The Effect of Using Origami Paper to Teach the Perimeter of Plane Figures on Cognitive Achievement of Students Grade IX

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Abstract

This pre-experimental research design aims to know whether there is an effect of using origami paper to teach the perimeter of plane figures on cognitive achievement of students in grade IX and how the use of origami paper can affect students' cognitive achievement. The subject was taken from 16 students of class IX-A as an experimental class that were going to study using origami paper as the teaching aid. The data obtained was students' pre-test and post-test. The gained mean of students' score between pre-test and post-test was significantly greater than the expected score 0.4, in fact the gain reached 0.82 which is categorized high. Thus, it can be concluded that there was an effect of using origami paper to teach the perimeter of plane figures on students' cognitive achievement.

Keywords: Teaching Aids, Origami Paper, Cognitive Achievement, The Perimeter of Plane Figures

Abstrak

Desain penelitian eksperimen ini dilakukan untuk melihat apakah terdapat pengaruh penggunaan kertas origami untuk mengajar keliling dari suatu bidang datar terhadap hasil belajar kognitif siswa kelas IX dan bagaimana penggunaan tersebut mempengaruhi hsil belajar. Sampel penelitian adalah 16 siswa kelas IX-A sebagai kelompok ekperimen yang akan menggunakan kertas origami. Data diperolehh dari hasil *pre-tests* dan *post-tests*. Hasil penelitian menunjukkan ada perbedaan rata-rata skor yang signifikan antara hasil *pre-tests* dan *post-tests* yang di duga, yaitu 4.0 (*normalized gain*), bahkan mencapai 0.8 yang termasuk golongan tinggi. Sehingga, dapat disimpulkan bahwa terdapat

pengaruh pada hasil belajar kognitif pada pengajaran keliling suatu bidang datar dengan menggunakan kertas origami

Kata Kunci: pengajaran, bantuan, kertas, origami, hasil belajar, kognitif, keliling, bidang datar.

Introduction

Mathematics is known as a subject that contains abstract concepts. Not surprisingly, there are still students who have low learning achievement. Students need a different way of learning mathematics, to help them understand the concept of mathematics, which is abstract to become more real. Thus, a teaching aid is needed to deliver the material to the students. In this research, the teaching aid which was origami paper, was used to teach the Perimeter of Plane Figures. By using origami paper, it was expected that students could understand the lesson more clearly and more easily, so it could affect their cognitive achievement. From that background, the problems of the research were:

1. Is there any effect of using origami paper to teach the perimeter of plane figures on cognitive achievement of students in grade IX?
2. How does the use of origami paper in teaching the perimeter of plane figures can affect cognitive achievement of students in grade IX?

Students' Cognitive Achievement

To define students' achievement, it cannot be separated from the definition of learning itself, which is a change happened after someone learned (Djamarah & Zain, 2013, p. 38). This change happened is going to be measured as students' learning achievement.

"Achievement is the degree of inference required on the part of student to give response, and by the type of reference to a learning process made explicit in the measurement tool" (Algarabel & Dasi, 2001, p. 45). From the *Education Research International Journal*, learning achievement is defined by how successful the learner can master the materials of the learning object (Feng, Fan, & Yang, 2013, p. 52). Still cited from the same journal, learning achievement is the acquisition of knowledge or skills that are developed by subject matter, usually indicated by test scores or numerical value is assigned by teachers (Chien, 1987, in Fen, Fan, & Yang, 2013, p. 52). From the definition above, it can be concluded that learning achievement is a result of the students during the teaching and learning process, and it usually represented by the score gained from the measurement tool. More specifically in Mathematics, achievement is defined by students' ability in computations and solving problems, which normally be measured by written test (Evans, 2007, p. 24).

While Benjamin Bloom (1956) categorized the result of learning into three domains, which are: cognitive, affective, and motor/skill. "Cognitive domain is defined as the domain that includes those objectives which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills" (Bloom, 1956, p. 7). Then the cognitive domain is divided into some levels, those are: knowledge (C1), comprehension (C2), application (C3), analysis (C4), synthesis (C5), and evaluation (C6) (Bloom, 1956, p. 18).

