THE IMPLEMENTATION OF PROBLEM BASED LEARNING MODEL THROUGH GROUP INVESTIGATION IN MATHEMATICS LEARNING VIEWED FROM STUDENT'S ADAPTIVE REASONING IN SMP NEGERI 1 SURAKARTA

By

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ABSTRACT

The purpose of this research is to analyze: (1) the influence of the use of problem based learning model through group investigation to student's mathematics achievement, (2) the influence of adaptive reasoning ability to student's mathematics achievement, (3) the interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement. The populations are all students of grade VIII of 2012/2013 academic year in SMP Negeri 1 Surakarta. Sample taken in this research as many as two classes, consist of VIII B as experiment class with 27 students and VIII A as control class with 28 students. The sampling technique used in this research is cluster random sampling. Data collection methods used are questionnaire method, method of test and documentation method. Data analysis techniques use two ways analysis of variance with unequal cells, a prerequisite test used the Lilliefors method to normality test and the Barlett method to homogeneity test. From the analysis of data with 5% of significant level, it is satisfied that : (1) there is no influence of the use of problem based learning model through group investigation to student's mathematics achievement with F_A = 3,33, (2) there is the influence of adaptive reasoning ability to student's mathematics achievement with F_B = 6,54, and (3) there is no interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement with F_{AB} = 0,16.

Keyword : Problem based Learning, Group Investigation, adaptive reasoning

INTRODUCTION

One of the basic competencies that is necessary to be achieved in learning mathematics is reasoning. Klipatrick, Swafford and Findell (2001: 116) introduce five components of mathematical proficiency that necessary to be developed in the learning mathematics of school, including adaptive reasoning. Adaptive reasoning has an important role in improving the thinking skills of students in mathematics. Due to the adaptive reasoning, students are trained to think logically, reflect and predict the answer, explanative or provide an explanation of the concept and answer procedure and justify or evaluate a mathematical truth.

However, so far mathematics is considered as absolute truth or as the product which is ready for use. Most students still must be guided and directed the steps in solving a mathematics problem. Students also tend to be afraid in solving a mathematics problem. In addition, the perception that mathematics is a scourge number one among other subject, make the student's reasoning weaker.

This condition is supported by the result of TIMSS (Trends in International Mathematics and Science Study). In TIMSS 2011 International Result in Mathematics, an average overall mathematics grade 8 in Indonesia only 386, while TIMSS uses the center point of the scale 500 as a point of reference that remains constant from assessment to assessment. Average mathematics in terms of cognitive dimensions that include understanding of 378 (31%), application of 384 (23%) and reasoning 388 (17%) (Ina et al., 2012: 462). From the cognitive aspect of the achievement is still far from the target, of which 35% for comprehension, 40% for application and 25% for reasoning (Ina et al., 2012: 86).

In this case, the learning model selection plays an important role to obtain the optimal learning outcomes, as revealed by the following Aunurrahman :

> "The use of appropriate learning models can encourage the growth of sense of fun learning, growing and improving motivation in doing the task, makes it easy for students to understand the lessons that allow students achieve better learning outcomes (Aunurrahman, 2009: 143)."

Problem Based Learning (PBL) through group investigation is one of the various models of learning that can be applied in learning mathematics. This model presents a variety of problematic situations authentic and meaningful to the students, which can serve as a springboard for investigation and inquiry (Richard, 2008: 41). Basically, the model is designed to leads students to define problems, explore the problem, collect relevant data, develop and test hypotheses (Aunurrahman, 2009: 151).

Research from Ima Mulyawati (2010) obtained result that :

> "It is obvious that different teaching approaches have different impacts on aspects of students' mathematical proficiency. Problem-based learning is significantly better for improving students' performances in conceptual understanding, strategic competence and adaptive reasoning, competences that strongly correlate with each other Teaching methods where students are able to use their language in order to discuss mathematical problems seem to have a positive effect on students' conceptual understanding, strategic competence and adaptive reasoning".

