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Brain based learning with contextual approach to mathematics achievement

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Abstract: The aim of this study was to know the effect of Brain Based Learning (BBL) with a contextual approach to mathematics achievement. BBL-contextual is the learning model that designed to develop and optimize the brain ability for getting a new concept and solving the real life problem. This study method was a quasi-experiment. The population was the junior high school students. The sample chosen by using stratified cluster random sampling. The sample was 109 students. The data collected through a mathematics achievement test that was given after the treatment. The data analyzed by using one way ANOVA. The results of the study showed that BBL-contextual is better than direct learning on mathematics achievement. It means BBL-contextual could be an effective and innovative model.

Keyword : BBL, contextual, mathematics achivement

1. Introduction

Education is one of the important factors for the development of a country. During this time, the government has to give some efforts to increase the quality through their various programs. Not only the government but also all schools and their components have to give some efforts in education quality. Teachers, who are the subject that have direct interaction with students, are also making a good condition in the learning process; especially in this study is the mathematics learning process.

Mathematics considered as the difficult subject for students. This case implies to the students' achievement. The data of Program for International Students Assessment (PISA) 2015 showed that the mathematics achievement score of Indonesian students was in 63rd of 69 participants. The data of Trends in Mathematics and Science Study (TIMSS) 2011 also showed the same results that achievement of Indonesian students was in 38th of 42 participants in TIMSS. It means that Indonesian students' mathematics achievement was in the bottom rank.

Students do some activities in the learning process. The definition of student's achievement is a result of activity that has done and created individually or group [1]. Another definition of it that supports the constructivist theory is an active activity where students construct their knowledge and find the meaning of what they learn [2]. The

constructivism states that students do the activity by constructing their knowledge through the activity which is designed by their teacher. Then, they conclude about what they get from the activities.

Students could also do activity in the mathematics learning. Johnson and Rising said that mathematics is about thinking, organizing, and also a logic proofing [3]. Students are thinking about the problem-solving. They list some information that given in the problem. Then, they make a design for the problem-solving. Besides that, students could develop their thinking ability through the proofing activity. Hence, they train their logic thinking through the mathematics problem-solving. So, student's mathematics achievement is a result of all activities during the mathematics learning process and also the interaction with their social environment and mathematical objects. So, they could develop their knowledge and skills.

There are also some issues in mathematics learning. The issue that found in the implementation is the difficulty to understand the concept. Students are difficult to solve some problem. Other issues are teacher centered and the passive students. So the active learning methods need in the learning process to support and optimize the students' ability.

Based on the problems that explained above, the learning process needs a learning method or model which help students to be active. The learning which facilitates students to be active and enjoy the learning is Brain Based Learning (BBL). BBL is learning that related to how our brain works naturally in the learning process [4]. This model focuses on how to optimize the brain ability. Students would enjoy for study when they are ready for it. The roles of the teacher are important to make a good condition for learning. The teacher should prepare the students' readiness and bring them into the learning when they are bored. The studies show that BBL was significantly positive in increasing the mathematics achievement [5] [6].

The student is the main subject in learning process who does some activities. Students have an interaction with each other and also their environment to develop their knowledge. Contextual approach is one of the learning approaches that gives an opportunity to construct the knowledge. The contextual learning approach involves students actively through a group discussion, learning based on the real problem, and also problem-solving. In the contextual approach, there are seven principles. They are constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment [7]. Those principles could be developed in the learning process.

Based on the definition of BBL and the contextual approach, BBL-contextual is the learning model that designed to develop and optimize the brain ability to make a good environment for getting a new concept and solving the real life problem. The steps of BBL-contextual built from the combination of the steps of BBL itself and the principles of contextual approach. The steps as follow:

1.1 Pre-learning

1.1.1 Students do some stretching and let them for drinking water.

1.1.2 The teacher asks their feeling; organizes their seat, and gives them a chance to speak what they want in learning.

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1.2 Preparation

1.2.1 Students get some motivation about the application of the concept.

1.2.2 Teacher informs the learning objectives.

1.2.3 Students work in a group (*learning community*).

1.3 Initiation and Acquisition

1.3.1 Students given some problems.

1.3.2 Students observe the problem.

1.3.3 Students ask about their concept that is not understood (*questioning*).

1.4 Elaboration

1.4.1 Students solve the problem individually. The problem is the 3D problem by using the contextual problem that shows in Figure 1. It challenges the students to create a box's net from the uncompleted cardboards that given. Firstly, students try to solve this problem by themselves. They think aloud by using their brain. Also, they facilitated by the environment that supported them in their study, such as drinking a water along the learning process, listening to the music, etc.

