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Improvement of Mathematical Ability through Discourse Teaching with Mathematical Belt Line at the Fourth Grade of Elementary School

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Abstract

This study was done in response to Farida's finding (Farida, 2015) about the analysis of errors made by the eighth grade students of junior high school in one of the schools in solving mathematical story problems which showed that their mathematical ability was still low. The students' low ability in solving mathematical story problems was caused by their low ability in understand mathematics. This aim was aimed at describing data on students' ability in understanding mathematics as the result of the implementation of discourse teaching with Mathematical Bet Line strategy. This study was a quasy experiment with nonequivalent control group design. The sample consisted of all students of the fourht gradde in one schooll in Kuningan district, Kkuningan regency. The study used mathematical ability test based on indicators developed by Skemp (1976). The statistical analysis used in this study was independent sample t-test. The result showed that the improvement in the students' mathematical understanding ability of those who learned through discourse teaching with Mathematical Bet Line strategy was better than that of those who learned through Direct Instruction in the topic criterion. fraction.The improvement in mathematical ability was shown by N-gain of 0.67 , falling in the medium criterion.

Key words: *mathematical understanding, discourse teaching, mathematical bet line strategy*

1. Introduction

In everyday life, people will find problems that have to be solved and are related to mathematics, such as counting, social arithmatics, etc. Mathematics is important in daily life for activities such as counting, cooking, financial management, and construction (TIMSS, 2015). One of the process skills the students have through mathematics is mathematical understanding ability/ Conceptual understanding. It is the ability to understand concepts, operations, and relations in mathematics (NCTM, 2014; Kilpatrick, Swafford, & Findell, 2001). Understanding is defined as the measure of quality and quantity of relation between one idea and another that has existed (Wale, 2006). Students with a high understanding ability will know the importance of mathematics and its use in mathematical context..

In the 21st century there are four minimal competencies that have to be mastered by students: a high understanding ability, critical thinking ability, collaborating and communicating ability and creative thinking ability (Morocco, 2008). A high understanding ability is a major competence that has to be developed in instruction nowadays. Mathematical understanding ability is important to develop in order for the students to be able to solve problems in real life by applying mathematics that they have learned and understood.

Skemp (1976) categorizes understanding into two as follows: (a) Instrumental understanding: knowing concepts / principles without relating them to other things; being able to apply formulas in a simple computation, and being able to solve a problem algorithmically. This ability belongs to a low level ability. (b) Relational understanding: being able to relate one concept/ principle to other concep/princple. This ability belongs to a high level ability.

Farida's study (2015) on the analysis of the eighth grade students' errors in the eighth grade in one of the junior high schools in solving mathematical story problems showed that their mathematical ability was still low. Another study done by Anggraeni (2016) with the seventh grade in one of junior high schools showed that level of the students' understanding

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of mathematical concepts was still low. The low level of the students' conceptual understanding could have been avoided in early years at elementary school. Mathematics education at elementary school as the basis for the students has an important role in supporting educational process at a higher level (Yastika & Haryanto, 2016). Mathematics teaching at elementary school has a very high status in the effort to achieve the specified goal of mathematics teaching (Kristiana & Suyanto, 2013).

Improvement in the mathematiical understanding ability cannot be achieved if the teaching is only oriented toward procedural and routined problems The teacher should implement approaches, strategies, and models that make students involved in learning mentally, physically and socially so that the students' ability can develop and the goal of learning that has been planned can be achieved.

One of the strategical alternatives of teaching that can be implemented is discourse teaching. Mathematical discourse enables the students to explain, justify and debate the way each student solves mathematical problems and supports the development of conceptual understanding (Trocki, et all, 2014). Mathematical discourse among the students helps in developing understanding of mathematical ideas through the ability to analyze and compare arguments (NCTM, 2014). Mathematics discourse is regarded as a means to improve students' learning (Stiles, 2016). To involve students in a productive mathematics discussion it is important for the teacher to create a learning environment that supports students' involvement (Kersaint, 2015; Bennet, 2014). Such teaching can provide the opportunity for the students to share ideas and clarify their mathematical understanding.

