Contextual Approach with Guided Discovery Learning and Brain Based Learning in Geometry Learning

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Abstract. The aim of this study was to combine the contextual approach with Guided Discovery Learning (GDL) and Brain Based Learning (BBL) in geometry learning of junior high school. Furthermore, this study analysed the effect of contextual approach with GDL and BBL in geometry learning. GDL-contextual and BBL-contextual was built from the steps of GDL and BBL that combined with the principles of contextual approach. To validate the models, it uses quasi experiment which used two experiment groups. The sample had been chosen by stratified cluster random sampling. The sample was 150 students of grade 8th in junior high school. The data were collected through the student’s mathematics achievement test that given after the treatment of each group. The data analysed by using one way ANOVA with different cell. The result shows that GDL-contextual has not different effect than BBL-contextual on mathematics achievement in geometry learning. It means both the two models could be used in mathematics learning as the innovative way in geometry learning.

1. Introduction
Learning process is not always a transfer of knowledge from teacher to student, but the students should be the main subjects who construct their knowledge through the real experience in mathematics learning. One of the learning approaches that give a chance to construct the knowledge is contextual approach. The contextual learning approach involves students actively through a group discussion, learning based on real problem, and also problem solving. There are seven principles of contextual learning, such as constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment [1].

Students do some activities to achieve their goal in mathematics learning. Mathematics is about thinking, organizing, and also a logic proofing [2]. The activity which did in mathematics learning is about how students thinking, organizing, and proofing by using their logic to solve problem in their life.

Based on the observation and interview with some junior high school teachers about the geometry learning, the active mathematics learning was not seen. Some students follow the activity actively and criticize the teacher's explanation, but commonly, they are passive during the learning process. There are some problems in mathematics learning, such as many students were difficult to understand the concept and solve a mathematics problem, teacher centered, students get the formula of geometry
directly from their teacher so the learning was meaningless, students’ differences were not considered by the teacher, and the passive learning process. Some students are difficult to solve the contextual problem. The contextual problem, which shown in Figure 1, is a daily life problem. But, students answer the problem theoretically. They use formula to find the volume of the aquarium directly. They do not realize that the water in the aquarium is not full in reality. According to the issues, the innovative learning methods need in learning process to give a meaningful learning.

**Solve this problem.**

1. Jane has two cube aquariums. The size of an aquarium is 40cm. He cleans the aquarium every week and fills it with the water. What is the possible volume of the water to fill the two aquariums?

**Figure 1.** The contextual problem of cube

One of the learning models is Guided Discovery Learning (GDL). Actually, the models could motivate students to be more active and help them for the deep understanding about the concept [1]. Teacher guides the students to use their previous knowledge in concept discovery. This is the essential step of the guided discovery. Actually, the formulas in geometry learning could be found by the students. So, the teacher does not need to give the formulas directly.

The discovery concept shows in Figure 2. Figure 2 shows that the students should observe the four cubes which built from some units of small cube. Where, the small cube is 1x1x1cm unit cube. Then, they complete the table based on their observation. Hopefully, they could find the pattern of their previous step. After that, they conclude what they discover. In the end, they could find the formula of the cube’s volume that is the cubic of the length of its side.

**Figure 2.** The discovery process of volume of the cube

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Another active model which facilitates students in the meaningful learning is Brain Based Learning (BBL). BBL is a learning that related how our brain works naturally in the learning process [3]. This model focuses on how to optimize the brain ability through the good environment for learning. This model also facilitates students to discover a concept.

According to the characterization of contextual approach, GDL and BBL are compatible to combine with this approach. The steps of GDL and BBL with contextual approach were built from the steps of each learning model and the seven principles of contextual approach. The discovery process as shown in Figure 2 would be integrated into the GDL-contextual and BBL-contextual learning.

GDL with contextual approach is a student oriented learning model which motivate student to involve in learning activity by guessing, using intuition, investigating, making conclusion, and guided by teacher. Teacher helps them to use their idea, concept, and skill to find a concept of the real problem. Basically, GDL-contextual is the learning model that students guided by the teacher in learning process to discover a concept and solve some contextual problem. The six steps of GDL-contextual are introduction, exploration, presentation, wrap up, practice, and evaluation. The implementation of GDL-contextual in geometry learning shows in Figure 3.

