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Effectiveness of Geometer's Sketchpad Learning in Two-Dimensional Shapes

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Abstract: *The present study was conducted to compare the effectiveness of Geometer's Sketchpad (GSP) learning in two-dimensional shapes. This study was designed as a quasi-experiment which involved 60 students of class VII in SMP Negeri 1 Ngoro, Mojokerto, Indonesia. The sample in study was divided into two groups, mainly 30 students are the experiment class (GSP) and 30 students are the control class (conventional learning). There were three instruments used in this study namely, students' responses, and pretest-posttests. The data were analyzed using analysis of covariance (ANCOVA). T-test showed that the effectiveness of student learning outcomes in GSP learning is higher than those in conventional learning. Based on the results of the student learning outcomes indicated that students in the experimental group outperformed those in the control group. In addition, a survey instrument was used to elicit students' perception on the use of GSP. Analysis of the questionnaire responses indicated a positive overall perception of using GSP in learning about two-dimensional shapes. Thus, it can be concluded that GSP learning was effective in two dimensional-shapes learning.*

INTRODUCTION

One of the mathematics topics considered difficult by junior high school students is geometry (Battista, 1999). In the teaching and learning of geometry, it has been often realized that students still lack the cognitive and process abilities in the total understanding of two-dimensional shapes. It is important for students to be able to imagine, construct and understand construction of shapes in order to connect them with related facts.

In this context, Geometers' Sketchpad (GSP) is one solution for understanding two-dimensional shapes (Dogan, 2010). GSP is a software that can be used in geometry to enhance teaching and learning (Kesan &Caliskan, 2013). Geometer's Sketchpad (GSP) can be used by students and teachers as an instrument to help them in learning geometry.

According to Meng (2009), using GSP, the level of van Hiele's geometrical thinking of students about cubes can increase from level 0 to level 2. In line with that research, Idris (2009) also shows that learning using GSP can improve performance and van Hiele's level of geometrical thinking students in Malaysia.

The purpose of this research is to compare the effectiveness of Geometer's Sketchpad (GSP) learning in two-dimensional shapes.

REVIEW OF LITERATURE

Geometer's Sketchpad (GSP)

Teachers are expected to integrate Information and Communication Technologies (ICT) as a learning medium for all subjects (Muhammad & Powel, 2019; Kemendikbud, 2014). Therefore, teachers must master ICT to support learning in the classroom. One of the ICT-based learning used by teachers in mathematics learning such as Geometer's Sketchpad (GSP) (Berezny, 2015; Johar, 2015). GSP is software that can help students understand geometry starting from points, lines and angles to more difficult understandings such as arches, turns and transformations. Students can associate points and lines that are connected with angles through animation that are easier to understand. Geometer's Sketchpad can also make learning more interesting and not boring, because this software can construct dynamic images so that they can be manipulated, analyzed, and processed into interesting learning (CITE).

In addition, the use of GSP can also help students think to solve problems, find ideas, and make the right decisions in learning geometry. In general, the use of GSP can be useful and realize healthy learning. Because students can see and imagine geometric shapes on the GSP. Kesan and kaliskan (2013) proposed some GSP characteristics, which are described below.

a. Accuracy in digitally painting and measuring
b. The process of visualization from the beginning with different dimensions of dimensions is easy to understand
c. Can be used to facilitate students conducting investigations, exploration and problem solving
d. Giving confidence and strong reasons for students in making conclusions can even provide motivation in doing proof
e. Has specific characteristics, animated images, trace images, and provides features to simulate various simulations

Steps to using GSP in two-dimensional shapes

To use GSP, the user must perform some basic steps.