There are two types of discourse, namely, cognitive and motivation discourses (Stein, 2007). The cognitive discourse refers to what the teacher says to promote conceptual understanding of the mathematics itself. Motivation discourse refers not only to the praising of the students, but also to the supporting of the students to participate in the discourse in the classroom.

Discourse teaching requires students to evaluate and interpret views, ideas, and other mathematical arguments and develop a valid argument by themselves. The discourse develops more creative and independent thinkers and at the same time reinforces procedural knowledge (Mercer, 2008). Mathematical discourse teaching supports the students in communicating mathematics, both in writing and speech that occur in the classroom since they develop new mathematical understanding (Lynch & Bolyard, 2016). Meaningful discourse occurs when the tasks are selected carefully and when the teacher comes back to the previous step to move to the center of the activity of the students' own learning (Reeder & Abshire, 2012). The participation of the students in the meaningful mathematical discourse gives the opportunity for explaining and evaluating their thinking. The focus of the details of the students' thinking and what they can do can help the the teacher in using the students' understanding and experience to design an appropriate instruction (Wilson, et al., 2017). Written discourse has a certain advantage sinnce writing is a reflective process that can improve understanding (Steele, 2007). Written discourse also creates a record for the students' work and enables the students to assess the strengths and weaknesses of their metacognition and problem solving ability (Kramarski, Mevarech, & Arami 2002).

Mathematical Bet Line was designed to promote classroom discourse and to support sense making when the teacher teaches mathematics story problems (Dick, L. et al., 2016). Bet Line was adopted from an English lesson in which the teacher tells a story and then asks the students to talk about the story that they have read and make a prediction about the continuation of the story.

In a mathematics lesson, , Mathematical Bet Line is used as a conversation between the teacher and the students that starts by a problem and stops when the students can anticipate and predict what will appear next in the problem. The aim of discourse teaching with Mathematical Bet Line is to help the students understand the story problem by focusing on the context of the story that is given in the problem and then making a prediction. This strategy requires the teacher to facilitate class discussion and monitor sense making through questions around the implication of the students' preditions. In this way the students can

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understand the context of the story, predict the problem and think to solve the mathematical story problem.

Discourse teaching with Mathematical Bet Line strategy done by Herrema (2016) to improve the second grade students' ability in addition and substration showed that the students' mathematical ability increased. Inspired by this the researcher did a quasy experiement with the aim of describing the data in the increase in the understanding mathematical ability of the fourth grade students of elementary school who learned through discourse teaching with Mathematical Bet Line strategy and compared it with the ability of the students who learned through Direct Insruction.

2. Methods

This study used quantitative approach with quasy experimental design. The experimental design in this study was Nonequivalent Control Group Design. The population of this study was the fourth grade students of one of the elementary schools in Kuningan District. The sample consisted of all students of the fourth grade with the total of 55 . The researcher grouped the sample into two, the experiment group of 27 students and the control group of 28 students. The choice of the sample was done purposively with out randomization. This was because the subjects to be studied were the ones who had enrolled in the class, thus, no randomization was done. If new classesi had been formed it would have disturbed the teaching process in the school. This is in line with Creswell's opinion (2015: 607) who stated that "Quasy experiment involves a placement (but it is not a random placement) of the participants into groups since the experimenter cannot form groups artificially for his or her experiment."

