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The Effect of Problem-Based Learning Model Using Contextual Teaching Learning Approach Viewed from Logical Mathematical Intelligence

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ABSTRACT

This research is aimed at determining 1) the difference of learning achievement using problem-based learning through contextual teaching learning and direct learning in Mathematics learning; 2) the difference of learning achievement among high, medium, and low logical Mathematical intelligence; and 3) the interaction between learning model and logical Mathematical intelligence on the students' learning achievement in Mathematics. The research was designed using quasi-experimental study of 2x3 factorial design. The population of this research was the third-grade students of elementary school. The data of students' learning achievement in Mathematics and their logical-Mathematical intelligence was obtained using test. The data were analyzed using two-way ANOVA. The results of the research show that 1) Problem-based learning model using contextual teaching approach makes the students obtain better learning achievement than direct learning model; 2) the students having high logical Mathematic intelligence get better learning achievement than those having medium and low logical Mathematic intelligence, the students having medium logical Mathematic intelligence gets better learning achievement than those having low logical Mathematic intelligence; 3) there is no interaction between learning model and logical Mathematic intelligence on the students' learning achievement.

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1. INTRODUCTION

The Government Regulation of the Republic of Indonesia Number 22 Year 2006 concerning the Content Standard for Basic and Secondary Education states that mathematics learning is provided to aid the students having logical, analytical, systematic, critical and creative thinking skills, as well as the ability to work together so that the students are able to have the ability to acquire, to manage, and utilize the information to survive in a dynamic, uncertain, and competitive situation. The achievement of these competencies is in the form of the improvement of knowledge and skills as well as the development of attitude through the learning process. Mathematics is one of the most important learning. Mathematics is used as a tool to organize our daily lives in the society. We use mathematics as a tool in many works and also in calculated decisions making [1].

Based on the regulation, problem-solving becomes a focus in Mathematics learning. In order to improve problem-solving skills, it is required to develop the ability to comprehend the problems, make mathematics model, solve the problems, and predict the solution. In some cases, Mathematics learning should be begun by introducing the problems that are based on the students' actual situation (contextual problem).

By posing the contextual problems, the students are gradually guided to master the concepts of Mathematics. The ability to solve mathematical problems is very important, many efforts have been implemented intensively and sustainably by the Indonesian government to improve education [2].

The research of PISA (The Program for International Student Assessment) in 2015 shows that Indonesia is ranked 62 out of 70 countries participating in PISA. The average score of Mathematics achievement of all countries is 490, while the average score of Mathematics students in Indonesia is 386. Based on the data, Indonesia's ranking is still far below the international average. It means that the Indonesian's students' ability in Mathematics learning remains low, therefore, the improvement of Mathematics learning in elementary school is demanded. Mathematics learning should be designed based on the objectives stated in the curriculum.

The low learning achievement in mathematics is caused by several factors affecting the learning process. Based on the results of interviews and observations in several schools in Banjarsari district, it is known that the learning is still dominated by material explained by teachers, they have not implemented the meaningful learning by providing problems related to daily life in initial stage to make the students find it easier to comprehend the materials, they have not yet let the students think freely in order to find out the concept as well as solve the problems related to the given materials, they tend not to relate the problems to the students' daily life that makes the students find it difficult to apply the acquired knowledge in the real world, the students do not have any adequate skill to ask during the learning process, the students have not been brought into the real situations during the learning process, students tend to memorize the formulas to solve the problems so that they have the difficulty in solving the developed problems, the learning model used by the teachers generally has not been able to enable the students to solve the problems, there is no learning atmosphere in learning that causes the students not to have the experiment or modelling in order to create actual learning through learning in their surrounding environment.

The problem that is frequently experienced by the learners is their mindset that Mathematics is a boring subject and very difficult to master. There are many learners who fail to master these subjects although the topic they learn is very easy [3]. The teacher is one of the important factors in the implementation of the curriculum [4]. Therefore, the teachers' ways to use the inappropriate learning model in Mathematics learning will affect the students' comprehension.

