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IMPROVING STUDENT CREATIVE THINKING ABILITY WITH PROBLEM BASED LEARNING APPROACH USING HAWGENT DYNAMIC MATHEMATICS SOFTWARE

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Abstrak

The main problem in this study is the lack of mathematical creative thinking abilities of elementary school students in Cimahi, Indonesia. This lack of mathematical creative thinking abilities is caused by an incorrect learning process. The teacher does not direct students to think creatively. In fact students still depend a lot on what is explained by the teacher in the class. The learning process with problem-based learning that is aided by hawgent dynamic mathematic software can direct students to think creatively. The population in this study were all elementary school students in Cimahi city. The samples were the students of elementary school Cimahi class 3A and 3B. The instrument in this study is descriptive test of students creative thinking abilities. This instrument was used to obtain data about students' creative thinking abilities with problem-based learning approach using hawgent dynamic mathematic software and by conventional learning. The data processed in this study was from the post-test score. These scores from both of the experimental class group and the control class group. Then, the data was processed by using SPSS 19.0 and Microsoft Excel. The data was analyzed using t-test statistic. The final result of this study concluded the achievement and improvement of creative thinking abilities of students whose learning problem-based approach using hawgent dynamic mathematic software.

Keywords: *Hawgent Dynamic Mathematics Software, Student Creative Thinking Ability, Problem Based Learning Approach*

Abstrak

Masalah utama pada penelitian ini adalah kurangnya kemampuan berpikir kreatif matematis siswa sekolah dasar di Cimahi, Indonesia. Kurangnya kemampuan berpikir kreatif matematis ini disebabkan oleh proses pembelajaran yang tidak tepat salah satunya Pembelajaran yang tidak mengarahkan siswa untuk berpikir kreatif dan siswa masih banyak bergantung pada apa yang dijelaskan oleh guru di kelas. Proses pembelajaran dengan problem based learning yang dibantu perangkat lunak matematika dinamis hawgent dapat mengarahkan siswa untuk berpikir kreatif. Populasi dalam penelitian ini adalah seluruh siswa sekolah dasar di kota Cimahi. Sampel pada penelitian ini adalah siswa SD Cimahi kelas 3A dan 3B. Instrumen dalam penelitian ini adalah tes tertulis kemampuan berpikir kreatif siswa. Instrumen ini digunakan untuk memperoleh data tentang kemampuan berpikir kreatif siswa dengan *problem based learning approach* menggunakan hawgent *dynamic mathematics software* dan dengan pembelajaran konvensional. Data yang diolah dalam penelitian ini berasal dari hasil skor pretest-posttest. Kemudian data diolah dengan menggunakan SPSS 19.0 dan Microsoft Excel. Hasil akhir penelitian ini menyimpulkan pencapaian dan peningkatan kemampuan berpikir kreatif siswa yang pembelajarannya menggunakan *problem based learning approach* menggunakan hawgent *dynamic mathematics software* lebih baik dibanding pembelajaran konvensional.

Kata Kunci: *Hawgent Dynamic Mathematics Software, Kemampuan Berpikir Kreatif Siswa. Pendekatan Problem Based Learning,*

INTRODUCTION

Mathematics is a very important lesson for the continuity of human life, especially in daily life (Aminah, Wijaya, & Yuspriyati, 2018; Dini, Wijaya, & Sugandi, 2018). Martin (Chotimah, Bernard, & Wulandari, 2018) said that mathematics is one of the lessons that is closely related to real life, there are a lot of things or problems around us that requires mathematics. mathematics has an important role in developing humans' thinking abilities (Kulsum, Hidayat, Wijaya, & Kumala, 2019),

that is why mathematics becomes the foundation in developing modern technology. Mathematics equips students to have the abilities to think logically, analytically, systematically, critically, and the abilities to cooperate. The importance of learning mathematics is to manage students' thinking abilities, reasoning (Chotimah et al., 2018), solving problems(Hutajulu, Wijaya, & Hidayat, 2019), communicating (Aminah et al., 2018; Andini, Mulyani, Wijaya, & Supriyati, 2018), linking mathematics to daily life, and being able to use and utilize technology (Wijaya, Ying, & Purnama, 2020a). One of the goal of mathematics learning is to improve students' creative thinking abilities. Mathematical creative thinking skill is needed by students to face the rapid progress in science and technology, also global competition that is more challenging and demanding (Jonsson, Norqvist, Liljekvist, & Lithner, 2014).