The procedure of the study consisted of three stages; preparation, implementation, and data analysis. At the preparation stage the study started with a preliminary study by identifying a problem, doing literary review, making a hypothesis, organizing steps in implementing an action and selecting the subjects for the study which consisted of experiment and control classes. At this stage other activities done were the writing of research instruments, the testing the instruments. At this stage the testing of instruments, and improvement of the instruments were done to have ready and practical instruments. The second stage was started by giving the pretest to both classes to find out the students' prior mathematical understanding ability. Then it was continued with the implementation of discourse teaching with Mathematical Bet Line and DIrect Insruction to the experiment and the control groups respectively. After all the activities had been done a posttest was given to the two classes. The posttest gave the picture of the effect of the teachings on the students' mathematical understanding ability. The data analysis stage was done by processing and analyzing the data and the writing of the results in complete form. The data analysis done was the testing of two means differences by considering normality dan homogeneity. The normality test was done by looking at the scores in the post test, pretest,and the *N-gain* of the experiment and the control groups to see whether they had normal distributions or not. The statistical test used was Kolmogorov-Smirnov aided by SPSS 20 for windows program at 0.05 level of significance. The homogeneity test was used to find out the variation in the population whether it was the same or different by using *Levene's Test* statistical test aided by SPSS 20 for WIndows program at the 0.05 level of significance. After knowing that the two samples were normally distributed and came from a population with homogeneous variations, then the data processing was continued with t-test at the 0.05 level of significance. The instrument used in this study was mathematical understanding test. The test was an essay test written by the researcher based on its indicators.

3. Results and Discussion

The study done was the implementation of discourse teaching with Mathematical Bet Line strategy in the topic of the concept of fraction in the fourth grade. The implementation of the research was done for 8 meetings. In this study the data which were analyzed were pretest and postest scores for mathematical understanding ability. Based on the pretest and posttest the *N-gain* score for mathematical understanding ability in the to classes was

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calculated. The following are the descriptive statistical scores for pretest, posttest and N-gain in experiment and control classes.

Table 1. Descriptive Statistic for Mathematical Understanding Ability

Statistic control	Experiment Class				Control Class			
	N	Min Score	Max Score	Mean	N	Score Min	Max Score	Mean
Pre Test	27	7	26	17.7	28	10	31	19.89
Post Test	27	9	40	32.63	28	12	37	25.536
N-gain	27	-0.12	1	0.67	28	-0.17	0.86	0.28

Before teaching, the researcher gave pretest to the to classes first. The result of initial data analysis showed that the data for the experiment class didnt have a normal distribution, while the data for the control class had a normal distribution. Then *Mann Whitney* test was done to find out the difference in the mean of mathematical understanding ability betweeni the control class and experiment class before being given treatments. The result obtained showed sig.value (2-tailed) was 0.353, greater than the significance level α = 0.05, thus, there was no difference in the means for mathematical understanding ability between experiment and control classes before treatments or the two classes came from the same condition.

After being given different treatments, it turned out that the data of the posttest for mathematical understanding ability in the two classses were different. This was also shown by a statistical test that the two classes had normal distributions and homogeneous variations. Thus, then the different of means test was done by independent t-test. The result of the test showed that the sig.value (2-tailled) was 0.001, smaller than the significant level α = 0.05 Thus, there was a difference in the means of the posttest for mathematical understanding ability between experiment and control classes.

To find out the data for mathematical understanding ability improvement based on the teaching the N-gain score of mathematical understanding ability was used for the experiment and control classes. This mean difference test in N-gain score for mathematical understanding ability was done to prove the research hypothesis, namely that the N-gain mean score for mathematical understanding ability of the students who learned through Mathematical Bet Line strategy was better than that of the students who learned through Direct Interuction.Based on the statistical test through independent t-test, the sig. value (2-tailled) was 0.000, smaller than the significance level α = 0.05,which means that the N-gain mean for mathematical understanding ability of the students of the experiment class was higher than that of the control class or the ability of the students who learned through discourse teaching with Mathematical Bet Line strategy was better than that of the students who learned through Direct Instruction. Based on the result of data processing and analysis, it was found that there was an increase in mathematical understanding ability of the students who learned through discourse teaching with Mathematical Bet Line strategy and the students who learned through Direct Instruction. The increase in mathematical understanding of the experiment class is indicated by the N-gain score, that is 0.67, falling into the medium criterion. On the other hand, in the control class the N-gain was 0.28, falling into the low criterion. The result of statistical test showedd that the mathematical understanding ability of the students of the fourth grate at a public elementary school in Kuningan district who learned through discourse learning with Bet Line strategy was better than that of the students who learned through Direct Intrucstion in the topic of fraction.the result of the study supports the result of the study done by Herrema in 2016 that the teaching by mathematical Bet Line strategy can increase students mathematical understanding ability. The increase in the students' mathematical understanding ability cannot be separated from the learning activities they did. In the discorse learning with mathematical Bet Line strategy. The lesson started with a conversation between the teacher and students. The teacher gave an unfinished story problem and stopped when the students