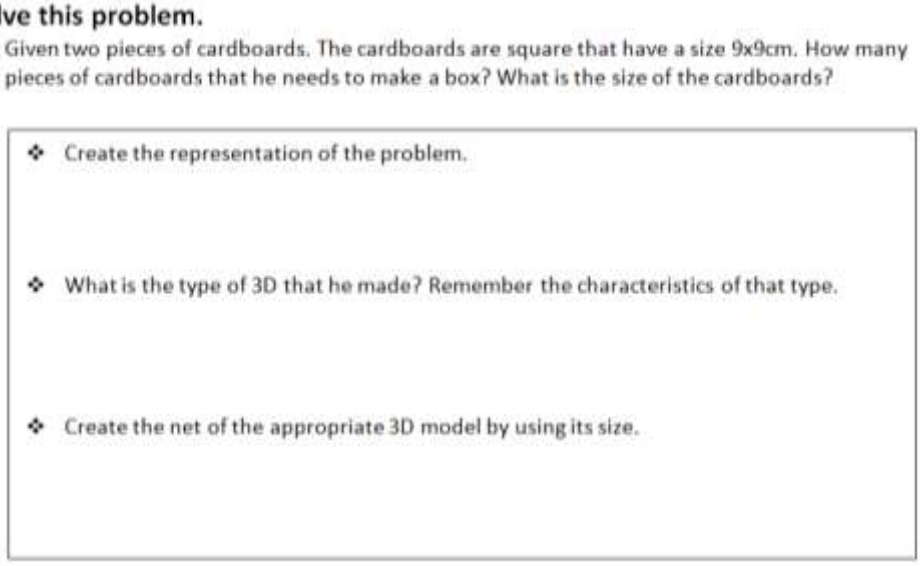

Figure 1. The contextual problem of the net of 3D

1.4.1 Students discuss the problem in a group (*learning community*). In this step, the students discuss it with their friends to share their ideas.

1.4.2 Students discuss and complete the worksheet and make a note about the necessary information using the book or the internet (*constructivism*). The students complete the worksheet as shown in Figure 1. First of all, they need to represent the problem into a picture. They draw two squares with the size 9x9cm. Then, they think what types of 3D should be made. Also, they need four pieces more of cardboards to make it. To answer it, they should remember the characterizations of 3D's models. In the end, they answer cube as the model of the box. After that, they create the net by using the size.

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1.5 Incubation and memory formation

1.5.1 Students arrange their solution and make a report of their work (*inquiry*). In the end, the answers of each group could be different. Figure 2 shows the types of the net of the box that is possible to make a box.

1.5.2 The students relax by listening the music, etc. (*reflection*)

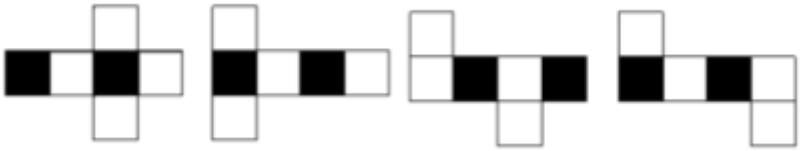
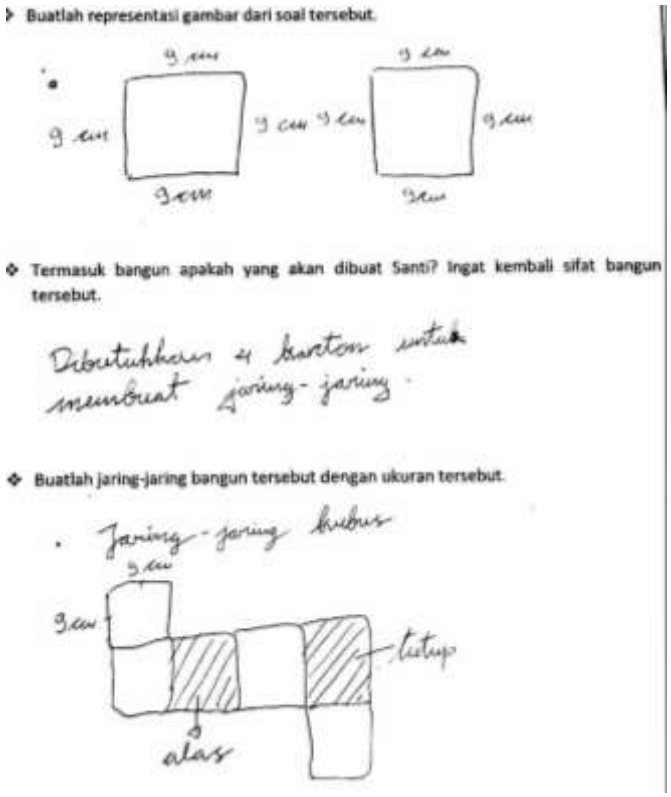


