**GeoGebra Assist Discovery Learning Model for Problem Solving Ability and Attitude toward Mathematics**

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**Abstract.** This study aims to describe the effect of GeoGebra utilization in the discovery learning model on mathematical problem solving ability and students’ attitude toward mathematics. This research was quasi experimental and post-test only control group design was used in this study. The population in this study was 181 of students. The sampling technique used was cluster random sampling, so the sample in this study was 120 students divided into 4 classes, 2 classes for the experimental class and 2 classes for the control class. Data were analyzed by using one way MANOVA. The results of data analysis showed that the utilization of GeoGebra in discovery learning can lead to solving problems and attitudes towards mathematics are better. This is because the presentation of problems using geogebra can assist students in identifying and solving problems and attracting students’ interest because geogebra provides an immediate response process to students. The results of the research are the utilization of geogebra in the discovery learning can be applied in learning and teaching wider subject matter, beside subject matter in this study.

1. **Introduction**

GeoGebra assisted discovery learning model is meant to students have a good problem solving ability and be positive in mathematics learning. Students need to develop and improve problem solving ability in mathematics learning because problem solving is considered as the proper way to practice thinking in general [1]. Attitude is also a very important variable in mathematics learning because students who have a positive attitude toward mathematics tend to show high metamatic ability than students who have a negative attitude to mathematics [2].

Some research results on problem solving skills and student attitudes toward mathematics: stractch-related gane activities made a more positive contribution to the logical mathematical-thinking skill, academic achievement, and problem solving ability of students than the educational program based on Lego Mindstotms Ev3 design activities and traditional teaching activities; this contribution was especially significant for the mathematical relationship factor [3], adoption of cloud services for augmenting learning results in strong positive mentality and confidence among mathematics education students, leading to student feeling good, thinking hard, and actively participating in their own mathematics learning [4], and students’ learning of the geometry through discovery learning assisted by saintific approach model is categorized well [5]. However, many teachers and students assume that the process of teaching mathematical problem solving as a very complicated activity to do [6]. Students have difficulty in solving mathematical problems due to the lack of skills and teaching
methods that are appropriate for students [7]. Historically, teaching mathematics at lower levels of education does not necessarily allow students to develop a better tendency toward subjects [4].

Different from other reports, researcher has a special method to solve these problems. That method is discovery learning assisted by GeoGebra. The presence of GeoGebra in every stage found in discovery learning can help students in finding knowledge effectively and efficiently, including in solving problems given by teachers. GeoGebra lets the students explore mathematics concept. The GeoGebra user is flexible and can be adapted to students need so that students tend to do math-related things [8]. This research attempts to determine the effect of GeoGebra assisted discovery learning model on problem solving ability and attitude toward mathematics.

2. Difficulties in Geometry Learning and Its Solution

The lack of understanding in learning geometry often causes discouragement among students, which invariably will lead to unfavorable performance in geometry. Some factors have been identified as causing difficulties in geometry learning; these are geometry language, visualization abilities, and ineffective instruction. Spatial visualization has been linked with geometric achievement because geometry is visual in nature. Learning geometry may not be easy and a large number of students fail to develop an adequate understanding of geometry concepts, geometry reasoning, and geometry problem-solving skills [9]. Researcher a solution to overcome these difficulties, researcher uses discovery learning model assisted by GeoGebra. GeoGebra will assist each stage found in discovery learning model (i.e., stimulation, problem statement, data collection, data processing, verification, and generalization) in learning geometry, especially part of circle matter. There is also a description of the material, as follows:

(1) Determine the area formula of the circle

The following are Steps to find the area formula of a circle using GeoGebra.

a. Stimulation

The problem is aired using GeoGebra, will be displayed as follows:

![Figure 1. Problem display of the area circle](image)

b. Problem statement, data collection, data processing, and verification

After the instructions contained in step “a” is done, then the result will look like in the following view.
c. Generalization

At this stage, each group is asked to determine the area of the circle based on the "wake of the triangle". Students are expected to get a formula around this circle like this:

\[ L = \frac{1}{4} \pi d^2 \text{ atau } L = 2 \pi r \]  

(1)

\( \pi, r, \) and \( d \) are value approach (3,14 or 22/7), radius, and diameter, respectively.

