

**THE EFFECTS OF GEOGEBRA ON MATHEMATICS ABSTRACTION:  
ON ELEMENTARY SCHOOL STUDENTS OF SULTAN AGENG  
TIRTAYASA UNIVERSITY IN LEARNING GEOMETRY**

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**Abstract.** Many research indicated that Geogebra has been proven useful as a tool in supporting and transforming teaching and learning. In mathematics classroom, Geogebra can help students and teachers to perform calculation, analyse data, explore mathematical concepts thus increasing the understanding in mathematics. The Geometry learning at the University of Sultan Ageng Tirtayasa, Indonesia, for examining functions and drawing their graphs. In 2017 the authors decided to improve the mathematics abstraction introducing GeoGebra application. This study investigates the effectiveness of using GeoGebra software on Mathematics abstraction among 74 students in Indonesia. This quasi-experimental study with non-equivalent control group post-test only design was conducted to examine the effects of using a free-software called GeoGebra in the learning of Geometry among students classified as Students were divided into two groups of the control group and the experimental group. The control group was given geometry problems to be solved without using GeoGebra. Comparison between those two groups of the Geometry learning, regarding, is described below. Before the Geometry learning, they were tested with a pre-test and their knowledge necessary for examining functions was verified. The pre-test showed that there was no significant statistical difference between the experimental and the control group. Findings of this study showed a significant difference existed in the mean scores between these two groups. The result indicated that students in the experimental group better than in the control group. Also, GeoGebra enables creation of effective learning environment for examining functions and drawing their graphs.

**Keyword:** Mathematics Abstraction, Geogebra, and Geometry

## A. Introduction

Mathematics as a symbol learning, including GeoGebra, language; deductive science; the Geometer's Sketchpad and science of patterns of order, and of Mathematica. Several studies have organized structures, ranging from been carried out on GeoGebra software undefined elements, to axioms or to study various aspects of learning. postulates, and finally the proposition GeoGebra has become a tool that can (Ruseffendi, 1998). Abstraction in help teachers to design effective mathematics has grown very rapidly in instructional lessons (Arbain and the mid-XX century. Along with the Shukor, 2015). development of abstraction in mathematics. With abstraction being a mathematical formalism becomes a necessity (necessity) in every development of mathematics (Murtiyasa, 2012).

In this rapidly changing environment, education should change as quickly as the technology does. According to Fluck (2010), the future of Information, Communication and Technology (ICT) should play as a transformation role in education rather than integration into existing subject areas. Technology has become one of the powerful resources of learning. The evolution in using technology in teaching and learning process has grown by leaps and bounds. There was a lot of Mathematics software have been developed to aid teaching and

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The educational technology is a widely-used and very broad term. It is also described as a usage of the many types of technology in education. The original definition was produced by the Association for Educational Communication and Technology (AECT) in 1963 and was rewritten in 1994 (Dorbolo, 2003). In the Encyclopedia of Educational Technology, it is defined as “a systematic, interactive process for designing instruction or training used to improve performance” (Walden, 2006).

Over the last few years researchers have developed a theory for analyzing abstraction processes. The authors consider abstraction as a cultural activity that leads to the formation of new meanings when

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organizing and restructuring mathematical knowledge into new structures. The process of abstraction occurs because of needs or motives (Hershkowitz, 2011).

According to Cox stated that one of the greatest strengths and beauties in mathematics is abstraction. Abstraction is a fundamental process in mathematics. Correspondingly Peretz et al stated that the essence of mathematics is abstraction and abstract concept. Conditions that occur today, students' mathematical thinking skills in Indonesia has not developed optimally and is still relatively low. This means that improving and developing the quality of mathematics learning should be a priority and an absolute must. Facts that can be used as indicators are still low quality of mathematics learning in Inodonesia, especially the ability of mathematical thinking of students who have not been optimal.

The teaching of geometry aims to provide students with critical thinking skills, problem solving, abstraction, and a better understanding of other fields of subjects in mathematics by giving students a high-level geometric

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thinking ability ( ahin, 2008), geometry which is one of the most branches important from mathematics education, a place of considerable geometry in our educational system (Yilmaz & Turgut, 2007).

