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Implementation of Geogebra Application to Improve Students' Mathematical Concept Understanding Ability

Rigus Ajiantoro[1*], Nurimani[2], Salman Al Farisi[2]
[1] AlMarjan Islamic High School, Bekasi, Indonesia
[2] Mathematics Education, STKIP Kusuma Negara, Jakarta, Indonesia
*rigusajiantoro@stkipkusumanegara.ac.id

Abstract

This study aims to evaluate the effectiveness of using the Geogebra application in improving the understanding of mathematical concepts. The research method used is Classroom Action Research (CAR) which is carried out in two cycles, involving 25 students. Which refers to the Taggart model, where each cycle consists of four stages, namely planning, implementation, observation and reflection. The results showed that the use of Geogebra significantly improved students' understanding of mathematical concepts, as indicated by an increase in the average score from 79 in the first cycle to 87.6 in the second cycle. In addition, the percentage of students who achieved the minimum completion criteria (KKM) increased from 76% to 88%. This study can conclude that the use of the Geogebra application can improve student learning outcomes in mathematics learning. seen in the learning process in each cycle, as well as satisfactory learning outcomes.

Keywords: Geogebra, understanding of mathematical concepts, three-Variable Linear Equation System

1 INTRODUCTION

Mathematics is often considered as one of the subjects that is less liked or even hated by most students, pupils, and even university students. This subject is often a scary specter for many students, both in the learning process and for their teachers. In the material of the three-variable linear equation system, which includes equations of lines, planes, and points in three-dimensional space, it often causes difficulties because of its abstract and complex nature. Students may face challenges in visualizing the complex geometric relationships between objects in the three-variable linear equation system (TSE). In situations like this, the Geogebra application becomes a very useful tool because it allows students to produce interactive visual representations of these concepts. By using Geogebra, students can easily manipulate the parameters in the TSE equation and see directly how these changes affect the position and properties of objects in three-dimensional space. Thus, the use of Geogebra not only helps students understand the concept of TSE with more good , but also improve skills they in solve problems and visualize concepts complex mathematics .

In traditional mathematics teaching methods, students often struggle with the abstract nature of three-dimensional space and how different variables interact with each other in it. SPLTV, which involves three linear equations with three variables, is a basic concept in algebra and is essential for students to understand as it lays the foundation for more advanced mathematics topics. However, the lack of visual aids in traditional teaching methods makes it difficult for students to understand and solve problems effectively. GeoGebra offers a solution by providing a visual and interactive platform where students can manipulate variables and observe their effects in real-time.

In mathematics, conceptual understanding is a very important basic skill. Good conceptual mastery can help students master other mathematical concepts. In the learning process, the emphasis is more on students' conceptual understanding, so that students understand the material being taught and have good basic provisions to achieve other basic skills such as communication, connection, reasoning and problem solving (Elita et al., 2019). Conceptual understanding also makes it easier for students to solve the problems they face, because by having a good conceptual understanding, students are able to solve these problems using the abilities gained from the conceptual understanding process (Sari et al., 2018). Conceptual understanding is the most basic skill in mathematics. An important foundation that students must have in their efforts to think about solving mathematical problems or problems in everyday life is the ability to understand concepts (Kesumawati in Ningsih, 2016). In other words, understanding mathematical concepts will affect the quality of student learning and ultimately affect students' overall mathematics learning achievement. With conceptual understanding, students are expected to better understand each concept they learn, the relationship between concepts, and use concepts to solve simple problems (Putra et al., 2018). A student will not be able to solve a problem according to the procedure if he does not have a good conceptual understanding (Ariyanto et al., 2018).

Teachers as the main factor in whether or not students understand a material must be able to explain not only by using the lecture method but other methods are needed so that students are actively involved in it. One of them is the use of interactive teaching materials (Supriani & Oktaviyanthi, 2014). The use of interactive teaching materials, especially in integrating mathematics software, can make it easier for students to understand concepts (Oktaviyanthi & Herman, 2016). By integrating technology into the teaching and learning process of mathematics, it is expected to improve students' abilities in understanding complex ideas and being able to construct solutions to mathematical problems (Oktaviyanthi & Supriani, 2015). In addition, technology-assisted mathematics learning can help students to be more involved in connecting the world of school with the real world (Oktaviyanthi, Safaah & Agus, 2017). One technology in mathematics learning that can be utilized is the Geogebra program.