Learning model that can be used as a solution to the problem is the problem-based learning model. PBL embodies the principle that learning begins when students are encouraged to work as a group to find the solutions to the real-world problems. PBL allows the students to apply their knowledge to solve the real-world problems. Moreover, PBL also creates supportive learning and continuous interaction that explicitly strengthens the students to learn in the social constructivist paradigm. By involving the students to learn in a group work, PBL can create the environmental support for the students to develop their scientific creativity [5].

In addition, the appropriate and suitable approach to Mathematics learning possibly influences the students' learning in Mathematics. The students have not been brought into the real situations during Mathematics learning process. One of the approaches that can be used to support learning in overcoming these problems is by allowing the students to be in the real situations to acquire the knowledge directly. Therefore, the researcher attempted to use problem-based learning model integrated with contextual teaching learning approach. The focus of problem-based learning model is to overcome the real problems and create learning by doing. Problem-Based Learning as a class approach is related to authentic learning. Authentic learning as the component contained in the Contextual Teaching Learning approach is suitable to the Problem-Based Learning model. The underlying belief in this approach is that the students can engage more effectively in the learning tasks and acquire concepts more easily and naturally while learning takes place in a meaningful context [6].

Learning should give the opportunities for the students to collect data and make decisions related to their knowledge of their daily life. The knowledge will be harder to learn if it is not based on the level of students' intellectual characteristics. Thus, according to the competency-based curriculum, learning does not only focus on students 'cognitive development, but also the development of students' scientific attitude ability to solve the problems. One of the approaches that can be used is a contextual approach that is based on constructivism philosophy. Contextual learning is a learning concept that helps teachers relate the learning materials to the students' real conditions and encourages them to use their own knowledge in their daily lives. This approach will help the students to be more independent and experienced learners in developing their knowledge [7].

The external factor that influences the student's Mathematics learning achievement is the learning model and approach applied by the teacher is inappropriate. Meanwhile, one of the internal factors is students' intelligence. The students' intelligence can distinguish the ability among the students. In

Mathematics learning, Mathematical logical intelligence is considered to be important due to the students' basic abilities that can be used to develop to think logically and to solve the problems.

Currently, the education system generally emphasizes on verbal and Mathematical intelligence. The tests, assignments, and teaching support both intelligences. However, the students' unique abilities and talents other fields are often neglected and ignored. In Gardner's perspective, several intelligences can have an important role in student learning. One of them is Mathematical logical intelligence [8].

The purpose of this research is to know 1) the difference of learning achievement using problem-based learning through contextual teaching learning and direct learning in Mathematics; 2) the difference of learning achievement among high, medium, and low logical Mathematical intelligence; and 3) the interaction between learning model and logical Mathematical intelligence on the students' learning achievement in Mathematics.

2. RESEARCH METHOD

This study was conducted in the first semester of academic year 2017/2018. The type of this research was quasi-experimental research. The population of this research was the third-grade students of the elementary school in Banjarsari sub-district, Surakarta. The sample of this study consisted of six elementary schools. The design of this research using 2x3 factorial design. There were two independent variables such as learning model of logical Mathematical intelligence; meanwhile, the dependent variable was the achievement of learning Mathematics. The learning model that was experimented was Problem-Based learning model using the contextual approach of teaching-learning for experiment class and direct learning model for control class. The logical Mathematical intelligence of the independent variables was divided into three categories: high, medium, and low. Data collection technique was test technique to collect Mathematics learning achievement data and logical Mathematical intelligence data. The data analysis technique used in this research was two-way ANOVA with the unequal cell.

3. RESULTS AND ANALYSIS

Hypothesis testing using two-way ANOVA with different cells was conducted. The Mathematics achievement test given to third-grade students in the experimental and control class consisted of 25 questions. Based on the results of the test, it was obtained that the average value for the experimental class was 58.848 and the average value for the control class was 48.939. Before conducting ANOVA test, the prerequisite test should be done such as normality test and homogeneity test. The normality and homogeneity test of learning achievement data were done using SPSS. The result of the test of the Mathematics learning achievement test was shown in the Table 1.

