Differences in Metacognition and Mathematical Communication Ability Between Students Taught Using Problem Based Learning Model and Numbered Head Together Cooperative Learning Model at SMP Kartika I-2 Medan

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Abstract
This research aims to know: 1) difference of metacognition ability of students taught using PBL model with NHT cooperative learning model, 2) difference of mathematical communication ability of students' taught using PBL model with NHT cooperative learning model, 3) interaction between learning and students' early math ability to metacognition ability, 4) interaction between learning and students' early math ability to mathematical communication ability. This research type is quasi experiment. The population in this study were all students of class VII at SMP Kartika I-2 Medan, while two randomly selected samples were consisted of experimental class I and experiment II class consisting of 32 students. Data analysis was done with ANOVA two-way. The results of this study indicate that: 1) there are differences in metacognition ability of students’ taught using PBL model with NHT cooperative learning model; 2) there is difference of mathematical communication ability students' taught using PBL model with NHT cooperative Learning model; 3) there is interaction between learning and students’ early math ability to metacognition ability, and 4) there is interaction between learning and students’ early math ability to mathematical communication ability.
Keywords: Differences, Metacognition Ability, Mathematical Communication Ability, Problem Based Learning Model, Number Head Together Cooperative Learning Model

1. Introduction

Education is a very important thing for humans, because education is a human resource investment in the long run. Education is also a vehicle to improve and develop the quality of human resources. According to Tirtarahardja (2008) "education is one of the main pillars in anticipating the future, because education is always oriented to the preparation of learners to play a role in the future". The role of education in facing the future is closely related to mathematics learning.

Mathematics is one of the subjects that must be followed by students in school. Given the importance of mathematics to human life, then mathematics as a discipline needs to be mastered and understood by school students in order to facilitate students to follow the development of science and technology. The importance of mathematics is also evident from the statement of Cockroft (Abdurrahman, 2012) that "mathematics needs to be taught to students because it is always used in all aspects of life". One of the goals of learning mathematics in the 21^{st} century is that students are able to have high-level thinking skills. In study of mathematics, the ability to think and to solve the problem is one of the very important abilities that must be owned by the students (Mustafa et al, 2017). One of the most important thinking skills possessed by a student is metacognition ability in mathematical communication.

Metacognition Ability becomes very important because it can train students' mathematical learning comprehension. Constructing mathematic understanding requires both cognitive and metacognitive elements, learners "construct mathematic knowledge" using metacognitive, and they guide, regulate, and evaluate their learning using metacognitive (TEAL, 2011). Metacognition has advantages in which one tries to reflect on the way of thinking or contemplating the cognitive processes it performs. Metacognition is also a process by which a person thinks about thinking in order to build a strategy for solving problems. Jayapraba (2013) says that "metacognition as thinking about thinking, metacognition is the ability where the object of thinking is the process of thinking that happens to yourself". Students are said to have metacognition ability if in problem solving students are able to fulfill the following stages: (1) develop an action plan, (2) organize or monitor the settlement action, and (3) evaluate the settlement action (NCREL, 2007).

However, based on preliminary observations at SMP Kartika I-2 Medan, the facts show that students' metacognition ability is still low. The low ability is evident from the results of diagnostic tests that there are errors in the student's answer process in metacognition which will result in error in solving the problem. The students' misconception is: 1) the student does not show awareness about the initial knowledge that will help him / her in solving the problem; 2) the student does not show awareness to describe the problem solving process, and does not show the high belief that the results obtained based on his accuracy in solve problems, and 3) students do not show awareness to describe the reasons for the process of completion they use well, students do not understand how to re-examine the answers correctly, and have not been able to conclude what he learned through solving the problem.

In addition to metacognition ability, one of the mathematical skills required in learning is the ability of mathematical communication. The importance of Mathematical Communication ability for students as Turmudi (2008) says that "The communication aspect trains students to be able to communicate their ideas, both oral and written communications". Sumarmo (2005) detailing the abilities belonging to the mathematical communication include: 1) declare a situation, drawing, diagram, or real object into language, symbol, idea or mathematical model; 2) explaining ideas, situations, and mathematical relations both orally and in writing; 3) listening, discussing, and writing about mathematics; 4) reading with the understanding of a written mathematical representation; 5) create conjectures, formulate arguments, formulate definitions, and generalize; and 6) reveals a mathematical description or paragraph in its own language.

Given the importance of Mathematical Communication ability, it is fitting that every student has good communication skills. However, based on initial observation at SMP Kartika I-2 Medan, the facts show that students' mathematical communication ability is still low. The low ability is seen from the results of diagnostic tests that show the problems that occur in students is that students are still not able to communicate the purpose of the given problem. This is because during this time the students are only accustomed to just counting without expressing ideas / ideas in oral and written form. In addition, students are always fixed with numbers, so when a mathematical problem is presented in the form of problems in the form of symbols or in-depth analysis then the students are unable to solve them.