Research from Elliott Ostler (2011) give the conclusion :

"Mathematical tasks involving dynamic solution methods such as formula derivations can strengthen mathematical proficiency for secondary level students through exposure to adaptive and strategic reasoning. Repeated exposure to such derivations not only provides procedural fluency for different maths, it also lends credibility to strategic and adaptive reasoning for fundamentally equivalent mathematical tasks".

From the description above, this study conducted aimed to analyze: (1) the influence of the use of problem based learning model through group investigation to student's mathematics achievement, (2) the influence of adaptive reasoning ability to student's mathematics achievement, (3) the interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement.

Research Method

This study used an experimental research, that is research procedures conducted to reveal a causal link two or more variables to control the influence of other variables. In this research, the independent variables are model of learning and adaptive reasoning. While, the dependent variable is student's mathematics achievement. In this case, the influence of application of problem-based learning model through group investigation will be controlled and viewed to other variables, that is mathematics achievement.

The research is conducted by dividing the subjects into two groups, experiment and control groups. The experiment group is given problem based learning model through group investigation in learning process, while the control group will be subject to conventional model.

The research is conducted in SMP Negeri 1 Surakarta located at Jalan MT. Haryono No. 4 Surakarta. The population in this study is students of grade eighth of SMP Negeri 1 Surakarta in the even semester, which consists of eight classes with an average of students per class is 27 people. The researcher takes samples two classes of grade VIII that are class VIII B as an experiment class uses problem-based learning model through group investigation and class VIII A as a control class uses conventional model in mathematics learning.

The sampling technique used in this study is cluster random sampling, done by selecting a sample based on its cluster, not individual (Tulus, 2007: 16). Before being given a treatment, both groups should be used to test whether the experiment class and the control class in a state of balance.

Data collection methods used are questionnaire method, method of test and documentation method. Before test and questionnaire are used, they need to be examined whether it is feasible to use in research. Test used is the validity and reliability test. To determine the validity of achievement test and questionnaire, it uses Product Moment Correlation formula. Whereas, the level of reliability of achievement test and questionnaire use Alpha Cronbach formula.

The technique of data analysis uses two-way analysis of variance with unequal cells. Before doing analysis of variance, prerequisites analysis test must be conducted. It consists of normality test uses the Liliefors and homogeneity test uses Bartlett.

The Result of Research and Discussion

In the implementation of research, researcher collects data to be processed. Before the sample is given treatment, researcher does the balance test to determine whether

experiment and control class are balance. Data for balance test are taken from the score mathematics in odd semester.

Instrument in the research include achievement essay test on the subject of circle and questionnaire of student's adaptive reasoning. The essay test consists of seven questions and the questionnaire consists of 30 questions that have been adapted to the lattice. After being arranged the instrument research, it is tested to 27 students of VIII F SMP Negeri 1 Surakarta in the even semester. The result of tryout instruments are tested validity test and reliability test. Items are used to obtain data from the respondent is valid and reliable items, the invalid and unreliable test are not used. There are six items of achievement and 22 items of adaptive reasoning used in this research.

The instrument of research qualified is tested in the experiment and control class. The data of mathematics achievement score and student's adaptive reasoning is obtained from score of test after doing treatment. There is 8 students have high adaptive reasoning, 13 students have medium adaptive reasoning, and 6 students have low adaptive reasoning in experiment class. In control class, there are 9 students in high adaptive reasoning, 14 students have medium adaptive reasoning and 5 students have low adaptive.

The data from each variable collected is used to test the research hypothesis. After the normality test and the homogeneity test can be fulfilled then analysis of variance can be done. Normality test is test to determine whether the data analyzed are in normal distribution. The method used in the normality test is Liliefors method in 5% of significant level. Homogeneity test is a test to determine whether two independent variables have the same variance or not. The homogeneity test in this research uses Barlett method with 5% of significant level. From the calculation of normality test and homogeneity test are obtained that samples come from population in normal distribution and the independent variables have the same variance or homogeneous.

