

THE EFFECT OF GEOGEBRA-ASSISTED DIRECT INSTRUCTION ON STUDENTS' SELF-EFFICACY AND SELF-REGULATION

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ABSTRACT

This study aims to find out the effect of Geogebra Assisted Direct Instruction on students' self-efficacy and self-regulation. This is a mixed method research with a sequential explanatory strategy, while the research design is a pretest and posttest nonequivalent group design. The experimental group applied Geogebra Assisted Direct Instruction while the control group used conventional learning. The population in this study is the third semester students who have studied Field and Space Analytic Geometry. The research sample was selected using cluster random sampling technique. The research instruments were self-efficacy and self-regulation questionnaires for quantitative data and interview sheets for qualitative data. Data analysis was performed quantitatively using inferential statistical analysis and qualitatively analyzing the results of interview with students. The results showed that there was a significant effect of geogebra-assisted direct instruction on the achievement of students' self-efficacy and self-regulation. From the interviews it was found that the application of Geogebra-assisted Direct Instruction can facilitate the achievement of students' self-efficacy and self-regulation.

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1. INTRODUCTION

The rapid advancement of technology has brought many changes in various fields, especially in education. Therefore, it becomes very important for educators and students to learn and be able to use technology in learning. The use of technology in learning has a positive effect on improving students' conceptual and procedural abilities (Zulnaidi & Zakaria, 2012). With the application of educational technology, students can master learning material independently, choose the accuracy of work, review lessons, and know their progress.

Technology has an important part in the development of education. It is also a part of supporting lecturing activities. A technology tool that helps teachers/lecturers and

students in learning especially demonstration and visualization mathematical concept is Geogebra software. Geogebra is one of software to visualize and demonstrate mathematical concepts, especially geometry and algebra. Geogebra is recommended to be included in the school curriculum because it has potential in mathematics education (Hohenwarter & Jones, 2007). For this function, students can use algebraic and geometrical functions simultaneously with interactive dynamics that will enhance their cognitive abilities. Besides visualization, Geogebra also serves to facilitate students / students to better understand abstract concepts (Dikovic, 2009). The use of geogebra by asking probing questions has a positive effect on the exploration phase (Hähkiöniemi, 2017; Zengin, 2017).

In order to make Geogebra have an impact on student's learning outcome, it takes a sense of self-efficacy and self-regulation. Self-efficacy and self-regulation or self-regulated learning are related to students' ability to believe in their own abilities and there is no inferiority in dealing with mathematical problems. Self-efficacy is an important and main concept to improve understanding and learning outcomes, so that students are able to develop their self-confidence and will correlate with improving learning outcomes (Hatlevik, Throndsen, Loi, & Gudmundsdottir, 2018). Self-efficacy can be defined as a perception of a person's ability to organize and implement actions to carry out certain skills (Zimmerman, 1989).

Furthermore, regarding self-regulated learning, Zimmerman (1989; 1990) defines that self-regulation is an idea that is proactively initiated, and cyclic planned and adapted behavior as feedback from performance in achieving certain goals. The same thing was conveyed by Arslan (2014), that self-regulation is a traditional concept related to monitoring and controlling individual performance (Iiskala, Vauras, Lehtinen, & Salonen, 2011; Isohätälä, Järvenoja, Järvelä, 2017).

Based on the opinions above, Nofriyandi (Zetriuslita, Nofriyandi, & Istikomah, 2019) compiled self-regulation indicators as follows: (1) learning initiatives, (2) diagnosing learning needs, (3) setting learning goals, (4) organizing and controlling performance / learning, (5) organizing and controlling Cognition, Motivation, and Behavior (Self), (6) looking at difficulties as challenges, (7) finding and utilizing relevant sources, (8) choosing and implementing appropriate learning strategies, and (9)) evaluate the learning process and results.