However, in traditional classrooms, learning geometry is usually done only through text description, 2D graphics and mathematical formulas on the board or paper. In some important topics, such as measuring the area and volume of 2D or 3D objects, traditional teaching methods often focus too much on the application of mathematical formulas, and the lack of opportunities for students to manipulate the object under investigation. As a result, many students can memorize formulas and even appear to succeed in their course of work without fully understanding the physical meaning of mathematical formulas or geometric concepts (Tan, 1994).

One of the computer programs (software) that can be utilized as a medium of learning mathematics, especially geometry is GeoGebra. According to Hohenwarter (2008), GeoGebra is a computer program

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(software) to teach mathematics, especially geometry and algebra. Based on the results of research Suweken (2011), obtained that the use of mathlet in learning mathematics also have a positive effect on student achievement. GeoGebra is multi-representation, ie (i) presence of algebraic appearance, (ii) presence of graphical display, and (iii) numerical display. These three views are interconnected dynamically (Suweken, 2011).

### B. Methods

This study applied quasi-experimental research design. Students were divided into two groups of the control group and the experimental group. The control group was given geometry problems to be solved without using GeoGebra. Meanwhile, The experimental group is the group of students were taught about how to use the GeoGebra software to solve geometry problems.

**Table 1**  
**Composition Of Sample**

Number of Students	Group of students	Breakdown of No (n)	Percentage (%)
74	Experimental	38	53
	Control	36	47
Total		74	100

Two intact classes consisting of 68 students in total were selected for this study from a population of 120 students. The experimental group consisted of 38 students while the control group consisted of 36 students. Abstraction test scores were analyzed using inferential statistics. Specifically, the *t*-test was executed using the Statistical Package for Social Sciences Version 18.0(SPSS 18.0) software. The *t*-test was used to test for statistical significance difference between the control and experimental groups at the beginning of the study and at the end. This was done primarily by comparing the mean score of the pre test and post score of both the groups. Descriptive statistics were used to analyze the data from the survey questionnaire.

### C. Finding

#### 1. Pre-Test

In this section we present the statistical analysis of the pre-test, test and post-test, based on the points of the students' achievement.

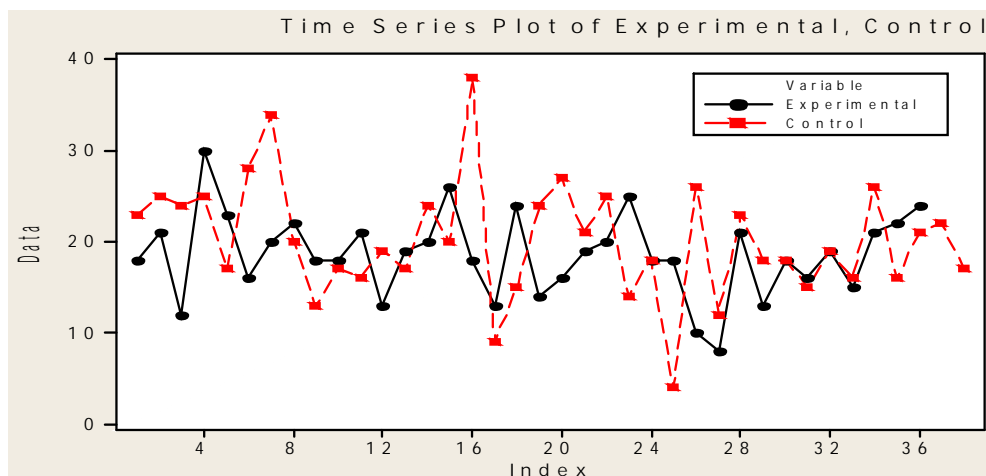
Student's t-test of difference between the means of the two large independent samples was applied in

each analysis. The statistical results for the pre-test are shown in Table 2:

As it was expected, the difference between the tested groups, Eksperimen and Control, was not statistically significant at the level of significance of 0.05 ( $t = -1.208$ ;  $p .231$ ).

**Table 2**  
**Results Of The Independent T-Test On The Pre-Test Of Both Groups**

Post Test				
Group	Mean	S. D.	t-value	Sig (2 tailed)
<b>Experimental (36)</b>	18.5833	4.58803	-1.208	.231
<b>Control (38)</b>	20.1579	6.42010		



**Fig. 1. Distributions Of The Number Of Students According To The Number Of Points (Scored On The Test).**

Looking at Fig. 1 it can be remarked that the black line (Eksperimen) is much more under the red line. In the control group even 15 student got maximum points.