Geogebra is a dynamic geometry system software so that it can construct points, vectors, line segments, lines, conic sections, even functions and change them dynamically. In addition, with Geogebra we can draw and determine equations and coordinates directly. Geogebra also has the ability to connect variables with numbers, vectors and points, find derivatives and integrate functions and provide commands to find extreme points or roots Purwanti, R. D., Pratiwi, D. D., & Rinaldi, A. (2016). Use Geogebra as learning aids mathematics No only help student in understand complex concepts , but also enhance skills they in solve problems and visualize concepts mathematics in a way interactive . With Thus , research This aiming For explore potential and strategy use application Geogebra in increase effectiveness SPLTV learning

2 RESEARCH METHODS

This study uses the Classroom Action Research (CAR) method which is implemented in two cycles. Each cycle involves the stages of planning, action, observation, and reflection . Data were collected through written tests and observations of student activities during the learning process.

Table 1. CAR Cycle Design

Cycle	Main Activities	Number of Meetings	Time Allocation
I	Planning, Implementation, Observation, Reflection	3	9 x 45’
II	Planning, Implementation, Observation, Reflection	2	6 x 45’

3 RESULTS AND DISCUSSION

Maximum learning outcomes can be achieved through an active process where students use all their basic abilities as a basis for carrying out various learning activities, and researchers provide motivation for students to carry out learning activities actively, researchers also direct all learning activities towards a specific goal.

Research conducted even semester of the 2023-2024 academic year using the Geogebra application and its implementation through two cycles showed an increase in students' mathematics learning outcomes. For more details, see the observation and evaluation table in cycles I and II below:

3.1 Observation of Students

The results of the researcher's observations of students during learning in cycles I and II can be summarized as follows:

Table 2. Recapitulation of observation results on student activities

Average Score	
Cycle I	Cycle II
16.32	18.16

Based on the Table 2. above about the results of observations on students, it is known that the average score obtained in cycle I was 16.32, and in cycle II it increased to 18.16. This means that by using the Geogebra application, student activity increased from cycle I to cycle II. With the increase in student activity, it will have a positive impact on student learning outcomes.

3.2 Observation of Researchers

The results of the observations that collaborators made on researchers in cycles I and II can be summarized in a final summary as follows:

Table 3. Recapitulation of observation results in cycles I and II

Average Score	
Cycle I	Cycle II
3.1	4.0

Based on the Table 3. above about the results of observations on researchers, it is known that the average score obtained in cycle I was 3.1, and in cycle II it increased to 4.0. This means that researchers have made improvements in learning activities from cycles I and II, especially the implementation of the use of the Geogebra application. With the increase in researcher activity in learning, it will have an impact on improving student learning outcomes.

3.3 Evaluation Test Results

Geogebra application can improve student learning outcomes, this can be seen from the activeness of students in the learning process. It can be seen from the results of observations of students, the average score in Cycle I = 16.32, and Cycle II = 18.16. This increase is because the teacher has made improvements to learning according to the reflection of each cycle starting from cycle I to cycle II with an average score in Cycle I = 3.1, and Cycle II = 4.0. Students' mathematics learning outcomes have increased. This can be shown by the results of the evaluation of each cycle, namely the average student

score in Cycle I = 79 and Cycle II = 88.4. The level of student completion has also increased, namely in Cycle I = 76% (19 students), and Cycle II = 92% (23 students)

Geogebra application according to the students' level of thinking who think critically. By using the *Geogebra application,* students learn SPLTV which is abstract in a critical step by step manner, this step by step process is very helpful for students in learning PLTV which is supported by teacher guidance and the learning process becomes active and more enjoyable .

4 CONCLUSION

Based on the results of the study, it can be concluded that the use of the GeoGebra application is effective in improving students' understanding of mathematical concepts in SPLTV material. Significant improvements were seen in student activity, researcher activity, average scores, and student completion levels after the application of GeoGebra.

Support teachers who want to conduct classroom action research to improve student learning outcomes. Provide rewards to teachers who excel and are committed to improving the quality of learning. Using the GeoGebra application as an alternative in mathematics learning to improve student learning outcomes. Looking for new innovations in teaching methods to make learning more interesting and effective. Conducting continuous learning and providing motivation and remedial for students who have not reached the KKM.

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