Because of the importance of developing students' self-efficacy and self-regulation, it is designed to develop the two attitudes above. With the application of Geogebra-assisted Direct Instruction, it is expected that self-efficacy and self-regulation can develop and ultimately improve both attitudes and have an impact on student learning outcomes in mathematics. The objectives in this study are to find out and describe : 1) the achievement of students' self-efficacy through Geogebra-assisted Direct Instruction, 2) the achievement of students' self-regulation through Geogebra-assisted Direct Instruction, 3) the response of mathematics students towards Geogebra-assisted Direct Instruction to the achievement of students' self-efficacy and self-regulation.

To find out the answer to the research objectives, the following hypothesis is: (1) The achievement of students' self-efficacy through Geogebra-assisted Direct Instruction better than conventional learning; (2) The achievement of students' self-regulation through Geogebra-assisted Direct Instruction better than conventional learning.

2. METHOD

The research method is a mixed method with sequential explanatory strategy. This method is used because the data is taken from quantitative data and qualitative data,

quantitative data is taken, qualitative data is taken. Filling in data to complete the results of quantitative data. The research design in this study is a quasi-experimental type with a non-equivalent control group design / with pretest and posttest non-equivalent group design (Cohen, Manion, & Morrison, 2002; Creswell, 2014).

The population in this study was mathematics education students who took the Analytical Geometry course, because research is conducted on these subject. The sample was selected using cluster random sampling technique. This way was chosen because the students who take this course consists of 3 classes, so after taking the sample, which was selected as the experimental class is class 3A and class control is class 3B. Jumlah sampel and each class totaling 42 people. Data collection used self-efficacy and self-regulation questionnaire sheets for Geogebra-assisted Direct Instruction in the experimental class and conventional learning in the control class. Data obtained from filling out the student self-efficacy and self-regulation questionnaires were analyzed statistically, both descriptive statistics and inferential statistics. Meanwhile, the results of student’s interview were analyzed in a descriptive narrative to complement the results of quantitative analysis. The results of the self-efficacy and self-regulation questionnaire were ordinal data and transformed into interval data using the Method of Successive Interval (MSI). Furthermore, the normality and homogeneity of the experimental class and the control class were tested and the two similarities were tested using the parametric statistical test, namely the Independent Samples t-test. If it did not meet normalcy, then the data is processed using a nonparametric test known as the Mann-Whitney U test.

3. RESULTS AND DISCUSSION

3.1. Results

Students’ Self-Regulation

Table 1. Description of students’ self regulation in experimental and control classes

Class	Mean	Deviation Standard	Minimum	Maximum	Variance
Experimental	117.74	8.36	103.00	137.00	69.81
Control	102.48	10.03	82.00	129.00	100.90

Table 1 show the students’ achievement of self-regulation in experimental class is better than that of students in control class; this can be seen from the mean difference of 15.26. To ensure that it is better to be significant, a statistical test is carried out, namely the difference test of the results of students' self-regulated achievement with the first step of the normality and homogeneity test, if the data is normally distributed and homogeneous, then a statistical t test is performed.

The criteria for testing students' self-regulated normality, H_0 is accepted if the probability value (sig.) is **greater** than α and H_0 is rejected if the probability value is **smaller than** α ($\alpha=0.05$). From the normality test results obtained Sig = 0.257 for the control class and Sig = 0.265 for the experimental class, because the two Sig is greater than $\alpha = 0.05$ means that both classes are normally distributed.

The results show the data is normally distributed, then we using the test of homogeneity of the variance of the posttest data using the Levene test. Homogeneity testing criteria, H_0 is accepted if the probability value (sig.) is greater than α and H_0 is rejected if the probability value (sig.) is smaller than α ($\alpha = 0.05$). From the Levene test

obtained $\text{Sig} = 0.485 > \alpha$, meaning that the data on the achievement of self-regulated homogeneous students varied.

Furthermore, t-test for the students' self-regulation achievement is used to test the hypothesis, namely:

H_0 : The achievement of self-regulation in experimental class is the same as the achievement of self-regulation in control class.