By the definitions of students' achievement and the explanation of cognitive domain of learning, then it can be concluded that students' cognitive achievement is a result of the students during the learning process, particularly for cognitive area. It usually represented by the score from the measurement tool given to the students. In this research, the cognitive area was restricted on the third dimension, which is application according to the learning objectives set by the school' curriculum.

Origami Paper as Teaching Aid

The definition begins with the understanding of teaching aid itself. "Teaching aids are tools to help the teacher in teaching and learning activity" (Aqib, 2014, p. 49). By using teaching aids, it is expected that the material can be delivered more clearly and more completely so that the learning goal can be achieved. "Teaching aids are the learning media that contains or brings the characteristics of the concept that is learnt" (Suharjana, 2009, p. 3). In delivering the material in mathematics, teaching aid bring the characteristics of abstract concept and bring it into a more-real and more-concrete to the students. From another source it is said more specifically that, "Mathematics teaching aids are a set of concrete object which designed, made, compiled, or arranged intentionally in order to be used to help embed and develop the concept or principles in mathematics" (Pujiati, 2004, p. 3).

Origami comes from Japanese words, "*oru"* means folds and "*kami"* means paper, which means the art of folding sheets of paper into beautiful objects (Lang, 2009, p. ix). Origami can be used to teach the concept of Mathematics. Norma J. Boakes in his research, *Origami-Mathematics Lesson: Paper Folding as a Teaching Tool*, defined that origami is the art of paper folding (Boakes, 2009, p.1) as an effective mathematics teaching tools. The base material to make origami is origami paper. In this research, the researcher took the origami paper in order to be used as teaching aid to teach the plane figures to the students. The consideration taken by the researcher to use origami paper was because that paper actually contained the particular size that was used by the researcher to form the figures more easily.

The Perimeter of Plane Figures

Mathematics divided into 5 content standards, which are (1) Number and Operations, (2) Algebra, (3) Geometry, (4) Measurement, and (5) Data Analysis and Probability (Van de Walle, 2007, p. 4). In this research, it will be focused only in the area of Geometry. "Geometry is the study of properties of shapes and is

used to reach conclusions about the sizes of angles and the lengths of lines" (Berry, Graham, Sharp, & Berry, 2003, p. 102). Therefore, geometrical problems cannot be separated with the figures, both plane and space figures. "Plane geometry is the study of two-dimensional figures, their properties and relationship" (Hatfield, Edwards, Bitter, & Morrow, 2005, p. 341). While the plane figure is a figure in two dimensions (Sheffield & Cruikshank, 2005, p. 336). For the plane figures, one of the matters is the perimeter which defined as the length of the line around the circumference of the figures.

Based on KTSP Curriculum, the perimeter of plane figures is one of the materials of Mathematics subject on grade VII and VIII of Junior High School. In grade VII, students learn about the perimeter of triangle and rectangular figures, such as square, rectangle, trapezium, parallelogram, rhombus, and kite. While in grade VIII, the figure is circle. In grade IX, students do a review on the previous grade's material. So the topic of the perimeter of plane figures that was going to be taught was including all of the figures. While the way to calculate the perimeter is actually by adding all of the sides of the figures.

The research hypothesis is the gained mean of students' score between pre-test and post-test was significantly greater than the expected score. Thus, there is an effect of using origami paper to teach the perimeter of plane figures on cognitive achievement of students in grade IX.

Research Methodology

This research method is an pre-posttest experimental design. The sample was taken by purposive sampling, by taking the available class to do the research, which was class IX-A as an experimental class. The instrument used were test and observation checklist. The data of students' cognitive achievement was taken from the test instrument, both pre-test and post-test, which consists of 10 essay questions. While the data of the use of origami as teaching aid was taken from mentor's observation checklist. The validity of those instruments were determined by content validity and instrument trial for test as the main instrument. First, content validity was done by two experts, who were mathematics lecturer and mathematics teacher. Then it was continued by doing instrument trial on class IX-B. The test given as instrument trial was only the pre-test because the material of both pre-test and post-test were designed parallel each other for each item number of the test. The validity of instrument testing was determined by using *Pearson Product Moment* correlation, while the reliability was using *Alpha Cronbach*. From the result of instrument testing, it was obtained that all of the test item were valid (the value of r for each item number > r table at the level of significance 5%). While the reliability obtained was 0.84, and it was interpreted as strong or high.

