Improvement of The Ability of Junior High School Students Thinking Through Visual Learning Assisted Geogebra Tutorial

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Abstract. This research is distributed on the issue of the lack of visual thinking ability is a must-have basic ability of students in learning geometry. The purpose of this research is to investigate and elucidate: 1) the enhancement of visual thinking ability of students to acquire learning assisted with geogebra tutorial learning; 2) the increase in visual thinking ability of students who obtained a model of learning assisted with geogebra and students who obtained a regular study of KAM (high, medium, and low). This research population is grade VII in Bandung Junior High School. The instruments used to collect data in this study consisted of instruments of the test and the observation sheet. The data obtained were analyzed using the test average difference i.e. Test-t and ANOVA Test one line to two lines. The results showed that: 1) the attainment and enhancement of visual thinking ability of students to acquire learning assisted geogebra tutorial better than students who acquire learning; 2) there may be differences of visual upgrade thinking students who acquire the learning model assisted with geogebra tutorial earn regular learning of KAM (high, medium and low).

1. Introduction

Geometry is one of scope in mathematics. Geometry in mathematics is the science that studies the points, lines, areas and spaces and the relationships among them. As one of the material scope of mathematics, geometry was studied at various level of education divided into several subjects at every level. In geometry, students will learn about the shape, structure and analyze the characteristics and relationships of geometric objects [1].

According to the process of learning geometry Budiarto include (1) visualization, construction and draw a picture; (2) the study of aspects of space; (3) using the tool for presenting math concepts; (4) the presentation of formal mathematical systems as Suparyan [2]. The ability of visualization is the most important and basic ability in learning geometry that supports the ability of mathematical concepts. According to Hershkowitz [3] visualization is the ability of interpretation of drawings, diagrams, and thoughts by writing or tech tools with the aim of describing or communicate information and develop ideas and increase understanding Visual thinking or also called the visual thinking is ability to transform information into images or other forms that can help communicate information [4].

The survey results Trends International Mathematics Science Study (TIMSS) 2007 [5] in the domain of visual thinking ability of geometry content has not been high that is said to be only 19% Indonesia students answered correctly. In addition, studies conducted (2011), obtained the results that
students can’t think visually. In addition, the ability of the students in mengkontruksi geometry is still classified as low. This, due to students not used to visualize math problems.

One of the efforts to develop the capabilities of the visual thinking is a method of teaching or learning carried out by the teacher. The learning process should be supported by learning media that develop visual thinking or visualization capabilities against material geometry. The application of appropriate learning model will encourage students increase and development of student’s visual thinking ability.

The model of learning can be collaborate with the use of a customized learning media with the advancement of technology. The utilization of technology in learning is by applying a computer-assisted learning. One of the computer-assisted learning model is a model of learning tutorials. This learning model provides a complex study designs that contain material learning, exercises that accompanied feedback [6]. The tutorial program is a program using software in the form of computer programs. As for the software used to assist in the learning of mathematics such as software geogebra.

Geogebra is developed by Markus Hohenwarter in 2001. According to Hohenwarter [7], geogebra is of project computers (software) to learning math. Geogebra combines geometry, algebra, statistics and calculus. Several studies [8] revealed that geogebra very effectively applied in learning mathematics. Geogebra-assisted learning improve independent study students. Guven and Kosar[9] which suggests that as a software geogebra geometry can be used as an effective tool in learning for the visualization object as well as improve understanding.

Based on the descriptions above, outline of problems on the research is "Whether the application of the model of learning assisted geogebra tutorial can improve the ability of visual thinking of Junior High School students?". The outline of the research issues elaborated in the form of research questions as follows: 1) If increase visual thinking students who obtain a model of learning assisted geogebra tutorial better than students who obtain a regular learning?; 2) if there are differences of increase visual thinking students who acquire the learning model assisted with geogebra tutorial students earn regular learning of KAM (high, medium, and low)?

This research aims to examine and elucidate 1) Examines the increase in visual thinking ability of students who obtained a model of learning assisted geogebra tutorial students acquire learning; 2) Elucidate the difference of visual upgrade thinking students who acquire the learning model assisted geogebra tutorial students earn regular learning of KAM (high, medium, and low)?