Creativity (creative thinking or divergent) is the abilities to find as much possible answers to a problem, where the emphasis is on the quantity, accuracy and diversity of answers (Suyidno, Nur, Yuanita, Prahani, & Jatmiko, 2018). creative thinking aims to gain new insights, approaches, or ways to understand things. While Johnson (Hidayat, 2017), states that creative thinking is a mind training by looking at instincts, triggering fantasies, creating new opportunities, developing admirable perspectives, expressing unexpected ideas.

Creative thinking abilities is the ability to produce or develop something new, that is different from others. creative thinking is a way of thinking that produces new concepts, understandings, inventions or work of art. a detail components of creative thinking, which are: Fluency that includes generating ideas, answers, solutions, or questions, proposing strategies, considering more than one strategy and its results; Flexibility that includes generating ideas, answers, or questions to perceive problems from various points of view, looking for alternatives, changing approaches or way of thinking; Originality includes bringing new or unique ideas, considering an unusual way, combining unusual parts or elements; Elaboration that consists of expanding and enhancing ideas or products, enlarging or determining an object, idea, or situation so that it becomes more interesting (Nuraini, Kusmayadi, & Fitriana, 2019; Rohaeti, Bernard, & Primandhika, 2019).

There has been a rapid development in information and technology in the field of education (Wijaya, Ying, Cunhua, & Zulfah, 2020; Wijaya, Ying, & Purnama, 2020b). Computers have been use mainly use to support the current teaching method especially in teaching science and mathematics (Wijaya, Ying, & Purnama, 2020a). Information and technology encourages teachers to continue innovating teaching aids or methods that will simplify the delivery of material in class so that student would be able to learn more effectively (Suan, Ying, & Wijaya, 2020; Wijaya, Sukma, Purnama, & Tanuwijaya, 2020).

Describing a difficult mathematic concept into a visual form such as using dynamic representation of mathematical modeling can improve the students' understanding abilities because by

only giving pictures of numbers would not be enough to push students to visualize or use their own words to explain the topic (Cunhua, Ying, Qunzhuang, & Wijaya, 2019). According to De Porter's research, humans can absorb more than 70% of the knowledge if they do it themselves. But if they only listen and see, they can only absorb 50%. If they only see something, they can only absorb 20% and they can only absorb 10% by reading something (Chotimah et al., 2018).

Hawgent Dynamic Teaching Software (Ω edition) is a powerful and easy-to-use tool for mathematics discipline recently introduced by Hawgent Mathematical Technology Center in 2018 (Cunhua et al., 2019; Wijaya, Purnama, & Tanuwijaya, 2020). Hawgent dynamic mathematic software has a powerful tool commands, but also allowing users to customize them. This includes editing existing and adding new menus and commands. This software can be use to portray mathematics questions from the easiest to the hardest questions very clearly. This is because this software can describe in detail about algebra, geometry and calculus (Wijaya, 2021). It is also very easy to use compared to other dynamic mathematic softwares. Hawgent is an open source that can be downloaded in http://www.hawgent.com. In this research, we will do an experiment of students' creative thinking abilities on fractions with the use of Hawgent Dynamic Mathematic Software and comparing it with the conventional teaching method .

METHOD

This research is using the method of pre-test and post-test that aims to test the different learning outcome between using Hawgent Mathematic Software with conventional teaching method in primary school. Samples are randomly selected for controlled and experimental class. The test for the students would be made according to the characteristic of creative thinking abilities towards mathematics and the guidelines for making good questions. The data analysis would use descriptive statistics and t-test by using SPSS 19.0. The design of the experiment would use the method of quasi-experiment like shown below:

A: O X O

A: O O

Key:

A: Classroom random sampling

0: Pre-test = Post-test students' mathematical understanding ability

X: Learning with Hawgent dynamic mathematics software

For the test data of the students' creative thinking abilities the two groups were processed with the help of Microsoft Excel software. Furthermore, the test results data (preliminary and final tests) of both groups were processed using Microsoft Excel and SPSS 19.0 software assistance with the following steps:

1) Testing the normality of sample data.

2) Test the Homogeneity of Variance.

