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The Use Of Cabri 3D Software As Virtual Manipulation Tool In 3-Dimension Geometry Learning To Improve Junior High School Students' Spatial Ability

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Abstract

This study is aimed to know students' spatial ability who work under 3-dimension learning use Cabri 3D software at Junior High School in Bandung. The using of Cabri 3D software as manipulative tool in 3-dimension geometry learning can reduce misperception about 3-dimension materials. This study is quasi-experiment and the instruments cosist of spatial ability test and students' worksheet. This study is conducted for 8th grade students at Junior High School in Bandung.

Based on study result, it is found that students' spatial ability enhancement under the learning, where Cabri 3D software is used, than those who were taught by conventional learning. From five elements of spatial ability based on Meir (1976), only 2 elements of spatial ability which do has no improve merit significantly, namely, perception ability component and visualization ability, while rotation ability, relation ability and orientation ability have improved significantly.

Key Words: Cabri 3D Software, Virtual Manipulation Tool, Geometry 3 Dimension, Spatial Ability

I. INTRODUCTION

1. Background

Geometry 3-dimension instruction by using 2 dimension blackboards in delivering 3-dimension material can result in misperception. It can be seen from Figure 1 :

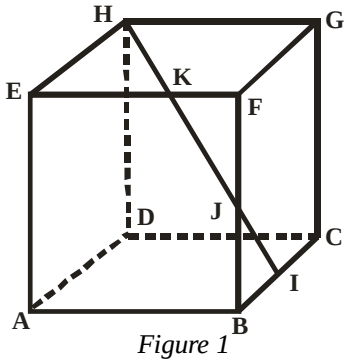

Figure 1

It is explained that segment HI where the line connect angle point H with point I towards BC side. At a glance, students can conclude that segment HI intersect at BF and EF side in succession at point J and at point K. But, in reality, both side of BF and EF do not intersect segment HI.

In the era of information and technology at present, such problems can be solved by

using software that is able to represent manipulation of three dimension geometry structure. One of the software that can solve such problem is Cabri 3D.

Cabri 3D is computer software which is able to display three dimension geometry on computer screen which resemble the reality. Cabri 3D is one of Dynamic Geometry Software (DGS). Below is one of the examples if the above problem is solved by using Cabri 3D:

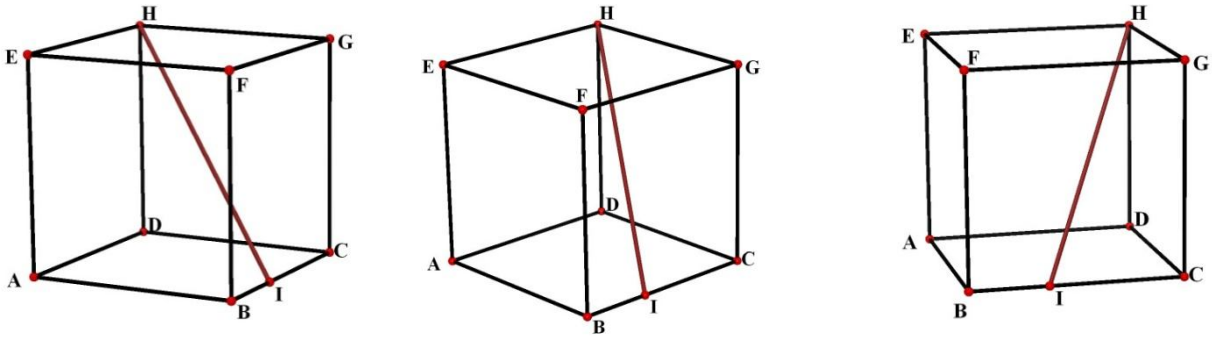

Figure 2

From the example above, it is clear that segment HI does not intersect other line except BC.

In this research, Cabri 3D has a function as virtual manipulation tool, where each student can directly operate Cabri 3D to understand 3 dimension geometry material at Junior High School by using constructivism instructional method.