Analysis of variance uses the analysis of variance two ways with unequal cell. From the calculation, it's the following summary:

Table 1

The Summary Of Analysis Of Variance Two Ways With Unequal Cell

Souce of Variation	JK	Dk	RK	F_{obs}	$F_{\propto}$	Decision Rule
Learning Method (A)	13,68	1	13,68	3,33	4,044	H_{0A} is accepted
Adaptive Reasoning (B)	53,76	2	26,88	6,54	3,194	H_{0B} is rejected
Interaction (AB)	1,28	2	0,64	0,16	3,194	H_{0AB} is accepted
Error	201,42	49	4,11			
Total	270,14	54				

Based on Table 1 above then the result of analysis of variance two ways with unequal cell is satisfied that: (1) there is no influence of the use of problem based learning model through group investigation to student's mathematics achievement with $F_A = 3,33$, (2) there is the influence of adaptive reasoning ability to student's mathematics achievement with $F_B = 6,54$, and (3) there is no interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement with $F_{AB} = 0,16$.

The average range of initial score between students with each other is very narrow or it can be said the spread measurement of data is less diverse. In other words, almost of all students have had high academic ability, especially in mathematics. Therefore, the use of problem based learning model through group investigation and conventional model are

accepted well by students because the students already have a good mathematical ability. In addition, the frequency of researcher in conducting the treatment problem based learning model through group investigation in experiment class is limited. So, it is less visible the influence of the use of problem based learning model through group investigation to student's mathematics achievement. This condition causes no influence of the use of problem based learning model through group investigation to student's mathematics achievement in SMP Negeri 1 Surakarta.

The difference of the level of student's adaptive reasoning (high, medium, low) causes the difference of the level of mathematics understanding. Because there is the influence of adaptive reasoning ability to student's mathematics achievement, then it is necessary done the multiple comparison test. The multiple comparison test is conducted to determine which levels of adaptive reasoning have significant different average of mathematics achievement. The result of multiple comparison test used Scheff method shows that there is difference marginal average of mathematics achievement between high adaptive reasoning and medium adaptive reasoning. Moreover, the high adaptive reasoning groups also have significant different marginal average of mathematics achievement with the low adaptive reasoning group. Due to the mean of high adaptive reasoning is higher than the low adaptive reasoning group, then it can be concluded that the high adaptive reasoning has better performance than the low adaptive reasoning group. It can be concluded that the high adaptive reasoning group have the best mathematics achievement.

This condition is in accordance with the proposed Klipatrick (2011:116) that one of the basic competencies that is necessary to be achieved in learning mathematics is reasoning. Adaptive reasoning has an important role in improving the thinking skills of students in mathematics. Due to the adaptive reasoning, students are trained to think logically, reflect and predict the answer, explanative or provide an explanation of the concept and answer procedure and justify or evaluate a mathematical truth. In addition, Ball and Bass in Elly Susanti (2012) expressed that students who learn mathematics through adaptive reasoning can find mathematics more meaningful. Students can integrate the knowledge and ability to see the mathematics activity minds as something precious.

Both of these opinions support the result of research and the condition in the field that the adaptive reasoning skills is required students in solving mathematical problem, so the adaptive reasoning skills a person will affect mathematics achievement that can be achieved.

There is no interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement in SMP Negeri 1 Surakarta. The lack of interaction between learning model and adaptive reasoning can be seen in the graph figure 1. In the figure 1, the graphs of average student's mathematics achievement in experiment class and control class do not intersect. This implies that the characteristic difference between problem based learning through group investigation and conventional models for each level of adaptive reasoning is consistent. Thus, the model of student learning and adaptive reasoning do not occur interaction systematically in affects student's mathematics achievement.