2. Method

This research uses quasi-experimental design research. This is because researchers couldn’t possibly classify subjects randomly so that researchers receive a State subject. This study uses two research groups, namely the Group of experimental and control group. As for the design of the research plan are presented as follows:

- **Experimental group**: O X O
- **Control group**: O O O

The population in this research is the whole grade VII in the SMP Negeri 5 Bandung. Sampling of the research done with the purpose of sampling technique, namely the determination of samples with specific considerations [10]. Consideration of sampling in this study using classes that have the characteristics and the same relative academic ability. Grade VII in the SMP consists of 10 classes from Class VII-A to J. Of the 10 classes, selected two classes that will be used as a sample in this research.

The instruments used in the research are of two types i.e. instrument test and non-test instruments. Instruments in the form of the test consists of pretest and postest to measure visual thinking ability of students, while the instrument is in the form of a non-test, namely the observation sheet which contains indicators of activity of teachers and students in learning.

The visual thinking ability test instrument consists of a written question 5. Stage of preparation of the matter to the test, beginning with the preparation of the lattice problem followed by compile
problem with alternative answer keys of each grain of matter. Before the question
of visual thinking ability test used, first do tests to find out the degree of validity,
reliability, power and difficulty distinguishing instrument.

| No. | Validity | Divicuity level | Criterion |
|-----|----------|----------------|-----------|
| 1   | Valid    | Easy           | Enough    |
| 2   | Valid    | Medium         | Enough    |
| 3   | Valid    | Medium         | Good      |
| 4   | Valid    | Medium         | Good      |
| 5   | Valid    | Difficult      | Enough    |

Based on the trial results, obtained interprets that all matter is worthy. After the analysis of the tests obtained \( r_{11} = 0.66 \), thus inferred that tests that tested had levels of reliability are. Data analysis carried out quantitatively. Statistical tests used are the average difference test, and calculations performed using Microsoft Office Excel and IBM SPSS Statistics 20 with the following steps:

- To see a visual thinking ability of students between the before and after is calculated by using the formula learning gain score normalization
  
  \[ g = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum ideal score} - \text{pretest score}} \]

- To perform a test of the hypothesis, first set level of significance that is \( a = 0.05 \), as well as the test data of its homogeneity and normality.

- Hypothesis testing using t-test 1 and test 2 using hypothesis testing ANOVA two lines.

3. Result And Discussion

3.1 Result

Visual thinking ability of data obtained through the pretest and posttest. From pretest data and visual thinking ability posttest calculated score gains normalization (N-Gain) in both classroom learning-assisted tutorial classes namely geogebra (PTBG) and the usual learning class (PB). The following are the data N-gain the ability of visual thinking.

| Class   | N  | \( \bar{x} \) |
|---------|----|---------------|
| PTBG    | 30 | 0.6673        |
| PB      | 30 | 0.5080        |

Table 2 shows that increased ability of visual thinking in classroom PTBG after applied learning assisted geogebra tutorial better than classroom learning with PB. The data increased the ability of visual thinking or score N-gain is grouped by category KAM (high, medium and low). The following table presents the descriptive data N-gain visual thinking ability of the students of class PTBG and class PB already grouped based on requirements KAM.

| N-gain | KAM Category | N  | Mean |
|--------|--------------|----|------|
| PTBG   | High         | 6  | 0.71 |
|        | Medium       | 19 | 0.67 |
|        | Low          | 5  | 0.61 |
| PB     | High         | 4  | 0.64 |
|        | Medium       | 21 | 0.54 |
|        | Low          | 5  | 0.26 |

Table 3 describes the score N-gain the ability of visual thinking class PTBG and class PB. The average score of N-gain PTBG class higher than the class of PB one each category KAM.
3.2 Analysis

