

TRAINING OF TEACHERS AT FAREL EDUCATION CENTRE AND PRIMA QUANTUM TUTORING IN USING GEOGEBRA

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ABSTRACT

Low results from studying mathematics at the Farel Education Center and the Prima Quantum tutoring can indicate a poor understanding of mathematical concepts among students. This community service activity aims to provide additional insights to teachers as participants in media and mathematics learning aids using the GeoGebra application. Teachers' ability to understand mathematical concepts can be improved to help students understand mathematics more effectively. Participants in this community service activity were the Farel Education Center for Teachers and the Prima Quantum tutoring in Jakarta. There are three phases of action: the preparation, implementation, and evaluation to implement this Community service activity. Observation, documentation, and demonstration are the method of execution of this community service activity. The result of this community service activity was that teachers at Farel Education Center and Prima Quantum tutoring who initially did not know the GeoGebra application and its benefits can now take advantage of GeoGebra in their learning. It can increase motivation, interest in education, student creativity, and understanding of mathematics.

Keywords: understanding; concept; mathematics; GeoGebra



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A. INTRODUCTION

Mathematics is an indispensable subject of the school curriculum and is vital in daily living and the study of other issues (Gafoor & Kurukkan, 2015). The interviews conducted at the Farel Education Center tutoring and the Prima Quantum tutoring in Jakarta provided several students data. Many students thought that mathematics was challenging to transform story issues into mathematical forms. Some students have difficulty applying basic concepts to problem-solving, and some students are the only ones who have difficulty using basic concepts to problem-solving.

Students find it challenging to present a concept in various forms of presentation and apply mathematical concepts coherently. It seems that when students answer the description questions. Students find it challenging to use, utilize, or choose a particular method of work to solve a situation in which many students only memorize the teacher's sample questions, resulting in students having difficulty doing the problems correctly for different queries. For example, students find it challenging to understand the story problem, so students tend to miswrite the mathematical sentence form. There are errors by going through several steps in working to experience difficulties that make them finally stop working on the problem.

Some of the obtained fields include students understanding mathematical concepts, defective geometry material, students having difficulty determining flat shapes and their characteristics, and finding it challenging to find the perimeter and area of these flat shapes. Students have a problem when the geometric material is applied daily (Masitoh & Prabawanto, 2016).

Students can understand mathematical concepts from several media; one of the media used is computers. Computers as a tool that is very strong and useful in learning, especially in learning mathematics (Rahadyan & Halimatussa'diah, 2019). The critical value in the mathematics education curriculum is when the software can connect geometry and algebra concepts. GeoGebra has features a Computer Algebra System (CAS) and Dynamic Geometry Software (DGS). GeoGebra can integrate dynamic geometry and computer algebra in one program for teaching mathematics (Rahadyan & Halimatussa'diah, 2019).

GeoGebra is a dynamic software with various features that can be used in mathematics learning to explore, visualize, and construct mathematical concepts to be a tool to improve the quality of learning. The application of dynamic GeoGebra software in mathematics learning can make learning more exploratory (Awaludin et al., 2019; Rahadyan et al., 2018; Rahadyan & Halimatussa'diah, 2019). In recent years, several studies have examined the dynamic mathematics software GeoGebra (Reis, 2010; Tatar, 2012; Zengin et al., 2012).

Based on previous research or dedication results, GeoGebra can create students who are more active and participate in learning so that learning becomes meaningful (Ekawati, 2016; Widyastuti & Nurhamida, 2017). GeoGebra can also support learning mathematics to become more effective (Novianggraeni & Siswono, 2017). GeoGebra can provide a quick and easy way to build a one-off application for a situation solving specific mathematical problems (Fisher, 2017). GeoGebra also allows students to increase their creativity because they can solve their own solutions problems as desired (Ekawati, 2016). GeoGebra can also serve as mathematics learning media that can demonstrate or visualize various mathematical concepts and as a tool to construct multiple concepts mathematics (Mahmudi, 2011). GeoGebra can also improve representation skills for student mathematics (Oktaria et al., 2016).