Figure 2. The nets of cube

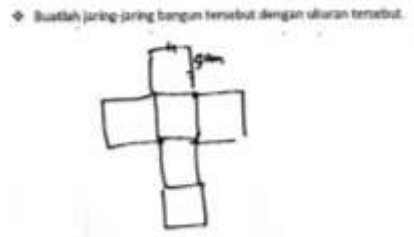
1.6 Verification

One of the group members presents their work in a class discussion (*modeling*). Figure 3 shows the reports of the students. Figure 3(a) shows that they could represent the problem into a picture. Then, they also determine the 3D model. Figure 3(a), (b), (c), (d) shows that they discover many types of the net of the box. They also determine the cover and the base of the box. So, the knowledge of the students is not bounded for the one model. But, they can develop their idea through the meaningful learning.



(a)

(b)



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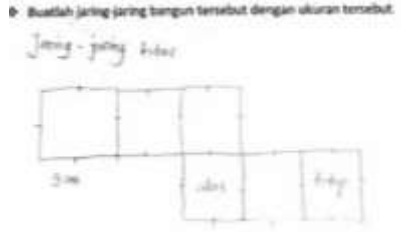

(d)

Figure 3. The students' answer

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1.7 Integration

Teacher gives a credit and reward for the one who presents in class as a motivation for other and does a quiz for the assessment (*authentic assessment*).

According to the issues, the study about BBL-contextual is essential to know the effect of this model on mathematics achievement.

2. Experimental Method

This study was a quasi-experiment. The research design was randomized static group comparison design [8] as shown in Table 1. BBL-contextual implemented to the experimental group.

Table 1. Randomized static group comparison design

Group	Treatment	Post-test
Experiment	X	T
Control	-	T

The population was the students of grade 8th of junior high school in Surakarta. The sample chosen by using stratified cluster random sampling. The sample was 109 students who were divided into two groups, 49 students as the experimental group and 60 students as the control group. Every group of students consisted of the high, medium, and low achievement of students

The variables consisted of an independent variable and dependent variable. The independent variable was the BBL-contextual model. The dependent variable was student's mathematics achievement. The instrument in this study was the test. It is the multiplication choice test. It validated by the masters. Also, it tested the reliability of the item. It consisted of 25 items of geometry problems. The item consisted of four choices as shown in Figure 4. It gave to the two groups after the treatment.

The wire has two meters long. It made as the frame of a cube. The size of the cube has four centimeters long. The numbers of the frame that possible made are … frames.
a. 2
b. 4
c. 8
d. 12

Figure 4. The item of the mathematics test

The data analyzed by using one way ANOVA to know the effect of the model. The hypothesis in this study was

H_0: $\alpha_i = 0$, for every $i = 1,2$

H_0: at least one $\alpha_i = 0$ was not zero

where

α_i : the effect of the i^{th} row to the dependent variable

i = 1,2

1 = BBL-contextual model

2 = direct learning model

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The level of significance is $\propto = 0.05$. The criteria of H_0 is rejected if $F > F_{table} = 3.93$ [9].

3. Result and Discussion

The data of mathematics achievement shows in Table 2. The data is the mean score, standard deviation, the maximum and minimum score of each group. Table 2 shows that the average score of student's mathematics achievement of experiment group was higher than the control group.