1. Turn on the computer
2. Click the Start menu, if there is already a Sketchpad Icon, select All Programs, then select and click the mouse on Sketchpad like Figure 1

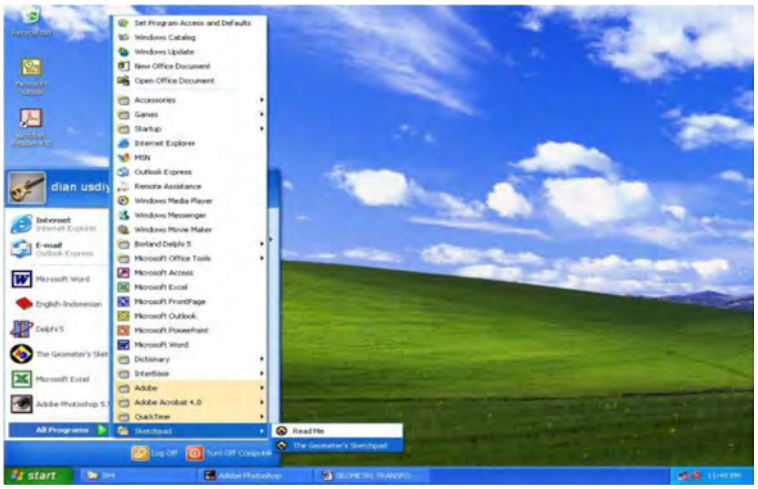

Figure1. Start to GSP program

3. Select the Geometer 'Sketchpad, as shown in Figure 2

Figure2. Icon the Geometer's Sketchpad

4. Click on The Geometer 'Sketchpad, so that you get a view like Figure 3

Figure3. The view of the Geometer's Sketchpad

5. Click any button of sketchpad field in left slide that the display of a worksheet in sketchpad, as in Figure 4.

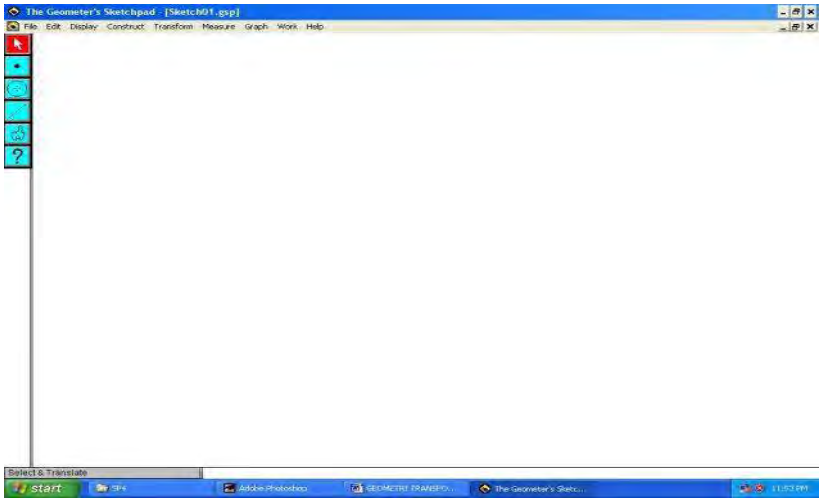

Figure4. The worksheet of Geometer's Sketchpad

Information:

	Selection Tool Selalu dipilih sebelum memilih yang lain Klick, hold dan drag untuk menggerakan objek
	Point Tool Klick pada sketch pad untuk memunculkan titik Untuk memunculkan "special" titik pindahkan kelokasi lain, periksa command line kemudian klick – selalu cek konstruksi dengan mendrag titik
	Circle Tool Klick, hold dan drag pada sketchpad untuk memunculkan lingkaran Lingkaran dimunculkan dengan satu titik kontrol pada kelilingnya dan pada pusat lingkaran
	Line Segment Tool Klick, hold dan drag pada sketchpad untuk memunculkan garis Klick, hold dan drag pada tool untuk mengganti garis, segemn atau sinar
	Text Tool Klick, hold dan drag pada sketchpad untuk memunculkan text box – kemudian siap menulis Tunjukkan atau sembunyikan label dengan mengklik pada object Tukar label dengan mengklik pada label

On the left side of the sketch field there is a menu for creating images, namely the Toolbox menu, for example points, lines, circles, etc. The user just needs to click the desired mouse image then move the cursor to the sketch field, move the cursor while determining the desired image size.