But in reality, at this time, many mathematics teachers both in traditional schools and especially mathematics teachers at the Farel Education Center and Prima Quantum tutoring have not understood the benefits and ways of using GeoGebra. The learning methods and learning media are less varied; it affects many students who do not understand mathematical concepts.

Based on the background of the problems above, the solution offered is to develop teachers' abilities in Farel Education Center tutoring and Prima Quantum tutoring in improving understanding of mathematical concepts through GeoGebra.

B. METHOD

In the implementation stage, this activity was carried out in socialization and was attended by 14 teachers from the Farel Education Center and Prima Quantum Tutoring.

1. **First Session.** The tutoring leaders and teacher representatives from Farel Education Center and Prima Quantum tutoring attended the outreach activity. The training began with the Farel Education Center opening as a place for implementing community service activities. Furthermore, it was followed by presenting the first material delivered by Mira Gusniwati, S.S., M.Pd. The material presented is GeoGebra's definition, its benefits, and how to use it in mathematics.
2. **Second Session.** In the second session, the speaker, Nia Gardenia, M.Pd., gave training on using the GeoGebra application in mathematics subjects.
3. **Third Session.** In this session, a question-and-answer session was held. The interaction between the speaker and the participants felt more spontaneous so that intimacy was established here.
4. **Fourth Session.** The fourth session is the last session closed with a prayer together and our gratitude for the activities.

In carrying out the activity, the team carried out several methods, including:

1. Observation

The team made observations to get information about the learning process at Farel Education Center tutoring and Prima Quantum tutoring. The team obtained data in learning situations in Farel Education Center tutoring and Prima Quantum tutoring. The group discussed to discuss solutions to problems that occurred in the mathematics learning process. This discussion took place between the team and activity partners, namely the Farel Education Center tutoring leader and Prima Quantum tutoring. From this discussion, the problem is that teachers have not been able to use the GeoGebra application as a learning medium, especially space building materials that can combine mathematical issues in building space. Solutions are needed to improve the quality of learning, especially in mathematics learning. Therefore, the team decided to develop the teacher's ability to understand mathematical concepts through GeoGebra better.

2. Documentation

The team carried out the documentation to obtain biological data related to the activity partners' mathematics learning process.

3. Demonstration

The team demonstrated the use of GeoGebra to mathematics teachers to implement in mathematics learning to develop teachers' abilities to improve understanding of mathematical concepts through GeoGebra. The group provides Linear Algebra material to activity participants.

C. RESULTS AND DISCUSSIONS

Community service program entitled GeoGebra to improve understanding of Mathematical concepts. In the preparation stage, the team leader and the leaders of the Farel Education Center and Prima Quantum Tutoring held a meeting to control this activity so that it can run properly. Next, the organizing team made preparations by socializing the GeoGebra application and its benefits in mathematics.

In the implementation stage, this activity was carried out in socialization and was attended by 14 teachers from the Farel Education Center and Prima Quantum Tutoring.

1. **First Session**

The socialization activities started at 08.00 to 09.00, which was attended by the leaders of the Tutoring and teachers from the Farel Education Center and Prima Quantum Tutoring. The training began with an opening from the Farel Education Center Guidance leader to implement community service activities. Furthermore, it was continued by presenting the first material delivered by Mira Gusniwati, S.Si., M.Pd. The material presented was GeoGebra's definition, its benefits, and how to use it in mathematics.

During the delivery of this material, the teachers paid great attention to it. The following was the material presented in the first session

GeoGebra is a dynamic software that supports constructions with points, lines, and shapes in various mathematics shapes. GeoGebra provides various features typical for computer algebra systems, such as determining the critical issues of a function (extremes and inflection points of functions), direct input of equations and coordinates, determining derivatives, and integrals of given functions. It is why GeoGebra is the right choice for rendering multiple objects in math.