H_1 : The achievement of self-regulation in experimental class is better than the achievement of self-regulation in control class.

Criteria for testing differences in the results of students' self-regulation achievement, H_0 is accepted if the probability value (sig.) is greater than $\alpha = 0.05$ and H_0 is rejected if the probability value is smaller than $\alpha = 0.05$.

Table 2. T-test data of students' self-regulation achievement in experimental and control classes

Class	Mean	Deviation Standard	Sig	Description
Experimental	117.74	8.36	0.00	Rejected H_0
Control	102.48	10.03		

Table 2 show the probability value (Sig.) is less than significance degree $\alpha = 0.05$. thus H_0 is rejected. Thus it can be concluded that students' of *self-regulation* are better in experimental class than control class.

Students' Self Efficacy

Table 3. Descriptions of the Self efficacy of the experimental class and control class

Class	Mean	Deviation Standard	Minimum	Maximum	Variance
Experimental	50.33	6.40	42	64	40.92
Control	45.90	5.65	32	59	31.89

Based on Table 3 suggests that the result of Self efficacy of experimental class students is better than control class students, the difference is 4.43. To ensure this conclusion, a statistical test is carried out, namely a test of the difference in the result of students' self-efficacy with the first step of the normality and homogeneity test. If the data is normally distributed and homogeneous, then a statistical t test is performed. *Liliefors* normality test results obtained control class data $\text{Sig.} = 0.805 (> 0.05)$, not normally distributed. However, for the experimental class $\text{Sig.} = 0.016 (< 0.05)$, the distribution is normal.

Because parametric statistical testing was not met, the test continued with the difference test, using non-parametric statistics namely the Mann-Whitney U Test. The testing hypotheses were:

H_0 : There is no a difference in the mean data (post-test) of the experimental class and the control class on students' self-efficacy.

H_1 : There is difference in the mean data (post-test) of the experimental class and the control class on students' self-efficacy.

The criteria for testing differences in students' self-efficacy results, H_0 is accepted if the probability value (sig.) is greater than α , and H_0 is rejected if the probability value is smaller than α ($\alpha = 0.05$).

Table 4. T-test data post-test self-efficacy of the experimental class and control class students

Class	Mean Rank	Rank Total	Sig	Decision
Experimental	50.75	2131.50	0.002	Rejected H_0
Control	34.25	1438.50		

Based on [Table 4](#) describes that the decision of H_0 is rejected, which means that the result (Post-test) of the self-efficacy of experimental class students is better than that of control class students.

Result of Interview

The results of student interviews about the effectiveness of Direct Instruction on the achievement of Self-regulation and Self-efficacy can be seen from the interview excerpt:

- Lecturer* : *What do you think about Geogebra's assisted direct learning in improving your self-regulation and self-efficacy?*
- Student 1* : *In my opinion, Geogebra can develop self-regulation, because of what we already understand from the lecturer, it can be done again at home, discussions with friends and can also improve Self-efficacy, because by being told to come forward to try to work on the problems given with the help of Geogebra to be more confident, especially if what is presented is true, but even if it is not true, the lecturer does not immediately say wrong, so it does not make us despair.*
- Student 2* : *Geogebra's assisted Direct Instruction can have an effect on my Self-regulation, where the material explained by lecturers can be studied and tried again at home and also has an effect on Self-efficacy, with evidence that I already have the courage to come to the front of the class. Field and Space Analytical Geometry courses are very suitable to be studied with Geogebra, and there is also a feeling of confidence in problem solving, and trying to do it yourself.*
- Student 3* : *My self-regulation increased because I was challenged to try it on its own, and my self-confidence also improved, although there was still fear / inferiority if I answered the wrong questions given.*

From the interview with students, it can be concluded that the application of Geogebra-assisted Direct Instruction has an effect on students' self-regulation and self-efficacy.