6. If the image size has been determined. Click the icon print so that the image is printed.
7. To record work results, click the File menu, and then select and click the Save or Save as menu, such as Figure 5 and Figure 6, name the file to be saved, the file name will be given extension.gsp, for example the name of the file works 1. gsp

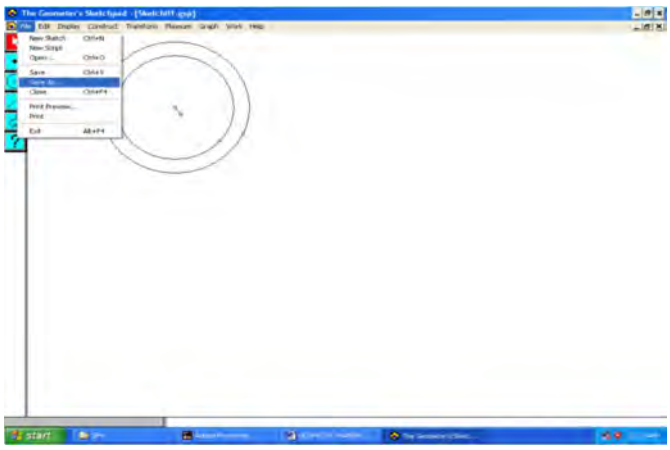

Figure 5. Saving files on Geometer's Sketchpad

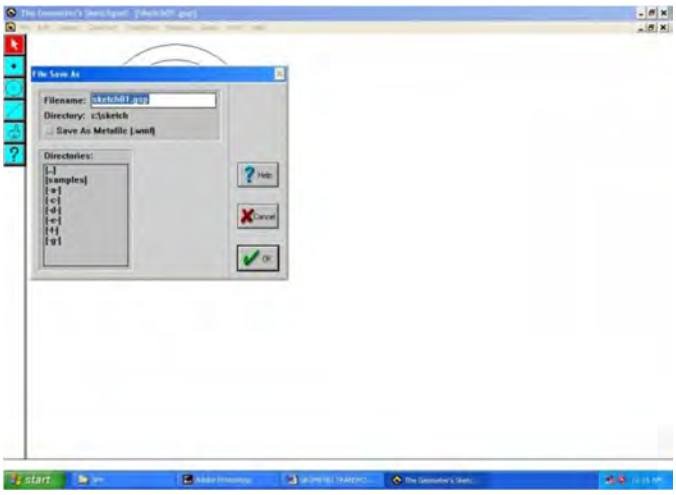

Figure 6. Saves file names on Geometer's Sketchpad

To exit the program, click the mouse on the file menu, as in Figure 2.5, then select and click the mouse on the Exit menu or press the Alt + F4 key.

RESEARCH METHODOLOGY

Research Design

This study is a quantitative study with quasi experimental design using one-group pretest-posttest design that conducted to compare the effectiveness of Geometer's Sketchpad (GSP) learning in two-dimensional shapes. This research was conducted in class VII of SMP Negeri 1 Ngoro, Indonesia. This study was implemented for three months.

Research Sample

The participants of the study were two classes that were selected from cluster random sampling from nine classes in the same grade from a junior high school at Mojokerto city, Indonesia. The sample in this study comprised two groups, 30 students are in the experimental group (GSP) and 30 students in the control group (conventional learning). All students are in grade VII and aged between 12 - 13 years.

Data analysis

Achievement test scores were analyzed using inferential statistics. Specifically, the t-test was executed using the Statistical Package for Social Sciences Version 22.0 (SPSS 22.0) 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. Descriptive statistics were used to analyze the data from the survey questionnaire.

RESULTS

Effectiveness of using GSP on students' understanding of two-dimensional shapes

To determine whether any significant differences existed between the pre-test mean score of both the control and experimental groups, an independent sample t-test was done.

Group	*Post test*			
	Mean	*S.D.*	*t-value*	*Sig (2 tailed)*
Experimental (n = 30)	*6.17*	*2.16*	*-1.265*	*.188*
Control (n = 30)	*6.94*	*2.68*		

t-value significant at $p < .05$

Table1. Results of the independent t-test on the pre-test for both groups

Table 1 shows that the control group obtained a mean score of 6.94 while the experimental group obtained a mean score of 6.17. The mean score difference between the groups was 0.81 with a t-value of -1.265. Nonetheless, the p-value was 0.188 ($p > .05$) indicating that the difference in the mean score of the two groups was not significant. This result illustrated that both the students in the control and experimental group were similar in abilities before the treatment was administered.