One of the ability to comprehend such 3-dimension geometry is spatial ability. According to McGee:1976 (in Kosa, T:2008) spatial ability consists of spatial skills namely changing, rotating, bending and reversing of an object presented for stimulating in the mind. Linn and Petersen :1985 (in Kosa, T:2008) define spatial ability with mental processes being used in perceiving, storing, recalling, creating, arranging and making related spatial images. According to Meir (1976), there are 5 spatial ability elements, namely; 1) Spatial Perception is ability to comprehend spatial depth and inclination towards vertical and horizontal reference; 2) Visualization is comprises the ability to visualize a configuration in which there is movement or displacement among (internal) parts of the configuration; 3) Mental Rotation involves the ability to rapidly and accurately rotate a 2D – or 3D – figure; 4) Spatial Relations means the ability to comprehend the spatial configuration of objects or parts of an object and their relation to each other; 5) Spatial Orientation require a person's own orientation in any particular spatial situation. Spatial orientation is the ability to orient oneself physically or mentally

in space.

This study is aimed to know the differences of spatial ability improvement on learning by using Cabri 3D compared to conventional lerning. Besides to know the differences of spatial ability improvement in general, this study is also to know which spatial ability element that has been improved in learning by using Cabri 3D.

II. RESEARCH METHOD

1. Study Design

In determining its design, this study use *quasi-experiment* design. This study also use control group and experiment group with two different treatments. Observation was conducted twice, namely, before learning process, which is called pre test and after learning process, which is called post test. Characteristic which is measured in this study is spatial ability. In short, the study designs as follows:

O X O

O O

Explanation:

O: pre test and post test (spatial ability test)

X: learning treatment by using Cabri 3D

2. Participants

This study was conducted in one private school in Bandung with participant in 1 class consist of 25 students in control group and 1 class consist of 25 students in experiment group. Sample is collected based on certain consideration from the Principal and the Teacher at that school (Purposive Sampling).

3. Instrument

Instrument in this study use 15 multiple choice items which has been tested its validity and reliability. In such 15 items, there are 5 elements of spatial ability based on Meir (1976) namely perception ability element, visualization ability element, rotation ability element, relation ability element, and orientation ability element.

4. Data Analysis

Data analysis by using t-test is conducted to know the differences of mean n-Gain improvement of spatial ability whether on generally or based on every spatial ability element.

III. RESULTS

The study result is presented in Table 1.

Table 1
Pre Test and Post Test of Spatial Ability
in Control Group and Experiment Group

Group	(N)	Ideal Grade	Pre Test				Post Test			
			Xmin	Xmax	$\overline{X}$	S	Xmin	Xmax	$\overline{X}$	S
Experiment	25	100	20	90	49.60	3.75	40	90	76.20	2.42
Control	25	100	35	85	52.90	2.40	35	85	56.50	2.04

From Table 1, it is known descriptively that there are differences of mean grade on spatial ability before and after getting instruction by using Cabri 3D, whether in control group or in experiment group. In control group, there is improvement around 4.4% (56.5-52.9), while in experiment group there is improvement around 26.6% (76.2-49.6). Study hypothesis to see spatial ability based on learning model: "Spatial ability which uses Cabri 3D learning significantly better than use conventional learning." To test hypothesis above, it is formulated statistic hypothesis as follows:

H_0: Students' spatial ability which is given learning with Cabri 3D is not differ with students who are given with conventional learning with Cabri 3D.

H_1: Students' spatial ability who are given learning with Cabri 3D is better than learning without using Cabri 3D.

this hypothesis will be analyzed by using t-test with the use of *SPSS 18.* Below is t-Test calculation which is presented in Table 2.

Table 2.
t-Test Result of Spatial Ability Gain Independent
on Experiment Group and Control Group

Aspect	Group	Mean	SD	t-Test Statistic	sig	Explanation
Spatial Ability	**Experiment**	0.507	0.191	10.985	0.000	Significant
	Control	0.062	0.062			

Based on Table 2 above, it is obtained sig value = 0.000 smaller than $\alpha = 0.05$ which means H_0 is rejected. So it can be concluded that students' spatial ability which use learning with Cabri 3D is significantly different with conventional learning. From Table

2, it can be seen the mean of students' spatial ability which use Cabri 3D learning is higher than the average of spatial ability which use conventional learning. So, it can be concluded that spatial ability which its learning use Cabri 3D significantly better than spatial ability which its learning use conventional learning.

In spatial ability, there are 5 elements of spatial ability, namely, perception ability element, visualization ability element, rotation ability element, relation ability element, and orientation ability element. To know which spatial ability element which has been improved significantly is conducted with t-test to each spatial ability element. Below is t-test calculation result by using SPSS 18 on Table 3.