3.2. Discussion

From the results of research and analysis of the data obtained, it can be explained that the application of Geogebra-assisted Direct Instruction has a positive effect on students' self-regulation and Self-efficacy. This means that self-regulated and self-efficacy of students who use Geogebra-assisted Direct Instruction in the experimental class is better than those who do not use Geogebra in the control class. This result is obtained from the function of Geogebra as a medium of visualization and demonstration of mathematical concepts, make students efficacy and trust the results obtained from the Geogebra display, and desires to try themselves so as to make self-confidence increase if no visualization of the concept is given. This is in accord with study result of Muslim & Haris (2017) that Geogebra-assisted learning in Geometry material is more effective than conventional learning in terms of self-efficacy. The same thing also obtained by the results of research that if students already have high self-efficacy, it will affect the learning outcomes of mathematics (Liu & Koirala, 2009). There is a relationship between self-efficacy and self-regulation. So the results of this study reinforce that if students have both, it will have an impact on learning outcomes (Los, 2014).

One of the advantages is that Geogebra demonstrates certain mathematical concepts (Hohenwarter & Fuchs, 2004). Besides, Geogebra helps students in the achievement of conceptual and procedural knowledge (Zulnaidi & Zakaria, 2012). Geogebra, with the visualization of the problem given, makes students challenged to find out more and the meaning of the visualization. This feeling of challenge will make curiosity and growing interest impact on learning outcomes. (Zetriuslita, Wahyudin, & Dahlan, 2018). The Geogebra application also provides an increase in student mathematical communication (Zetriuslita et.al., 2019).

The results of the analysis of interviews with students found that Geogebra helped them understand the concepts of ellipse, satellite dishes and hyperbole because they could be seen directly in the picture and the desired calculation results. One of the results of the Geogebra visualization for Ellipse material can be seen in the following Figure 1.

Geogebra visualization for describe Ellips Equation $16x^2 + 25y^2 = 400$

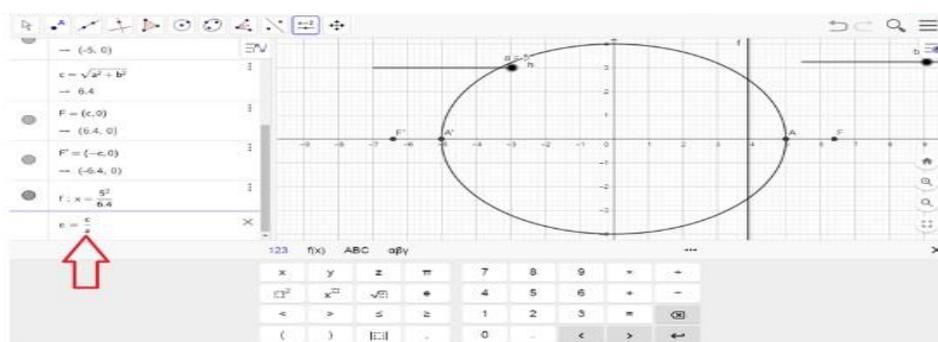


Figure 1. Geogebra display results for Ellipse material

Based on Figure 1, with the help of Geogebra, students can see directly the shape of the Ellipse and their eccentricity value. On the left there is a red arrow, it can be seen the results of the calculation of the algebra, so that students only have to analyze the results.

4. CONCLUSION

From data analysis and discussion, we could concluded that : 1) achievement of students' self-efficacy through Geogebra-assisted Direct Instruction better than conventional learning, 2) achievement of students' self-efficacy through Geogebra-assisted Direct Instruction better than conventional learning, 3) the response of mathematics students towards Geogebra-assisted Direct Instruction to the achievement of students' self-efficacy and self-regulation are very good and positive. Confidence and certainty in what is obtained will make students challenged and excited to solve the problems given by the lecturer. It is recommended that this learning be applied better and developed for other materials and other learning model, such as Model Problem Based Learning.

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