Group	*Post test*			
	Mean	*S.D.*	*t-value*	*Sig (2 tailed)*
Experimental (n = 30)	*15.17*	*3.21*	*3.278*	*.000*
Control (n = 30)	*13.94*	*4.62*		

t-value significant at $p < .05$

Table 2. Results of the independent t-test on the post-test of both groups

This table shows that the control group obtained a mean score of 13.94 while the experimental group obtained a mean score of 15.17. The mean score difference between the groups was 5.12 with a t-value of 3.278. Furthermore, the p-value was low ($p < .05$) indicating that the difference in the mean score of the two groups was significant. Thus, the students in the experimental group performed better using GSP than the control group using the conventional learning method. The students in the experimental group performed better in the post test compared to the control group.

The value	*Mean*	t_{obs}	t_{table}	*Sig*	*Sig(2-tailed)*
Pretest – posttest scores (experimental group)	*67.17*	*34.655*	*2.042*	*0.185*	*0.000*
Pretest – posttest scores (Control group)	*38.30*	*15.931*			

Table 3. Results of the paired sample t-test

Based on the above table, the result of the one sample t-test shows t-test of control group is 15.931, while t observed of experimental group is 34.655. If the result of the calculation is compared with t table (2.042) then t test count is greater than price t table. Because t observed > t table then there are differences in student learning outcomes control group and experimental group in learning two-dimensional shapes.

For the other results showed that the questionnaire of students' response completed by 30 students after following GSP learning on statistical materials obtained as follows:

No	*Responded aspect*	*Percentage (%)*	
		Agree	*Not Agree*
1	*I was excited about using Geometers' sketchpad (GSP) software*	*98*	*2*
2	*I was very engaged in the learning process*	*95*	*5*
3	*I was able to visualize and answer the questions after each activity*	*96*	*4*
4	*I enjoyed learning mathematics much more using GSP*	*90*	*10*
5	*I learnt a lot using GSP*	*80*	*20*
TOTAL		*91.8*	*8.2*

Table 4. The results of response students toward GSP design

Based on the criteria of students' responses, it can be concluded that the overall percentage of students' responses to learning tools amounted to 91.8 % which means that students' responses are positive to follow GSP lessons in two-dimensional shapes materials.

DISCUSSION

Based on the results that technology is a great motivational tool as students' understanding of geometric improved when GSP was used to enhance the students' learning process. This was especially beneficial for the lower ability students. Technology acted as a scaffold which enabled learners to reach their zone of proximal development (Vygotsky, 1978). The improved cognitive process is supported by Dogan's (2010) study where he observed that computer-based activities encouraged higher order thinking skills, and had a positive effect in motivating students toward learning.

Besides that, the student's response in this study is positive such 91,8% such that can improve students' mathematical understanding. Then, this results also shows that difference of learning result of control and experimental group given can be shown with average value is 5.12. The result indicated that students in the experimental group outperformed those in the control group. For test result tobserved pre-test and pos-test value show bigger than t table, that is t count pretest = 15.931, t count posttest = 34.655, and t table = 2.042. Thus it can be concluded that there are differences in student learning outcomes between control group and experimental group after learning GSP, so that GSP can give effect to students' mathematical understanding so that student learning outcomes increase compared to control group.

CONCLUSIONS

Based on the above results, we can conclude that the student's response in this study is positive so that in using of GSP in mathematics learning make to improving students' mathematical understanding. Besides that, this results also show that difference of learning result between control and experimental group which students in the experimental group outperformed those in the control group.

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[ii] This notion of a hierarchy of matrices is similar to Vygotsky's (1997,p.199) notion of a hierarchical structure of concepts. which also contains two defining characteristics "coordinates" one is the degree of abstraction of the concepts and the second is the collection of situations in which it is relevant. The notion of a systems or hierarchies of matrices or concepts based upon relevancy and abstraction bridges the gap between "action schemes" related to a specific situation, and the notion of a collections or toolbox of schemes relevant in any given domain.