Table 3
t-Test Result of Gain Independent on Each Spatial Ability Element in Experiment Group and Control Group

Element	Group	Mean	SD	t Test Statistic	sig	Explanation
Perception Ability	Experiment	0.146	0.290	0.376	0.708	Not Significant
	Control	0.115	0.295			
Visualization Ability	Experiment	0.246	0.303	1.855	0.070	Not Significant
	Control	0.093	0.281			
Rotation Ability	Experiment	0.773	0.366	9.430	0.000	Significant
	Control	0.043	0.125			
Relation Ability	Experiment	0.417	0.466	4.466	0.000	Significant
	Control	0.000	0.000			
Orientation Ability	Experiment	0.744	0.311	10.016	0.000	Significant
	Control	0.050	0.153			

Based on Table 3, it can be seen, that rotation ability element, relation ability element and orientation ability element has sig value = 0.000 < 0.025, this means that there is significant differences between learning by using Cabri 3D with conventional learning. From Table 3, it is also can be seen mean grade of spatial ability in experiment group is higher than control group. It shows that experiment group has improved their spatial ability significantly towards rotation ability, relation ability element and orientation ability element.

Perception ability element and visualization ability element on Table 3 has sig value > 0.025 namely on perception ability element has sig value = 0.708 > 0.025 and on visualization ability element has sig value = 0.070 > 0.025. It shows that there are no differences significantly between experiment class and control class. Based on Table 3, it can be seen average grade of experiment class is still higher than control group. It shows that although there are no significant differences between experiment group and

control group, but if it is viewed from its gain average, experiment group has higher grade than control group. It shows that there is improvement of spatial ability towards perception ability element and visualization ability element although its improvement not significant.

IV. DISCUSSION

Based on calculation result in Table 2, it can be concluded that spatial ability which use Cabri 3D learning significantly better than spatial ability which use conventional learning. It can be seen from sig value = 0.000 which is smaller than 0.05 and its mean higher than class which use its learning use Cabri 3D. It is in line with study which was conducted by Temel Kosa and Bulent Guven in 2008 which showed that the using of Cabri 3D software can improve Spatial Visualization ability towards students. Such study used instrument which has been developed by Guay (1976) from Purdue University which is called as Purdue Spatial Visualization Test or PSV Test. This PSV Test is only can use 3 spatial ability elements, namely, development ability element which is similar with visualization element in this study, rotation element which is also used in this study. Beside 3 elements of spatial ability, in this study are used also 2 additional elements, namely, perception spatial elements and relational spatial elements. So, in this study, aspect or element which is measured is more complete.

In every spatial ability elements, it appears that its improvement is different. It can be seen from Table 3, on each perception ability element and visualization ability element do not improve significantly. It can be seen from perception ability sig value = 0.708 is higher 0.05 and on visualization ability sig value = 0.070 is higher than 0.05. While for rotation ability, relational ability, and orientation ability improve significantly. It can be seen from each sig value which is lower than 0.05.

In this study, rotation ability and orientation ability show that high gain mean value around 0.733 and 0.744 successively for rotation ability and orientation ability. It means in 3 dimension instruction by using Cabri 3D is very effective to improve rotation and orientation ability elements.

Besides the calculation data above, it can be showed that when students work their worksheet in ordinary class (in regular class). When they work the worksheet which one of them is item about making cubes and blocks, students can present cubes such as seen

on Figure 3.

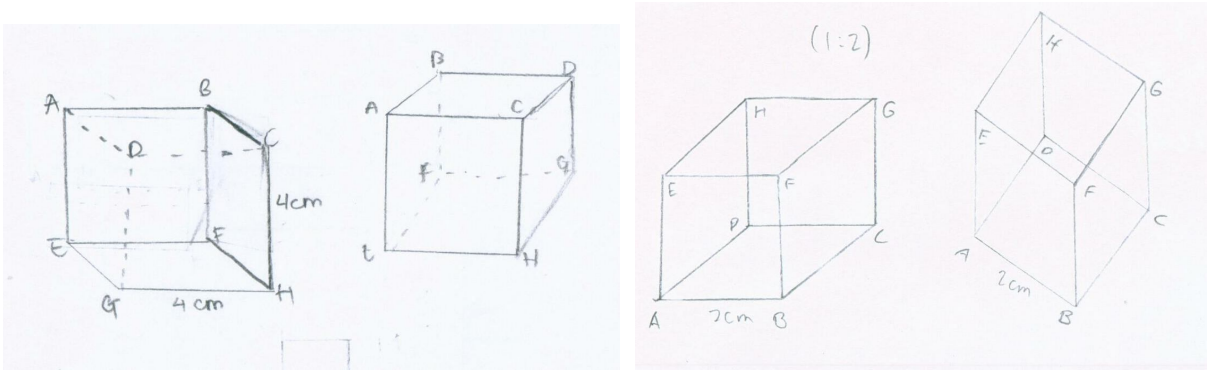

Figure 3.