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could anticipate and predict what would appear next in the problem. At this stage the students tried to develop their arguments, criticize others' arguments, and defend their arguments.

In the first three meetings, the students were still shy in giving their arguments. The discourse teaching with active students who gave arguments to each other and analyzed others' arguments only appeared first in the fourth meeting. It was not easy for the teacher to make all the students able to be involved in the discourse teaching. Thus, it is important for the teacher to create a learning environment which support students' involment as stated by Kersaint (2015) and Bennet (2014). The teacher has to give questions which encourage the students to give their opinions. Thus, knowing what is asked and when and how the teacher asks is very important (Bofferding & Kemmerle, 2015). Question and answer is used to facilitate the discouse class that gives opportunities to the students to develop their understanding (Martin, et al., 2015). In addition, the teacher gives motivation to the students as what is expressed by Stein (2007) that there are two aspects of the discourse, namely, cognitive discourse and motivation discourse. The giving of motivation is done by the teacher by the giving prraises and rewards.

In the process of defending an argument, the teacher gives the opportunity to all students to give opinions by continuing the story problem. The teacher stresses that there is no wrong opinion, all of the students' opinions are said to be correct and they are written on the blackboard. For example, in the process of fraction substaction, there was a student's opinion which was not related to the unfinished story problem. The teacher still wrote the opinion, so that other students gave different opinions by responding to the opinion which was different. In the next process in teaching, the students were grouped into some groups consisting of four students each. The students answered on the group worksheet to finish the mathematical Bet Line strategy, that is, all students defended their opinions, thus the most appropriate opinion was chosen by each group.In that way the students could understand the story context, predict a problem, and think to solve the mathematical problem. To increase the students' involvement in the discourse with their groups, the teacher gave motivation and reward to three good groups in each meeting.

The implementation of discourse teaching with mathematical Bet Line strategy stresses the active participation of the students in finding and constructing their knowledge through experience that they had based on their prior knowledge. As the meaning of learning put forward by Bruner (Soviawati, 2011), that is a process is active in which the students construct new ideas, or concepts. This is in line with constructivist view that a person's knowlegde comes from outside but is constructed inside in his or her mind. (Syarifudin & Kurniasih, 2013).

Coorporation among students in the group has a role in improving mathematical understanding ability. The interaction with other people in completing the worksheet in group stimulates cognitive development. Like the concept of Zone of Proximal Development (ZDP) by Vygotsky which states that an individual can reach his or her potential development level through the help of others who are more capable than him or her (Arends, 2007). The students who give opinions and comment point to the mathematical concept that is not understood by other students in the group. Thus, the students who learn through discourse teaching with Mathematical Bet Line strategy perform better than those who learn through Direct Instruction.

4. Conclusion

The implementation of discourse teaching with Mathematical Bet Line strategy stimulates the students to be actively involved during the learning process through defending the students' opinions so that the students can develop their mathematical understanding. The giving of motivation to celebrate the students success in the learning process can lead to the students' involvement. Thus, the improvement of the students' mathematical understanding ability of those who learned through discourse teaching with Mathematical Bet Line strategy. Was better than that of those who learned through Direct Intruction. The study about discourse teaching with Mathematical Bet Line strategy was only restricted to

the concept of fraction in the fourth grade. Thus, it is suggested to other researchers to continu this line of study using other topics in the effort to develop students' mathematical thinking ability.

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