3.2.1 N-gain Data analysis of Visual Thinking Ability

Based on table 3 that average N-gain visual thinking ability of the students of the PTBG class is higher than the average of N-gain PB. If you want to know the significance of the difference the average N-gain visual thinking ability of the students of PTBG class and PB class, then performed a test of the difference the average N-gain. Before that, first conducted the test of its homogeneity and normality test against N-score gain visual thinking ability of students in both classes. Test result data normality N-gain visual thinking ability of students both classes are presented in the following table.

| Class | Shapiro-wilk Statistic | Shapiro-wilk DF | Shapiro-wilk Sig |
|-------|------------------------|-----------------|-----------------|
| N-gain | PTBG          | 0.946          | 30              | 0.136          | Normal |
|        | PB            | 0.965          | 30              | 0.414          | Normal |

It is known that the data table 4 N-gain the ability of visual thinking both of the class. The next test is done to find out whether its homogeneity of variance class PTBG and class PB are the same or different. As for its homogeneity test results data N-gain visual thinking ability of students both classes are presented in the following table.

| Class | Levene Statistic | Levene df1 | Levene df2 | Levene Sig |
|-------|-----------------|------------|------------|------------|
| N-gain| 0.134           | 1          | 58         | 0.716      |

In table 5 it appears that data N-gain the ability of visual thinking shows a value greater than the significance $\alpha = 0.05$ i.e. of 0.716, so $H_0$ received. This means that the data N-gain visual thinking ability of the students of class PTBG and class PB has a variance homogeneity. Based on table 5 Note that N-gain data visual thinking ability has a variance homogeneity. Therefore, to know the differences of averagedata N-gain used Test $t$. As for the working hypothesis used is

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 > \mu_2$

Test result average difference data N-gain visual thinking ability of students are presented in the following table.

| N-Gain | t     | df  | Sig. (2-tailed) | Sig. (1-tailed) |
|--------|-------|-----|-----------------|-----------------|
|        | 3.038 | 58  | 0.004           | 0.002           |

Table 6 shows the value of the $\text{sig}(2$-tailed) is smaller than from $\alpha = 0.05$ so that $H_0$ is rejected. It means an increase in the ability of visual thinking PTB grade students acquire learning assisted geogebra tutorial better than grade PB which acquired learning.

3.2.2 N-gain Data analysis capabilities of Visual Thinking based on Category KAM

Based on table 4, note that score N-gain visual thinking ability of the students of class PTBG is higher than the score of N-gain PB class on each category KAM. To find out the difference of score N-gain significantly based on ANOVA 2 Way. Before that first test conducted a test of its homogeneity and normality. Test result data normality N-gain visual thinking ability of the students of the third category KAM served in the following table.

| Class | KAM Category | Shapiro-wilk Statistic | Shapiro-wilk DF | Shapiro-wilk Sig |
|-------|--------------|------------------------|-----------------|-----------------|

Table 7 shows data normality N-gain the ability of Visual Thinking based KAM.
Table 7 shows that all data N-gain the ability of visual thinking in both the class of each category KAM. Furthermore its homogeneity of variance test done. The following summary of test results of its homogeneity.

|        |       |      |      |      |
|--------|-------|------|------|------|
|        |       | df1  | df2  | Sig  |
|        |       | 5    | 54   | 0,101|
|        |       |      |      |      |
|        |       |      |      |      |
|        |       |      |      |      |
|        |       |      |      |      |
|        |       |      |      |      |

Table 8. Its homogeneity test Score N-gain the ability of Visual thinking and Learning based KAM

Test results of its homogeneity and normality is known that N-gain data visual thinking ability based on the category of KAM distributed class on both normal and homogeneous. ANOVA test done the next two way. As for the working hypothesis used is

Colum Factor

$H_0 : \mu_{PTBG} = \mu_{PB}$

$H_1 : \mu_{PTBG} \neq \mu_{PB}$

Line Factor

$H_0 : \mu_1 = \mu_2 = \mu_3$

$H_1 : \mu_i \neq \mu_j$, wherei, j = 1, 2, 3

ANOVA test results two lines can be seen in the following table.