Several advantages of using GeoGebra (Rahadyan & Halimatussa'diah, 2019), including the following:

- a. Compared to graphing calculators, GeoGebra is more user-friendly, offers easy-to-use, multilingual commands and assistance.
- b. GeoGebra supports student assignments on mathematics learning, such as presentations and experimental learning or guided discovery.
- c. Students can make their creations through interface adaptations (such as font size, language, graphic quality, color, coordinates, line thickness, line style, or other features).
- d. GeoGebra was created to help students gain a better understanding of mathematics. Students can easily manipulate variables by dragging "free" objects in the image area or using sliders. Students can produce change by using free object manipulation techniques, and they can learn how the item in question is influential. In this way, students have the opportunity to solve problems by investigating mathematical relationships dynamically.
- e. Cooperative learning is the right context for mathematics.
- f. Algebraic input allows the user to generate new objects or modify existing ones.
- g. GeoGebra stimulates teachers to use and assess technology in: mathematical visualization, mathematical investigations, interactive math classes from on-site or remotely, mathematics and its applications, and more.

In this first session, the teachers understood the material presented well. Some were active in the discussion so that the teacher's understanding of GeoGebra had increased. It is evidenced by asking questions after the material's presentation randomly appointed teachers to answer correctly. The following is a picture of this activity



Figure 1. GeoGebra Training Materials

2. Second Session

In the second session, this activity was held from 09.00 to 11.30 with the speaker Nia Gardenia, M.Pd., namely training on the use of the GeoGebra application in mathematics subjects. In interactive teaching and learning on linear algebra, one example is understanding the solution to systems of linear equations. This illustration helps students personalize important concepts about linear equations with the discovery method. Previously, the teacher had to define the terms "consistent, inconsistent, homogeneous," "one solution, infinite solution, no solution," "system of linear equations, a system of nonlinear equations." Such terms should have been given and explained to students before exploring the knowledge of linear equations via GeoGebra.

Example: Given a linear equation

$$ax + by = c \quad (1)$$

With different. The graph of this equation is a 2-dimensional line in the coordinate system. From this system of equations, we can determine different real numbers, so we get two other unknown linear equations, namely:

$$a_1 x + b_1 y = c_1 \quad (2)$$

$$a_2 x + b_2 y = c_2 \quad (3)$$

These charts can easily be created using the GeoGebra application. In this case, students can investigate all possible solutions of the two linear equations. Do the two equations have exactly one solution, no solution, or no solution. Here's an example of a graph of a linear equation and possible solutions using GeoGebra.

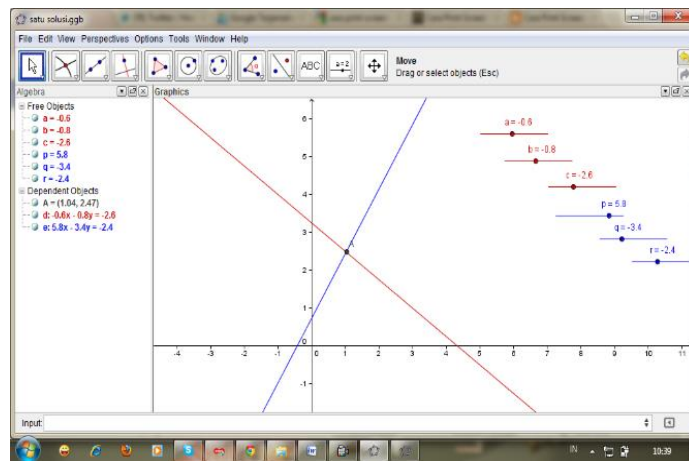


Figure 2. Graph of One Solution Linear Equations

Figure 2. shows that of the two linear equations, we can investigate the solution, which is to have exactly one solution at point A. from the model, we can compare the coefficients a, b, c, and p, q, r for each line. It is found that each of these coefficients has a different ratio when the two equations have exactly one solution.