3. Experimental Method

This research was quasi experimental and Post-test only control group design was used in this study. The population in this study were all students of class VIII junior high school of which there are 181 NTT-Indonesia students come from 6 classes. The researcher used cluster random sampling to select 4 classes as a research sample, where 2 classes as class and 2 class as control class. Students of each class are composed of men and women in equal numbers. They have low, moderate, and high ability. Data collected are problem solving ability data and attitude data. Problem solving ability data is collected through a description test and attitude data is collected through a questionnaire. The questionnaire data was measured using the Likert scale. Data were analyzed using one way MANOVA.

4. Results and Discussion

4.1. Results

The data used in this research is the test of problem solving ability and score questionnaire attitudes toward mathematics. These data were used to provide an overview of the distribution and distribution of data. As previously described, this experimental study used Post Test Only Control Group Design with multivariate analysis and obtained several data groups including: 1) mathematical problem solving ability with discovery learning model assisted with GeoGebra; 2) problem solving ability using conventional learning model; 3) attitude toward student mathematics by using discovery learning model assisted with GeoGebra; and 4) attitude toward mathematics by using conventional learning model.
Table 1. The result of the problem solving ability and attitude toward mathematics of each group.

| Statistic | $X_1Y_1$ | $X_2Y_1$ | $X_1Y_2$ | $X_2Y_2$ |
|-----------|-----------|-----------|-----------|-----------|
| N         | 30        | 30        | 30        | 30        |
| Mean      | 39.03     | 29.6      | 90.34     | 64.13     |
| Modus     | 36        | 30        | 13        | 61        |
| SD        | 7.94      | 5.70      | 168.83    | 5.56      |
| Varian    | 63        | 32.52     | 101.16    | 30.95     |
| Min       | 24        | 21        | 63        | 57        |

Information: $X_1Y_1$ : mathematical problem solving ability with discovery learning model assisted by GeoGebra, $X_2Y_1$ : mathematical problem solving ability with conventional learning model, $X_1Y_2$ : attitude toward mathematics with discovery learning model assisted by GeoGebra, and $X_2Y_2$ : attitude toward mathematics with a conventional learning model. Based on the table 1, the average of mathematical problem solving ability and attitude toward of the experiment class math is higher than the average of problem solving ability and attitude toward of the control class. Then, the hypothesis was analyzed using one way MANOVA has results as shown in the following table:

Table 2. MANOVA summary and test of between subjects effects.

| Statistic        | Test of Between Subjects Effects | $F$  | Sig |
|------------------|---------------------------------|------|-----|
| Pillai’s Trace   |                                 | 3.543| 0.000|
| Wilk’s Lambda    |                                 | 3.543| 0.000|
| Hottelings’ Trace|                                 | 3.543| 0.000|
| Roy’s Largest Root|                               |      | 0.000|
| X                | Mathematical problem solving ability | 354.67 | 0.000 |
|                  | Attitude Toward Mathematics     | 563.66 | 0.000 |

Based on table 2, the results of multivariate test as presented in table obtained analysis result showing that F for Pillae Trace, Wilk Lambda, Hotelling Trace, Roy's Largest Root. X having significant less than 0.05. This means that the price of F for Pillae Trace, Wilk Lambda, Hotelling Trace, Roy's Largest Root were all significant. Furthermore, the test of between subjects effects indicates that the relationship between learning model (X) and mathematical problem solving ability (Y1) gives the price of F at 354,667 with significant 0.000. This shown that there were differences in students' mathematics problem solving ability caused by the applied learning model. On the other hand, the relationship between the learning model (X) and the attitude toward mathematics (Y2) gives the F price of 563,664 and the significance of 0.000. It also shows that there were differences in attitude toward mathematics caused by differences in learning models. This result is used as a benchmark in making decisions, namely accepted and rejected. This suggested that there were differences simultaneously of students’ problem solving ability and attitude toward mathematics between were taught through discovery learning model assisted with GeoGebra and conventional learning model.

4.2. Discussion

This research was conducted for the nint meeting which was meeting for the treatment and one meeting was for post-test. Students were given problems related to the material learned at each meeting. The problem is served using GeoGebra and students solve the problem based on the instructions on lesson plan. Students are distributed in several groups and from the beginning to the
end of the event there are intergroup discussions, teachers only as facilitators and motivators. In this case, discovery learning model assisted with GeoGebra media successfully created student-centered learning. Discovery learning model assisted with GeoGebra media was able to focus students’ attention on learning and other positive attitude.