Table 2. The data of mathematics achievement

Statistics Description	Experiment	Control
Mean	61.22	53.60
Standard Deviation	13.35	12.44
Max Score	92	88
Min Score	32	32

The variables consisted of an independent variable and dependent variable. The independent variable was the BBL-contextual model. The dependent variable was student's mathematics achievement. The Normality and homogeneity test did before the hypothesis testing. Normality test was done to know the data normally distributed or not. If the significance value was less than 0.05 or $L_{obs} > L_{table}$, then H_0 is rejected. The result of normality test by using Lilliefors method shows in Table 3. The data that used in normality test was the data of mathematics achievement test of each group.

Table 3. Normality test

Class	Normality Test (Lilliefors Method)			Conclusion
	L_{obs}	L_{table}	Interpretation	
Experiment	0.09	0.13	H_0 is not rejected	Normal
Control	0.10	0.11	H_0 is not rejected	Normal

Table 3 shows that the L_{obs} score of mathematics achievement in experiment group was less than $L_{table} = 0.13$ and also L_{obs} mathematics achievement in the group was less than $L_{table} = 0.11$. So the population normally distributed for both groups. Then, it continued to the homogeneity test.

Homogeneity test used F-test two samples for variances. It was done to know the classes had the same variance or not. If $F > F_{table} = 0.51$, then H_0 is rejected. The data of mathematics achievement test of two groups compared. The result was $F_{obs} = 0.47$ is less than $F_{table} = 0.51$. This result shows in Table 4. Table 4 shows that the variance of the score of student's mathematics achievement in experiment group one and two was homogenous. After normality and homogeneity test then it continued to the hypothesis test.

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Table 4. Homogeneity test

Test	F_{obs}	F_{table}	Interpretation	Conclusion
Student's mathematics achievement	0.47	0.51	H_0 is not rejected	Homogenous

The results by using one way ANOVA with different cell shows that $F = 9.49 > F_{table} = 3.93$. It concluded that there was significantly different from learning by using BBL-contextual or direct instruction on mathematics achievement. It means BBL-contextual is better than direct learning model.

The BBL-contextual model helps students to optimize their brain and develop their thinking ability. The best way of learning is using the balancing of the brain to get the best result [5]. To optimize the brain ability, the teacher facilitates students to make their environment that suits for them by themselves, such drinking water or stretching, etc. Students could make a pattern that is related to the topic by using their brain [10]. They also collect some information in the various ways to achieve their goal. So, the student could study well as they want.

Based on the result, there is significantly different between learning mathematics by using BBL-contextual and direct learning. In the learning process, students have to achieve their competency in some indicator as for their achievement. Not only get the best achievement but also they could get some experiences through the activities in problem-solving around them. Besides that, they learn by using their cognitive or brain ability. The brain would be optimal when there is no pressure for the student. Students would be free for study. In this situation, the hard work of teacher needed to control them. In the other hand, direct learning does not facilitate students to do some activity. Students do some exercises from the lowest to the highest level. Students would get bored by listening or only do exercises. If they are not focused; then it impacts to their achievement. This study supported by the research that shows the effectiveness of BBL on the students' achievement [5] [6]. Also, BBL gave the positive contribution to the achievement [11]. Based on the previous research, BBL is better than the traditional method. In this study, BBL-contextual is better than direct learning to implement in mathematics.

4. Conclusion

According to the result, it concluded the learning by using BBL-contextual is better than direct learning. The result of one way ANOVA with different cell shows that the score of $F = 9.49 > F_{table} = 3.93$. Also, the mean score of BBL-contextual group is higher than the control group. So, BBL-contextual is better than direct learning. BBL-contextual could be implemented in mathematics learning as an active and effective learning model for getting the best achievement. BBL-contextual facilitates the students to discover a concept of geometry through the contextual problem. Also, the students can do some

activities to create the comfort zone for their study. The students have no pressure in the learning process by using this model.

The researchers recommend for school to implement this model and also develop this model by making a combination with another learning model to increase the student's mathematics achievement. Besides that, students have the different ability, personality, background, etc. So perhaps, this factor could be attention. For another researcher, this study could develop with another variable or compare BBL-contextual and the other learning model.

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