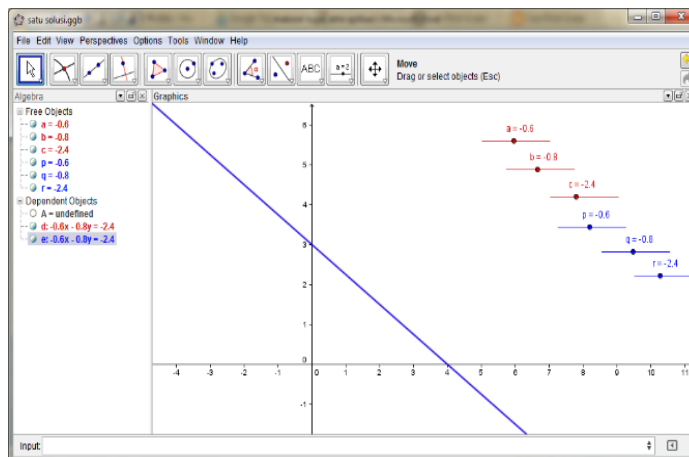


Figure 3. Graph of Infinite Linear Equations Solution

Figure 3. shows that of the two linear equations, we can investigate that when the solution is many (infinite solutions), the comparison of all the variables (variable x, variable y, and constant) is the same. The graph shows a coinciding line.

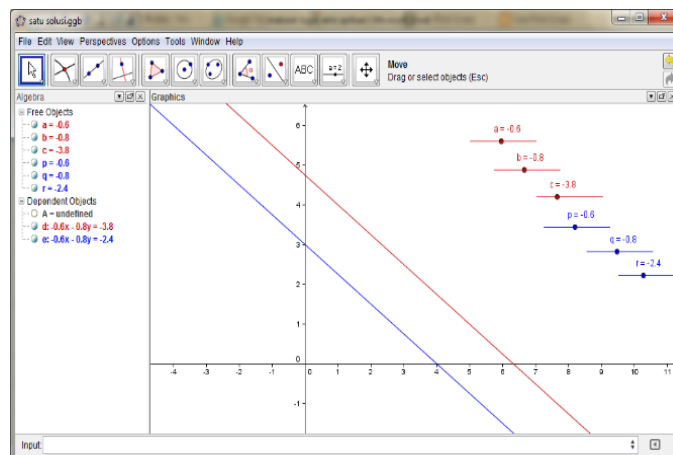


Figure 4. Graph of Linear Equations with No Solution

Figure 4. shows that of the two linear equations, we can investigate that in no solution is when there is an equal ratio between the x and y coefficients of the two lines. In this case $a/b = p/q$. If investigated further, the two lines' c and r coefficients will not affect the resulting solution.

Teachers try to follow suit in solving algebra with GeoGebra. The obstacle experienced by the teacher is that they are not familiar with the use of this application so that they are still confused about inputting the required data. Yet, after being briefed by the team, each teacher can overcome the difficulty so that the teachers already understand GeoGebra's application in solving equations linear one solution.

3. Third Session

In this session, a question-and-answer session was held. The interaction between the speaker and the participants felt more spontaneous so that intimacy was established here. The teachers asked whether it could be applied to other topics and applied in solving a linear equations system. It indicates that the teachers who take part in this activity want to go deeper. Apart from investigating the types of solutions of two linear equations, GeoGebra can provide opportunities for both students and teachers to learn individually. It produces their illustrative examples, brings the topics studied to be deeper, can choose their problems, and is an appropriate tool to solve the problem. Students can concentrate on the topic's ideas understudy and stimulate students' geometric intuition through engaging 2D visualization through GeoGebra.

4. Closing Session

The last session closed with a prayer together and is our gratitude for the activities carried out.

D. CONCLUSSIONS AND SUGGESTIONS

From the results of socialization and training for teachers at Farel Education Center and Prima Quantum tutoring, it was concluded that most of the teachers at Farel Education Center and Prima Quantum tutoring finally know the GeoGebra application. They know its benefits and how to use it. It is intended for teachers to be additional insight and reference in developing their knowledge. Besides, the team hopes that the teacher can convey the knowledge obtained so that it is expected to help students increase their understanding of mathematical concepts. The notion that mathematics is a challenging and boring subject can be eliminated.

GeoGebra is very useful in increasing students' understanding and knowledge in understanding mathematical concepts. The GeoGebra application is beneficial, especially in improving students' mathematical experience and expertise. However, not all materials can be studied with the GeoGebra software application, especially in manual calculations. In this

case, GeoGebra only helps provide a more concrete understanding of abstract material to be understood. However, personally, for students and teachers, GeoGebra can increase motivation and interest in learning. Teaching with the help of technology applications like this is very good for growing students' creativity and understanding of mathematics.

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