### Figure 3. The steps of GDL-contextual in geometry learning

| Introduction | Exploration | Presentation | Practice | Wrap Up |
|--------------|-------------|--------------|----------|---------|
| Teacher informs the learning objectives and motivating students to active in learning activity. Such as, the volume of cube uses to know the volume of water in bath, aquarium, etc. | **Students work in group (learning community).**<br>**Students complete the worksheet guided by the teacher as shown in Figure 2.**<br>**Students observe and ask if they do not understand (questioning).**<br>**Students arrange the conjecture (hypothesis) of their analysis by teacher guidance.**<br>**Students find the solution by teacher guidance (inquiry).** | **Students write the result of their group discussion and present it in the class (modeling).** | **Students solve some problem in life about the volume of cube by using the formula that they discovered before (reflection).** | **Teacher asks some questions to test their understanding about the concept (questioning).** |
| Evaluation | **Teacher does a quiz to know their understanding about the concept (authentic assessment).** | | |

Another model, BBL-contextual is the learning model that designed to develop and optimize the brain ability to making the good environment for getting the new concept and solving the real life problem. The implementation of BBL-contextual shows in Figure 4.
In the end, students could get two benefit, those are problem solving and social, through this models. The previous research shows that Guided Discovery Learning was leading rather than the conventional method in increasing mathematics achievement [4] [5]. Further, Guided Discovery was significantly positive to the student perform in geometry [4]. The previous research shows that BBL was significantly positive in increasing the mathematics achievement [6] [7]. So, the study about the two models, GDL-contextual and BBL-contextual, is essential to know the effect of each model on mathematics achievement in geometry learning.

2. Experimental Method
This study was a quasi-experimental research. The research design was randomized static group comparison design to know the effect of the each treatment to dependent variable [8]. The experiment 1 is the group that using GDL-contextual model in the geometry learning. The experiment 2 is the group that using BBL-contextual model in the geometry learning. The post-test was given to the two groups after the treatment as shown in Table 1.
Table 1. Randomized Static Group Comparison Design

| Group       | Treatment | Post-test |
|-------------|-----------|-----------|
| Experiment 1| X₁        | T         |
| Experiment 2| X₂        | T         |

This study did at Surakarta, Indonesia. The population was the students of grade 8th of junior high school. Then, they categorized as the high level school, middle, and low. The sample was chosen by using stratified cluster random sampling. Two classes were chosen randomly from each level of school. The samples were 76 students as the experiment group 1 and 74 students as the experiment group 2. The students of each experiment group consisted of the high, middle, and low of students’ achievement.

The variables consisted of independent variable and dependent variable. The independent variable was the learning models. The dependent variable was student's mathematics achievement. The instrument in this study was the test of student's mathematics achievement. The test was given after the treatment. The data analysed by using one way ANOVA to know the effect of the two models. The level of significant is $\alpha = 0.05$. The criteria of $H_0$ is rejected if $p$-value (sig) < $\alpha$ or $F > F_{table} = 3.905$ [9].

3. Result and Discussion

The data of student's mathematics achievement test is shown in Table 2 by describing the mean score, variance, maximum and minimum score of each experiment group. Table 2 shows the average score of student's mathematics achievement of experiment group 1 were higher than experiment group 2.

Table 2. The data of students’ mathematics achievement

| Statistics Description | Experiment 1 | Experiment 2 |
|------------------------|--------------|--------------|
| Mean                   | 69.30        | 68.26        |
| Variance               | 249.91       | 274.92       |
| Max Score              | 92           | 96           |
| Min Score              | 24           | 32           |

Hypothesis testing did after normality and homogeneity test. Normality test is a test to know the data normally distributed or not. If the significant was less than 0.05 or $L_{obs} > L_{table}$, then $H_0$ is rejected. Table 3 shows the result of normality test by using Lilliefors method. The data that used in normality was the data of mathematics achievement test of each experiment group. The test was given after the treatment. Table 3 shows the $L_{obs}$ score of student's mathematics achievement in experiment class 1 were less than $L_{table} = 0.103$ and in experiment class 2, $L_{obs}$ were less than $L_{table} = 0.102$. So that the conclusion was the population normally distributed for both experiment groups. Since the population was normal, it continued to the homogeneity test.