3) Average Difference Test.

RESULTS AND DISCUSSION

At the beginning, researchers gave two classes a random pre-test sample. The two classes did the pre-test on fractions before learning about fractions.

Table 1.

Description of Control and Experimental Classes during Pre-test

Statistics		Experimental Class		Controlled Class	
		Pre-test	Post-test	Pre-test	Post-test
Creative Thinking Abilities towards Mathematics	N	27	27	27	27
	$\bar{x}$	3.70	18.33	3.67	14.74
	(%)	15%	76%	15%	61%
	S	1.35	4.50	1.90	0.59

According to Table 1, the average score in experimental class for their pre-test was 3.70 with an creative thinking abilities score percentage of 15% while in the controlled class, their average score was 3.67 with an creative thinking abilities score percentage of 15%. We can see that there is no significant difference between the two classes and so we can conclude that the creative thinking abilities of the two classes towards mathematics are the same in the beginning.

Later on, in the post-test, the experimental class have an average score of 18.33 with an creative thinking abilities score percentage of 76% while in the controlled class, their average score was 14.74 with an creative thinking abilities score percentage of 61%. With the data collected, we can see that the experimental class is better than the controlled class.

In the experimental class, the percentage of student that got creative thinking abilities during the pre-test was 15% and it increased during the post-test to 76% from the average ideal score. In the controlled class the percentage of student that got creative thinking abilities during the pre-test was 15% and it increased during the post-test to 61% from the average ideal score. From the data, we can see that there is an increase of 51% in the experimental class and 46% in the controlled class.

Table 2.

Class Control and Experiment Normality Test of pretest

Tests of Normality							
	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest	1	.328	27	.000	.828	27	.000
	2	.183	27	.021	.916	27	.031

According to Table 2, the significant value of experimental class that uses realistic learning is 0.000. While the significant value of the controlled class that uses traditional learning is 0.021 the value of sig taken from the Kolmogorov-Smirnov normality test. We can conclude that the normality test of the pre-test in not distributed normally. This means that both data must be continued to be tested with a different non-parametric mean called Mann-Whitney test.

Table 3.

Pretest of Mann-Whitney Test

Avg.Test	Value
Mann-Whitney U	328.500
Wilcoxon W	706.500
Z	-.643
Asymp. Sig. (2-tailed)	.520

According to Table 3, there is a significant figure of 0.520. Because the significant figure is more than 0.05, this means during the pre-test, there is no difference in their initial creative thinking abilities towards mathematics of primary school students that uses realistic learning and traditional learning.

After we know that the initial creative thinking abilities towards mathematics on the topic of fraction is the same, so we continue the teaching fraction by using Hawgent Dynamic Mathematic Software for the experimental class and conventional teaching method in the controlled class. After the teaching, we did a post-test to see the difference in the students' creative thinking abilities on the topic of fraction in the two classes.

Table 4.

Class Control and Experiment Normality Test of post-test

Tests of Normality							
	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Posttest	1	.200	27	.007	.830	27	.000
	2	.335	27	.000	.753	27	.000

According to Table 4, we can see that the significant value of the experimental class that uses realistic learning is 0.007. While the significant value of the controlled class that uses traditional teaching method is 0.000. This means that the significant value for both class is less than 0.05 and we can conclude that the normality test of the post-test is not distributed normally and need to continue to be tested with the Mann-Whitney test.

Tabel 5.

Average Test of Experiment Class and Post-test Control

Avg.Test	Value
Mann-Whitney U	126.500
Wilcoxon W	504.500
Z	-4.222
Asymp. Sig. (2-tailed)	.000

In Table 5, we can see that the result of the post-test on the creative thinking abilities towards mathematics has a significant value that is 0.000 on both sides (sig. (2-tailed)). Because we are only on one side (1-tailed) so P-Value = 1/2 Asymp.Sig (2-tailed)= 1/2 x0,000=0,000 and H0 is rejected. This shows that the achievement of creative thinking abilities towards mathematics with use of Hawgent Dynamic Mathematic Software is better than the students that uses traditional teaching method. This research result is the same result as the research that was done by Bernard where in by using mathematic software can, it can boost the learning result of students (Bernard & Chotimah, 2018).