Tabel 1. Tests of Normality

MODEL		Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Value	PBL-CTL	.081	79	.200*
	DIRECT	.085	98	.075

* This is a lower bound of the true significance.
a Lilliefors Significance Correction

The table shows that the sig value in the experimental class and the control class is and the value was more than 0.05. It means that the samples were from a normal distribution population. Furthermore, the homogeneity test results of Mathematics learning achievement can be shown in the Table 2.

Tabel 2. Test of Homogeneity of Variances

Value			
Levene Statistic	df1	df2	Sig.
2.655	1	175	.105

The table showed that sig. was more than 0.05 which means that the population has the same or homogeneous variance. The two-way ANOVA test results can be shown in the Table 3.

Tabel 3. Tests of Between-Subjects Effects

Dependent Variable: NILAI

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	16985.480[a]	5	3397.096	20.691	.000	.377
Intercept	525586.027	1	525586.027	3201.188	.000	.949
MODEL	4266.529	1	4266.529	25.986	.000	.132
KLM	12640.341	2	6320.171	38.494	.000	.310
MODEL * KLM	371.632	2	185.816	1.132	.325	.013
Error	28075.582	171	164.185			
Total	569216.000	177				
Corrected Total	45061.062	176				

a. R Squared = .377 (Adjusted R Squared = .359)

Based on the above calculation results, it can be seen that the test results on the source variation of the learning model showed that the sig value was 0,000 <0.05 so that H_0 was rejected. It means there were differences in Mathematics learning achievement between students who were taught using Problem-Based Learning model with the contextual teaching-learning approach and direct learning model. Below was the average score on each learning model and the logical Mathematical intelligence category.

Tabel 4. Summary of the average score in each cell

MODEL	LOGICAL MATHEMATICAL INTELLIGENCE			Total of Average
	High	Medium	Low	
PBL-CTL	73.273	60.516	47.692	59.848
Langsung	60.444	49.171	41.867	50.041
Total of Average	65.623	54.291	43.784	

Table 4 shows that the total mean of the experimental class using PBL-CTL was 59.848 and the total mean in the control class using the direct learning model was 50,041. Based on the total of average score, it can be concluded that the PBL-CTL learning model has better Mathematics learning achievement than the direct learning model.

The results show that Problem-Based Learning model using contextual teaching-learning approach influences the achievement Mathematics learning. It is in line with the dominant purpose of the PBL which is to show the students about the relevance of the subject material that is placed in an appropriate and realistic practical context. In addition, PBL is built to promote the range of learning outcomes and objectives that were required, including (1) helping the students build a basic knowledge that is broad and flexible, (2) helping the students become the effective collaborators, (3) improving the effective problem-solving skills, 4) motivating the students to learn intrinsically, and (5) developing self-learning skills [9]. Moreover, contextual learning is a teaching and learning concept that helps the teachers relate the material to the real-world situations and encourages them to make relate their knowledge to its applicability in their lives as the members of family, society, and nation. Therefore, contextual learning allows the students to link the material to the context of daily life to find the meaning [10].

The results of Padmavathy's research indicate that PBL learning model is more effective for teaching mathematics. By adopting the PBL model in teaching, the Mathematics teachers can allow the students to think creatively, make important decisions, and solve the needed problems in the world competition. Moreover, the Problem-Based Learning strategy also has an effect on the knowledge which gives bigger opportunities for the students to learn by being more engaged and increases students' active participation, motivation, and interest among students. It causes the students to have the positive attitude towards Mathematics and help them to improve their achievements that will result in long-term memory. It provides a new and desirable experience for students [11].

PBL is generally consistent in demonstrating their effectiveness for long-term knowledge and its application. However, the study of the PBL process is still reassuring which PBL components that are most influence the students' learning although the causal studies have shown that all the PBL phases are required in influencing the students' learning outcomes [12]. The Problem-Based Learning model is by allowing the students to solve the problems in groups. By using group learning, the social interaction can be created among students. A contextual approach is essential for determining the type of meaningful social skills in the children's social network [13].

The test results on the variation source of logical Mathematical intelligence in Table 3 shows that the sig value was 0.000 <0.05 so that H0 is rejected. It means that there is a difference in Mathematics learning achievement between categories of logical Mathematical intelligence. Below is a pairwise comparison between categories of logical mathematical intelligence.