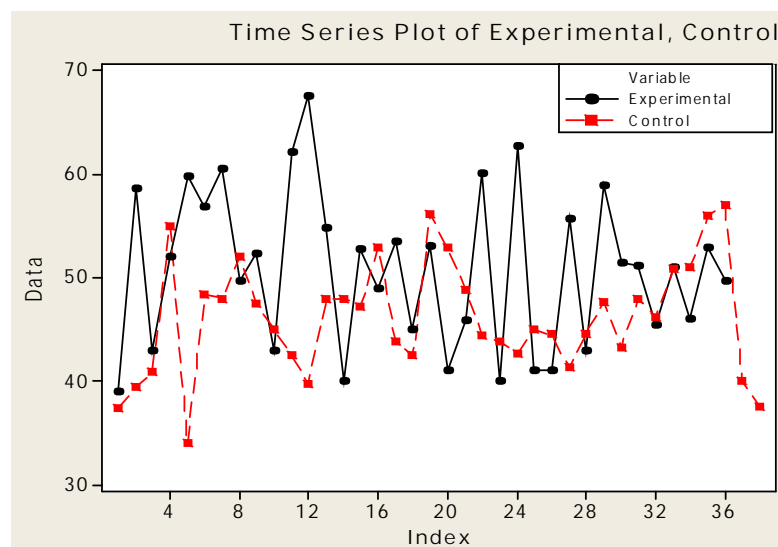
#### 2. Post-Test

Two months after geometry learning, both the groups had a post-test. The students of the experimental and the control group, respectively of the post-test. In both the groups.

From the table 3, the independent-t test results comparing the post-test results of the two groups showed that there was a significant difference between the mean test scores of the GeoGebra group (M = 55.3056, SD = 6.98905, N = 36) compared with the control group (M = 44.3421; SD = 5.01498; N = 38)  $t = 7.784$ ,  $p = 0.00 < 0.05$ ). The difference between the mean is 10.96345 points on the 100 point test. These findings indicate that students who have studied mathematics using GeoGebra are significantly better in achievement than students who underwent traditional learning.

**Table 3**  
**Results Of The Independent T-Test On The Post Test Of Both Groups**

Post Test				
Group	Mean	S. D.	<i>t</i> -value	Sig (2 tailed)
<b>Experimental (36)</b>	55.3056	6.98905	7.784	.000
<b>Control (38)</b>	44.3421	5.01498		



**Fig. 2. Distributions Of The Number Of Students According To The Number Of Points (Scored On The Test).**

Looking at Fig. 2 it can be remarked that the black line (Eksperimen) is much more above the red line. In the eksperimen group even 12 student got maximum points.

In this study, the influence of learning methods that are assisted with Geogebra learning software is implemented in the learning of class mathematics in Primary School

Teacher Education Study Program at the Faculty of Teacher Training and Education of Sultan Ageng Tirtayasa University. Based on data entered in the pre-test of mathematics learning, there was no significant difference between groups using geogebra and conventional learning. Throughout the study, the success of both groups increased. According to the results of post-test trigonometry tests, structured instruction according to mathematical teaching approaches is more successful than conventional learning. The results showed that there was a significant difference between the mean score of students on posttest using GeoGebra learning.

The findings suggest that Geogebra's software-assisted learning is more effective than conventional teaching methods. The findings of this study are consistent with Ross & Bruce's (2009), Reis (2010), Tatar (2012) study which found a positive impact on the use of mathematics learning software so as to enhance student learning and understanding. After the study, there was a difference between the mean score of two group trigonometric achievement tests and this difference was statistically significant to support the GeoGebra group.

#### **D. Conclusion**

In this study, the GeoGebra software has proven to be an effective tool in enhancing mathematics abstraction, specifically in learning geometry.

Learning and teaching of Mathematics should not be focused on purely theoretical, but also a variety of learning approaches that involve the use of teaching aids proven to help

stimulate students' interest in Mathematics. The Mathematics software available in the market or even online has facilitated the task of the teacher to impart knowledge beneficial to the students. However, it depends on the teacher to utilize existing materials without the need to allocate extra time to developed other teaching aids.

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