisite test, which are the normality test, the homogeneity test, and the variance homogeneity test, the colinearity test and finally the hypothesis test. Hypothesis testing in this study used MANOVA test.

## **RESULTS AND DISCUSSION**

The data obtained in this study are the results of problem solving abilities and critical thinking skills in learning mathematics in groups of students who take a problem-based learning model assisted with geogebra and groups of students who take conventional learning. Prerequisite tests must be fulfilled first before conducting the Manova test. The prerequisite test are the test for the normality of data distribution using the Lilliefors test, the Variance Homogeneity test using the Levene's test, the Variance-covariance Homogeneity Test using SPSS 20 for windows through the Box's M test and finally the bounding variable linearity test using the product moment correlation test fellow dependent variables.

Homogeneity variance test is used to ensure that the differences obtained come from differences between groups, not based on differences in groups. Testing of homogeneity of variance is carried out using the Levene's test. The variance-covariance homogeneity test is intended to show that the variance-covariance of the dependent variable is the same. Homogeneity testing is done by the variance-covariance matrix similarity test using SPSS 20 for windows it can be seen that the price of Box's M = 7,422 with a significance of 0.067, if a significance level of 0.05 is determined, then the price of Box's M obtained is not significant. Thus, the variance-covariance matrix of the dependent variable is homogeneous.

Collinearity test of the dependent variable is done using the product moment correlation test between fellow dependent variables (complete calculations can be seen in the Appendix). The rule that is used to express whether or not a colleague is between fellow dependent variables is price (the price of product moment correlation between fellow dependent variables). If there is no strong correlation between the dependent variables from this research it showed that the price of product moment correlation between dependent variables is equal to . Thus, between problem solving skills and critical thinking skills in the experimental group shows a positive impact while it do not occur very strong correlation between bound variables so that if students have good problem solving abilities, they might not show good critical thinking skills as well. Thus, the ability of problem solving and critical thinking skills in the control group have a positive impact and a very weak relationship level so sometimes when students have good problem solving abilities of course the ability to think critically shows good results and vice versa.

This study has a hypothesis of problem-solving ability and the ability to think critically in mathematics for students who take learning with Problem Based Learning models assisted with Geogebra are better than students who take conventional learning.

the statistical values of Pillai's Trace, Wilks' Tambda, Hotelling's Trace, and Roy's Largest Root were respectively  $F = 1917,095$  and had a significance of less than 0.05 ( $p < 0.05$ ). This result is used as a basis for making decisions. The decision that can be taken is that  $H_0$  is rejected and  $H_1$  is accepted. These results state that the problem-solving abilities and mathematical critical thinking skills of students who take learning with geogebra-assisted Problem Based Learning models are better than the problem-solving abilities and mathematical critical thinking skills of students who take conventional learning

## **CONCLUSIONS AND SUGGESTIONS**

Based on the results of the study and discussion of findings that are the answers of the formulation problem proposed in this study, that is the ability of problem solving and critical thinking skills of students who take learning with geogebra-aided learning models better than the ability to solve problems and think critically mathematics students who follow conventional learning. Based on these findings, it can be concluded that the Problem Based Learning model assisted with geogebra has a positive effect on students' mathematical thinking skill and problem solving abilities.

The suggestions that can be delivered based on the research results that has been carried out are as follows.

1. Mathematics education practitioners, especially mathematics teachers, are expected to apply geogebra-assisted Problem Based Learning models as an alternative learning in classroom learning activities considering this learning model has a positive influence and is able to improve problem solving skills and critical thinking skills
2. For teachers who will use Problem Based Learning are expected to be able to prepare tools, concepts and relevant problems in a completely, so there would be no miss-conception and time consuming. Thus, student' understanding would be increased and time efficiency can be maximized to increase student learning achievement .
3. High dominance of mentors will result in failure in the application of Problem Based Learning model
4. The application of the Geogebra-aided Problem Based Learning model in mathematics learning is expected to involve students so that they can build their own knowledge by relating students' daily lives.

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