Figure 3.
Students' sketsa about Cube

From Figure3, students have a strong rotation element ability and orientation element. Where students are able to present cubes in different point of view.

While on element of students' relational ability, gain average value which is obtained is 0.417. It shows that relation ability element has improved significantly. This relation ability element shows how strong students recall towards parts on a 3-dimension geometry structure.

In this study, students' visualization ability element has not improved significantly. It can be shown from sig value = 0.708 is higher than 0,05 on Table 3. It is supported by Cabri 3D feature which can sort a 3-dimension geometry into grids such as Figure 4.

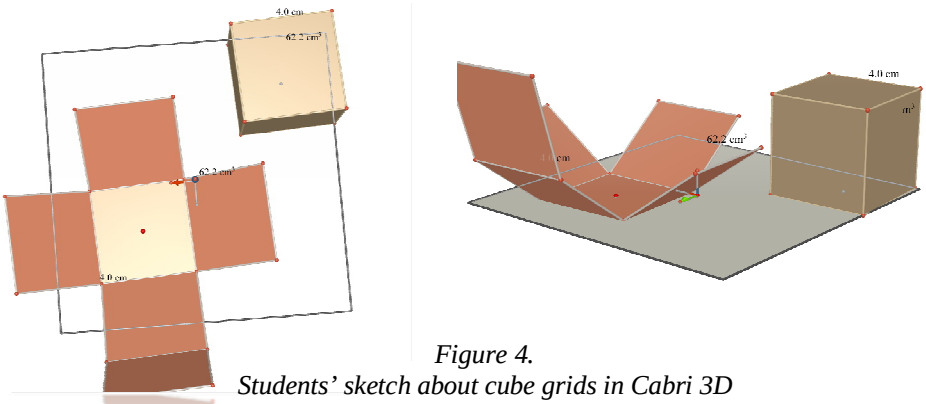

Figure 4.
Students' sketch about cube grids in Cabri 3D

But statistically, the improvement of visualization ability dimension in this study does not improve significantly. Mean gain value of visualization ability improvement is only 0.246. It shows that this visualization ability does not improve significantly by using

Cabri 3D software. It is assumed in this visualization ability is required dynamic mental ability so tool that is required must be more concrete, such as the use of cardboard box or other real manipulative tools.

So, in perception ability element in this study has not improved significantly by statistic, although descriptively, this perception ability element has improved around 0.146. It because this perception ability must be trained with various condition in the daily life. The using of Cabri 3D software is not sufficient to train perception ability improvement. Because this perception ability element depends on big thing such as reference in determining a picture about 3-dimension geometry.

Although this perception ability element has not improved significantly, but the awareness about this change in comprehending a 3-dimension geometry has increased. It can be felt when students work their worksheet by drawing cubes, students propose a question such as: "whether sides on cube when draw the depth should be similar or no?". This question is interesting because students has begun to understand about the depth of 3-dimension geometry structure. The depth comprehension about this 3-dimension geometry is included in spatial ability, especially perception ability element. Although statistically in this study, perception abilty does not improve significantly, but students' awareness in comprehending perception ability has emerged.

V. CONCLUSION AND SUGGESTION

1. Conclusion

Based on data collection and finding from this study, it can be concluded that:

a. The improvement of students' spatial ability which are taught by Cabri 3D learning is better than students who are taught by conventional learning.
b. In learning by using Cabri 3D from spatial abilty element improvement, element of rotation abilty, relation, and orientation have improved significantly, while perception ability and visualization ability does not improve significantly.

2. Suggestion

a. In this study, the using of Cabri 3D only can improve ability of rotation ability, relation, and orientation, while ability of perception and visualization do not improve significantly. So, it is required to conduct study about spatial ability by using other tools, whether virtual manipulative tool or real manipulative tool.

b. In this study, only Cabri 3D that can be used to know spatial ability improvement, so it is needed to conduct further study in integrating virtual manipulative tools (whether Cabri 3D or other DGS) and real manipulative tool.

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