The data of students' tests were calculated its normalized gain score (N-gain) in order to know the transition of learning from pre-test to post-test. The data of pre-test and post-test were merged into the data of students' normalized gain score that was going to be analyzed. The normality testing was done by Kolmogorov-Smirnov while the homogeneity testing was not done because the

data was only single data. The statistical technique used to make decision of the hypothesis was Z-test. Using the mean of students' N-gain score, the expected mean, and the standard deviation, the Z-score was obtained. Then the value of Z was compared to Z-table at the level of significance 5%.

The Use of Origami Paper as Teaching Aid

The use of origami paper as teaching aids was shown by the steps of teaching students by direct instruction: opening, presentation, evaluation, and closing. The evidence of using origami in teaching was shown by the lesson plan made by the researcher, and also by the observation checklist from mentor as an observer to the researcher. From the observation done during the three times of treatment, it was concluded that the researcher had done all the steps of teaching using origami as teaching aids in a proper way.

Students' Cognitive Achievement

The students' N-gain score was calculated according to the formula of:

$$\langle g \rangle = \frac{Posttest\ score - Pretes\ \ score}{Maximum\ score - Pretest\ score}$$ (Hake, 1998, p. 65)

The table below shows the N-gain result of each student:

Students' No	Pre-test	Post-test	N-gain
S-1	86	94	0.57
S-2	50	82	0.64
S-3	76	100	1.00
S-4	64	72	0.22
S-5	70	100	1.00
S-6	70	94	0.80
S-7	80	100	1.00
S-8	86	100	1.00
S-9	78	100	1.00
S-10	42	94	0.90
S-11	50	98	0.96
S-12	55	92	0.82
S-13	72	96	0.86
S-14	60	96	0.90
S-15	64	88	0.67
S-16	66	94	0.82
Average			0.82

Table 1. Normalized Gain Score for Each Students

Then the descriptive statistics of the data now became:

Descriptive Statistics of NGain

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
N_Gain	16	.22	1.00	.8225	.21193	.045
Valid N (listwise)	16					

Table 2. Descriptive Statistics of N-gain Score

The normality testing using Kolmogorov-Smirnov obtained that the significance of the data was 0.971 and it can be concluded that the data distribution is normal.

The calculation of Z-score according to the formula is:

$$Z = \frac{X - \mu}{S} = \frac{0.823 \quad 0.4}{0.212} = 1.995$$

This value is bigger than the critical value 1.645 (α=5%, one tail). Thus, H_0 is rejected. The statement of H_0: The mean of the normalized gain of students' cognitive achievement is less than 0.4, is rejected, or, H_1: The mean of the normalized gain of students' cognitive achievement is greater than or equal to 0.4 is supported. Thus, it can be said that the students' cognitive achievement after being taught using origami paper is significantly higher than students in the general population and hence represent a population of students whose cognitive achievement is higher.

It also means that the average of students' gained score is 0.82 and is categorized high. This score also greater than the expected value, which is 0.4. It can be said that the students' cognitive achievement after being taught using origami paper is high. Thus, the result of the hypothesis testing shows that there is a positive and significant difference between the students' result on pre-test before learning using origami paper and post-test after using origami paper as teaching aid to teach the perimeter of plane figures on cognitive achievement of students' grade IX.

Conclusion and Recommendation

From the result of the research, it was concluded that there is an effect of using origami paper as teaching aid to teach the perimeter of the plane figures on students' cognitive achievement grade IX. While the effect is represented in the normalized gain 0.82 and categorized as high. While Origami paper as a teaching aid can affect students' grade IX cognitive achievement by using it in the classroom. To improve the reliability of the result, it is going to be better if the research design is an experiment-control group design.

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