Table 9. ANOVA test results two lines of Data N-gain the ability of Visual Thinking

| Factor        | Sum of Squares | Df | Mean Square | F    | Sig.  |
|---------------|----------------|----|-------------|------|-------|
| KAM Category  | 0,319          | 2  | 0,159       | 4,384| 0,017 |

Table 9 shows that the category KAM give significant effects against visual thinking ability of students. It can be seen from the significance value less than $\alpha = 0.05$, namely 0.017. This means that there is a difference of visual upgrade thinking students who obtain learning tutorials and regular learning geogebra assisted by category KAM. Next, to find out which category of KAM differs significantly to the enhancement of the capabilities of visual thinking done test Advanced ANOVA Tukey HSD Test I. Tukey HSD test results can be seen in the following table.

Table 10. Advanced Anova Tukey HSD Test

| Pair of KAM     | Mean Difference | Sig  | Explanation       |
|-----------------|-----------------|------|-------------------|
| HSD             | High-Medium     | 0,0797| 0,468 | Receive $H_0$     |
| Tukey           | High-Low        | 0,2470| 0,015 | Reject $H_0$      |
| Medium-Low      | 0,1673          | 0,042| Reject $H_0$      |

Based on the table above it can be concluded that there was no significant difference in visual thinking ability of students improved on the category high with medium. While there is a significant difference of visual thinking ability enhancement in the categories high-low and medium-low category.

4. Discussion

Based on the analysis results data N-gain inferred that increased the ability of visual thinking, it was concluded that upgrades visual thinking PTBG grade students significantly better than PB. Preferably visual upgrade thinking of students in the class of PTBG of learning is done in the class. Learning-assisted tutorial geogebras (PTBG) gives students the opportunity to discover their own knowledge or
concepts of transformation and develop visualization resources with students who are in the program geogebra.

The process of discovery and knowledge of the construction of a new look at the use of learning activities is characterized. Power visualization students developed through the course of geogebra. Geogebra program gives students the ease in exploring the ability of visualization by shifting, reflect, rotate and zoom in or out of the object. According to Saha [8] assisted learning geogebra is very effective in learning geometry. Gumanti [11] in his research mentioned that the program displays a simple visualization of geogebra some concepts geomeri. The existence of the visualization features in geogebra is very effective in helping students understand the concept of geometry of the particular transformation.

Geogebra also assisted tutorial learning dilengkap with exercise matter contained on the tutorials. Administering the practice question interactive learning is useful to check for understanding student learning to the materials. Good or not understanding the students towards the subject matter will be assessed by computer. This is in accordance with the opinion of Rusman [12] which stated that the practice of reserved in interactive media can maximize learning activities and subject matter, as well as helping students independently to perform reflection against the learning material. Assessment or feedback is very important as a basis to refine learning [13]. From the explanation above, it can be concluded that learning assisted geogebra tutorial better than usual in developing learning and to improve the ability of visual thinking students.

Based on the analysis of test ANOVA 2 lines, note that there is an increase in the ability of the visual thinking of students based on the category of KAM. From the analysis of ANOVA Tukey HSD further noted that there was no difference in improvement of visual thinking ability of students of a high significant between categories category with KAM currently, but there is a difference of visual thinking ability of students improved significantly between categories with KAM low category. And there is the visual thinking ability of students improved significantly between categories are categories with KAM.

This happens because students are high category of KAM a lot more benefit from the learning that has been implemented. Students of higher and medium KAM had mathematical ability is stronger than students with KAM students low so high and medium able to absorb information properly. In line with the results of the research of Elda [14] that students with high and medium KAM can receive the material well and are able to teach it to students who are low-skilled.

5. Summary And Suggestions

Based on the results of data analysis and discussion can be drawn the conclusion that the increased ability of visual thinking students who obtain learning assisted geogebra tutorial better than students who obtain the usual learning, and there is an increased ability of visual thinking students based on category KAM.

From the summary above, then it is recommended to teachers to make learning assisted geogebra tutorial as an alternative learning that can enhance the visual thinking ability of students. Next learning assisted geogebra tutorial suitable for Junior High School students applied to the categories medium and low for develop the visual power of students.

6. References

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