From MANOVA statistic test results made on the research hypothesis shows that $H_0$ is rejected, which means that students’ mathematical problem solving ability and attitude toward mathematics by discovery learning model assisted with media GeoGebra is better than the students' mathematical problem solving ability and attitude toward mathematics with conventional learning. Differences in mathematical problem solving ability between students who follow discovery learning model assisted with media GeoGebra with students who follow conventional learning are caused by differences in learning processes that occur. Discovery learning model assisted with media GeoGebra that begins by showing problems using GeoGebra, then teacher asks or gives the students an opportunity to observe the problem. The goal is for students to participate actively during the learning process so that students are able to identify and determine a good resolution strategy related to the problem. The classroom environment affects students' attitude in learning math. Furthermore, students take the initiative to discuss in groups in solving the problems given [10]. Displaying problems through the GeoGebra media can focus students’ attention on the problems that are displayed and affect the mastery of the material better because the media really help students in interpreting the problems given, as well as the media functions required in the learning process, namely a) able to facilitate students in learning and help facilitate teaching for teachers, b) provide more real experiences; c) focus students’ attention (lessons are not boring); d). All students’ senses activated, e) more interest and attention of students in learning [11]. Next, students discuss the problems posed with the members of each group. GeoGebra assist discovery learning model provides students with full opportunity to solve problems in their own way so as to enhance students’ cognitive skills and processes. Meanwhile, conventional learning is more dominated by teachers. The difference in learning process has an impact on students ‘mathematical problem solving ability and attitude toward mathematics that follow the learning of GeoGebra-assisted discovery better than the students' mathematical problem-solving ability that follow conventional learning.

5. Conclusion
Based on the results of research and discussion, it can be concluded that problem solving ability and attitude toward the mathematics of students who was taught by discovery learning model assisted with GeoGebra media were better than problem solving ability and attitude toward the mathematics of students who was taught by conventional learning. GeoGebra Assist discovery learning model should serve as a learning method used in the class besides other learning methods and to other researchers should conduct research with GeoGebra Assist discovery learning model with a wider population and subject matter to look deeper the influence of the application of this method.

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References
[1] Nahil M A and Eman Geith 2016 Jorand pre-service class teacher’ ability in solving mathematical problem and skills in solving daily problems Canadian Center of Science and Education 6 3 32-47
[2] Adeneye O A A 2014 Nigeria examining personalisation of instrumet., attitudes toward and achievement in mathematics word problems among nigerian senior secondary school students International Jurnal Of Research In Education And Science And Technology 2 4
[3] Ozgen 2016 Turkey the effect of scratch and lego mindstorms ev3-based programming activities on academic achievement, problem solving skills and logical mathematical thinking skills of students Malaysian online journal of educational sciences 4 3 73-88

[4] Clement O I Joshua A A and Joseph W A 2017 Nigeria impact of cloud services on students’ attitude towards mathematics education in public Universities in Benue State, Nigeria. International Journal of Research in Education and Science 3 1 228-244

[5] Akhsanul I and Siti H 2017 Indonesia learning geometry through discovery learning using a scientific approach. International Journal of Instruction 10 1

[6] Soancalt V et.al 2010 leading students to solve math’s using question-led learning Proceedings of the 4th European Conference on Games-Based Learnig.

[7] Mwei P K 2017 Problem Solving: How do in-service secondary school teachers of mathematics make sense of a non-routine problem context International Journal of Research in Education and Science 3 1 31-41.

[8] Kahif G 2012 the difficulties faced by third year pre-service teacher in solving mathematical problems from their point of view Al-Fathih journal 8

[9] Idris N (2006) Malaysia teaching and learning of mathematics, making sense and developing cognitives ability Malaysia online Jurnal of Eductional Teknology

[10] Hutkemri Z and Sharifah N A S Z 2017 terms and conditions of creative commons attribution 4.0 international (cc by 4.0) apply 13 6

[11] Joice N L Hasan O and Maria H S 2013 the influence of classroom environment on students’ attitudes for math lesson Humanitas X 1 37-48 EURASIA Journal of Mathematics Science and Technology Education