Tabel 5. Pairwise Comparisons

Dependent Variable: NILAI						
(I) KLM	(J) KLM	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval for Differenceb	
					Lower Bound	Upper Bound
HIGH	MEDIUM	12.015*	2.390	.000	7.298	16.732
	LOW	22.079*	2.517	.000	17.112	27.047
MEDIUM	HIGH	-12.015*	2.390	.000	-16.732	-7.298
	LOW	10.064*	2.296	.000	5.532	14.596
LOW	HIGH	-22.079*	2.517	.000	-27.047	-17.112
	MEDIUM	-10.064*	2.296	.000	-14.596	-5.532

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Based on Table 5, it can be seen that there is a difference between high logical Mathematical intelligence to medium and low logical Mathematical intelligence, and also there is a difference of medium logical Mathematical intelligence to low logical Mathematical intelligence. The students' Mathematics learning achievement is also influenced by the external factors derived from within the students that is logical Mathematical intelligence. These results indicate that the students with high logical Mathematical intelligence have better learning achievement than those with medium and low mathematical intelligence. Moreover, the students with medium logical Mathematical intelligence have better Mathematics learning achievement than those with low logical Mathematical intelligence.

In Mathematics teaching, we need to solve the problems by finding and considering logical Mathematical intelligence. Therefore, by promoting the introduction of students' intelligence diagrams, we can improve their skills. The logical Mathematical intelligence consists of the capacity to analyze the problems logically, do the Mathematical operations, conducying experiments, solving puzzles, asking cosmic questions, analyse circumstance and peoples behaviour, working with numbers and formulas, creating codes, classifications and categorizations, mathematical problems on the board, and investigate the scientific issues. In mathematics education, our goal is to solve the problems by thinking logically and to give the reasons deductively [14].

Moral-Perez's study states that each of the multiple intelligences including logical Mathematical intelligence is increased significantly at the end of the study so it emphasizes the positive influence. The study also categorizes logical Mathematical intelligence into four namely very low, low, high, and very high. Based on the average scores on logical Mathematical intelligence, very high mathematics category is better than the high, low, and very low categories. High category logical Mathematical intelligence is better than low and very low categories. Logical low mathematical logic intelligence is better than the very low category [15]. Tezer's research states that the students whose logical intelligence is dominant have higher motivation in geometry courses. In addition, it is stated that the students' distribution into classes according to the type of intelligence will have a positive impact on the students' success. Based on the obtained data, the opinions are stated about how it is possible to improve students' success [16].

Based on table 3, test results on the source of interaction variation between the learning model and logical Mathematical intelligence shows sig value was 0.325 > 0.05 so that H0 was accepted. It means that there is no interaction between learning model and logical Mathematical intelligence. Serine's research mentions that logical Mathematical intelligence does not represent a significant effect on teaching styles [17].

4. CONCLUSION

Based on the result of the research, it can be concluded that: (1) there is the difference of the students' Mathematics learning achievement between Problem-Based Learning model using contextual teaching-learning approach and direct learning model. Problem-based Learning using contextual teaching-learning approach gives better Mathematics learning achievement than direct learning model. (2) there is a difference in Mathematics learning achievement between high, medium, and low logical Mathematical intelligence. The students with high logical Mathematical intelligence have better learning achievement than those with medium and low Mathematical intelligence. The students with medium logical Mathematical

intelligence have better learning achievement than those with low logical Mathematical intelligence. (3) there is no interaction between learning model and logical Mathematical intelligence on Mathematics learning achievement.

The results of this study can be used by teachers as a reference to the use of effective learning models to improve the students' learning achievement. The teachers are suggested to use Problem-Based Learning model with the contextual teaching-learning approach in teaching Mathematics. The teachers should pay attention to less-active students to engage in any problem-solving activities. In addition, the success of learning in the classroom is also influenced by the students' internal factors such as logical mathematical intelligence. The teachers should know the category of the students' logical Mathematical intelligence in order to understand the characters of each student so that the application of learning models is based on the category of logical Mathematical intelligence.

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