During the teaching process, students can be seen to have difficulty in creative thinking abilities the meaning of fractions, way of calculating and using their own words to explain fractions. This is because students are still unable to find the connection between fractions and their everyday life. After students see the connection between fractions and their everyday life with the help of Hawgent Software, students are able to creative thinking abilities the meaning and solve fraction problems.

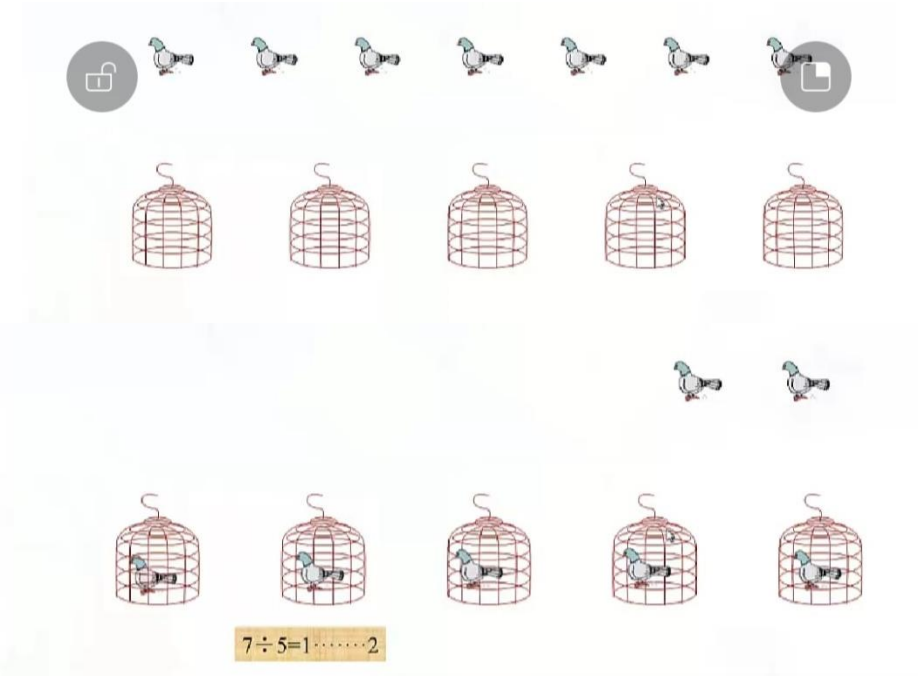

Figure 1. Basic example fraction with using Hawgent Dynamic Mathematic Software

Students are given some basic examples on fraction with the help of Pigeon animation (figure 1). Researches see that students are more interested when the teachers explain the topic using Hawgent Software than the conventional teaching method. Figure 2 presents a dynamic image of fraction. When learning fraction, students will feel boring. This dynamic situation mobilizes students' enthusiasm for learning. This problem can help students to solve a question easily by using hawgent dynamic math software. Therefore, The algorithm of the method makes it easy for students to understand and master this knowledge point. In order to provide some reference for the teaching of fraction. After students see the fraction question with the help of Hawgent Software, the creative thinking abilities of students are better compared to the class that uses conventional teaching method.

Gambar 2. Story about fraction using hawgent dynamic mathematic software

In addition to the descriptive test as a media evaluation, students gave their perception on the hawgent software that are later tested to solve various fraction problems. Researchers picked 3 out of 27 students from different abilities level to be a representative for evaluation.

Table 6

Students' Respond and Suggestion for Evaluation

Students' abilities	**Respond**	**Suggestion**
High Abilities	1. Very helpful to explore more	1. More interesting as a game
	2. Becomes easier	
	3. Want to learn more	
Moderate Abilities	1. Easier to be understood when explained	1. Add a background so that it will be more interesting to be seen
	2. Easier to understand compared when not using a media	2. The writings on the template need to be bigger
	3. When given a picture, it's clear	
	4. Happy to be able to find answers using Hawgent	
Low Abilities	1. Interesting and easy to understand	1. The steps should not be too fast
	2. More enthusiastic to learn when using Hawgent	

CONCLUSION

From the research we can conclude that the mathematic teaching that uses Dynamic Mathematic Software is much better than the conventional teaching method for primary school students. Hawgent Dynamic Mathematic Software can help students to give visualization example to students on the fraction topic that will increase the creative thinking abilities of the students.

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