Table 3. Normality test

| Class       | Test              | Normality Test (Lilliefors Method) | Conclusion |
|-------------|-------------------|------------------------------------|------------|
|             |                   | $L_{obs}$ | $L_{table}$ | Interpretation |         |
| Experiment 1| Mathematics achievement | 0.077     | 0.103      | $H_0$ is not rejected | Normal |
| Experiment 2| Mathematics achievement | 0.101     | 0.102      | $H_0$ is not rejected | Normal |

Homogeneity test is a test to know the classes had the same variance or not. If $\chi^2_{obs} > \chi^2_{table} = 3.841$, then $H_0$ rejected. Homogeneity test used Bartlett test by using chi-square test. The data of
mathematics achievement test of two experiment groups was compared. The result was $\chi^2_{\text{obs}} = 0.167$ is less than $\chi^2_{\text{table}} = 3.841$. Table 4 shows the variance of score of student's mathematics achievement in experiment group 1 and 2 were homogen.

| Test                  | $\chi^2_{\text{obs}}$ | $\chi^2_{\text{table}}$ | Interpretation                      | Conclusion   |
|-----------------------|------------------------|---------------------------|-------------------------------------|--------------|
| Mathematics achievement | 0.167                  | 3.841                     | $H_0$ is not rejected                | Homogen      |

After normality and homogeneity test, then continued to the hypothesis test. The results by using one way ANOVA shows that $F = 0.153 < F_{\text{table}} = 3.905$. It was concluded that there was no significant different of learning by using GDL-contextual or BBL-contextual on mathematics achievement.

GDL-contextual is a learning model that developed to involving students in the contextual problem solving through a group discussion. Students were given some contextual problem. Then, they do observation, analyse, discovering, and arranging the solution to find a concept in their group by teacher guidance. This point about teacher guidance is necessary in this model. Teacher should guide them through some questions or hints so that students got the idea to finding something. The benefit of using GDL in learning is the involvement of students in activity and how teacher guide the students in their process [4]. GDL-contextual performs students by discovering and solving problem in daily life. So, it creates a meaningful learning.

Another model is BBL-contextual which help students to optimizing their brain. In the learning process, students are free to make the comfort situation for their study, such as drinking water, listen to the music, do some stretching, etc. If they feel good, then they have a motivation for study. Besides that, they could be understand the lesson well than usual as the benefit of this model. Thus, the students need the best way for learning that supported by their environment. The best way of learning is using the balancing of brain to get the best result [6].

According to the results, this two models is not significant different. In the learning process, students need guidance from teacher to achieve the learning objectives. In the other hand, they learn by using their cognitive or brain ability. The brain would be optimal when they were on the good situation for them and there is no pressure for that. This study also supported by research that shows Guided Discovery had a potential to increase students’ achievement [10]. Guided Discover had a significant to the students’ perform in learning geometry [4]. In the other hand, the previous research also shows the results that BBL was significant effected the students’ achievement [6] [7]. Based on the previous research, that relevant to this study, Guided Discovery is good as BBL model. So that GDL-contextual as good as BBL-contextual to implement in geometry learning.

4. Conclusion

Based on the results of this research, it can be concluded the learning by using GDL-contextual as good as BBL-contextual since there is no significant different of them. It was shown by the result of one way ANOVA testing that the score of $F = 0.153 < F_{\text{table}} = 3.905$. The result of the effect of them means they could be used in mathematics learning for getting the best mathematics achievement. GDL-contextual and BBL-contextual could give the benefits, such as the meaningful learning through the contextual problem and social through the group discussion.

For the next study, researchers recommend for students to do a discussion with his members group and not always ask teacher, and also following the learning activity well in group discussion. For school, it would be good to develop and implementing any learning models or methods in mathematics learning to increase the student’s mathematics achievement, such as GDL-contextual or BBL-contextual could be an alternative of learning to increase the student's achievement. In the other, students are different in some personality, interest, and ability so need an attention. For other researcher, this study could develop by adding another variable or comparing GDL-contextual or BBL-contextual and the other learning model to get the better results.
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