Figure 1
The Average of Student's Mathematics Achievement
in Experiment and Control Class
Viewed from Adaptive Reasoning
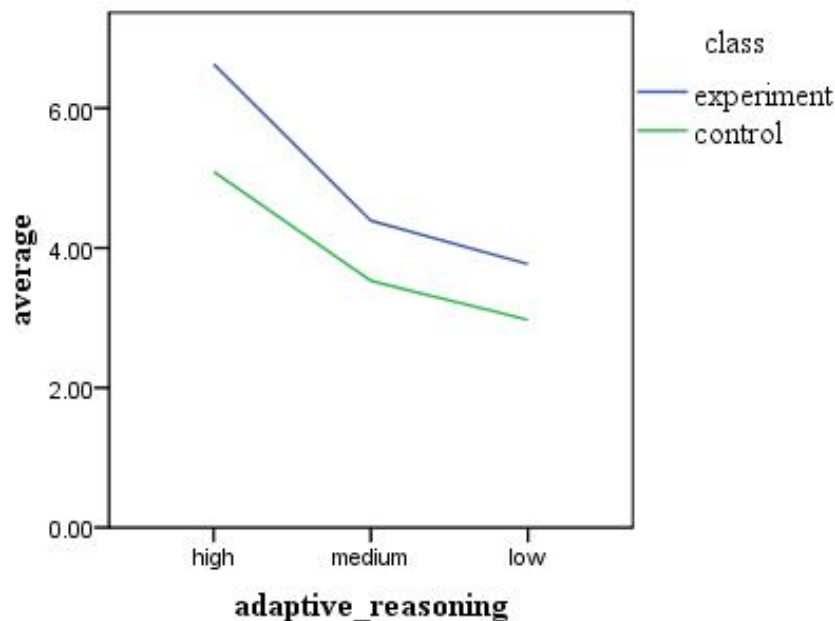
Conclusion

Based on the result of analysis and discussion done in the previous chapter with 5% of significant level, it can be concluded that:

1) There is no influence of the use of problem based learning model through group investigation to student's mathematics achievement in SMP Negeri 1 Surakarta with $F_A = 3,33$.

2) There is influence of adaptive reasoning ability to student's mathematics achievement in SMP Negeri 1 Surakarta with $F_B = 6,54$. From the result of multiple comparison test show that the average which is obtained from high adaptive reasoning group significant different with the average of medium adaptive reasoning group. Moreover, the average which is obtained from high adaptive reasoning group also significant different with the average of low adaptive reasoning group. Thus, it can be concluded that the mathematics achievement of high adaptive reasoning group is the best.

3) There is no interaction between the use of problem based learning model through group investigation and adaptive reasoning ability to student's mathematics achievement in SMP Negeri 1 Surakarta with $F_{AB} = 0,16$.

Bibliography

Arends, Richard I. 2008. *Learning to Teach.* Translated by Helly Prajitno Soetjipto and Sri Mulyantini Soetjipto. Yogyakarta: Pustaka Belajar.

Aunurrahman. 2012. *Belajar dan Pembelajaran.* Bandung: Alfabeta.

Kilpatrick, Jeremy, et al. 2001. *Adding It Up.* Washington: National Academy Press.

Mullis, Ina V, et al. 2012. *TIMSS 2011 International Result in Mathematics (Trends in International Mathematics and Science Study at the Fourth and Eight Grades).* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Mulyawati, Ima. 2010. *The Impact of Teaching Approaches on Students' Mathematical Proficiency in Sweden.* International Electronic Journal of Mathematics Education – IΣJMΣ, volume 5, issue 3 page 61-78.

Ostler, Elliott. 2011. *Teaching Adaptive and Strategic Reasoning Through Formula Derivation: Beyond Formal Semiotics.* International Journal of Mathematics Science Education, volume 4, issue 2 page 16-26.

Susanti, Elly. 2012. *Meningkatkan Penalaran Siswa melalui Koneksi Matematika.* Prosiding, ISBN: 978-979-16353-8-7, FMIPA UNY.

Winarsunu, Tulus. 2007. *Statistik dalam Penelitian Psikologi dan Pendidikan.* Malang: UMM Press.