One of the causes of low metacognition ability and students' mathematical communication ability is influenced by the learning model used by the teacher. During this time teachers use conventional learning methods in the classroom. The facts on the ground show a fairly apprehensive phenomenon, namely: 1) learning during this time students cannot make a connection between what they learn in school and how the knowledge will be applied. 2) students face difficulty understanding academic concepts (such as mathematical concepts) when they are taught with traditional learning, whereas they are very necessary to understand concepts as they relate to the real world. 3) students are expected to make their own relationships outside of class activities. In response to the problems that arise in the learning of mathematics, the need for the use of learning models that can make students active in learning activities, making learning meaningful, and able to train students to accustomed to mathematical and mathematical communication in learning activities.

Problem Based Learning Model (PBL) is one solution, because according to Arends (2008), problem based learning model is a model of learning by learning approach the students on the issue of authentic and meaningful to students who serve as the foundation for investment and research students, so students can construct their own knowledge, to develop higher skills and inquiry, independent students, and increase the confidence of students. In addition, NHT cooperative learning can also be used as one solution. This is because in this learning the students are no longer passive recipients, the students are more actively involved in investigating, investigating, trying and finally finding their own mathematical concept (Isjoni, 2010).

Some things that still need to be considered is related to the early ability of mathematics students who are divided into groups of low, medium, and high. The early ability of the student's mathematics is the knowledge that students have before the ongoing learning that must be possessed by students in order to follow the lesson smoothly. Students who follow the learning process have different background skills, so the ability to follow different lessons. Therefore, the initial ability of the students affects their interaction with the learning model that the teacher is given only, the influence or interaction is given equal. For that teachers need to pay attention to the initial ability of students, so that by knowing the initial ability of students vary teachers can choose a suitable model for use in learning.

2. Literatures

2.1. Metacognition Ability

Metacognition is a thought process involving control of its own cognitive activity. On the other hand Wellman (1985) states "metacognition is a form of cognition, a second or higher order thinking process which involves active control of cognitive processes. It can be simply defined as thinking about thinking or as a "person's cognition about cognition". Simply put, metacognition is thinking in thinking (Jayapraba 2013). As Schoenfeld (1992) says "metacognition is thinking about our thinking and control, self-regulation, and belief and intuition. Metacognition has advantages in which the student tries to reflect on the way of thinking or contemplating the cognitive processes it performs.

According to Flavell (Jonnasen, 2000) Metacognition Ability is one's awareness of how he or she learns, the ability to judge the difficulty of a problem, the ability to observe the level of self-understanding, the ability to use information to achieve goals and the ability to assess self-learning progress. While Uno (2007) states "metacognition ability is a person's skills in managing and controlling the thinking process". Metacognition Ability according to Flavell (Jonnasen 2000) is one's awareness of how he or she learns, the ability to assess the difficulty of a problem, the ability to observe the level of self-understanding, the ability to use information to achieve goals and the ability to assess self-learning progress. Uno (2007) states Metacognition Ability is a person's skills in managing and controlling the thinking process. Metacognition ability has 3 Indicators according to NCREL (2007) that is: (a) develop action plan, (b) arrange or monitor action and (c) evaluate action.

2.2. Mathematical Communication Ability

Communication in general can be interpreted an event of mutual conveying messages that take place in a communication and cultural context (Ansari, 2009). Communication as a means of conveying a message to the recipient of the message to inform, opinion, or behavior either directly, verbally or indirectly. Sulivan and Mousley (Hulukati, 2005) argue that the ability of mathematical communication not only express the written idea but more broadly, that is part of the student's ability in expressing, explaining, drawing, listening, asking and cooperating.

Greenes and Shulman (Saragih, 2007) suggest that mathematical communication is 1) the central strength for students in formulating concepts and strategies; 2) the success capital for the students towards approach and completion in the exploration and investigation of mathematics; 3) the container for students in communicating with the theme for information and discovery, brainstorming, judging and sharpening ideas to convince others. The indicator of mathematical communication ability in this study refers to four indicators, namely the ability of students to declare a situation or mathematical ideas in the form of drawing, expressing the Image into the situation or ideas of mathematics, able to formulate mathematical ideas into mathematical models, and able to explain the procedure settlement (Ansari, 2009).

2.3. Problem Based Learning Model

Problem-based learning is a learning model that uses problems as the starting point of learning. The problems that can be used as a means of learning are problems that meet the real-world context, which is familiar with the daily life of the students. Eggen and Kauchak (2012) mentions problem-based learning is a set of teaching models that use problems as a focus for developing problem-solving skills.

Arends (2008) suggests that the problem-based learning model is a learning model in which students work on authentic issues with the intent to structure their own knowledge, develop inquiry and higher-order thinking, develop self-reliance and self-confidence. Tan (Rusman, 2012) adds that problem-based learning is the use of the various intelligences needed to confront real-world challenges, the ability to deal with everything new and complexity. The problem-based learning indicator in this study refers to Arends (2012) stating five stages in problem-based learning are: 1) student orientation on the problem, 2) organizing students to learn, 3) assisting individual and group investigations, 4) developing and presenting results works, and 5) analysis and evaluation of problem solving.

2.4. Number Head Together Cooperative Learning Model

According Slavin (2008) cooperative learning one form of learning based on constructive understanding. On the theory that students will find it easier to understand difficult concepts if they can discuss the concept with their friends. According to Ibrahim (2000) Numbered Heads Together (NHT) is an approach developed to involve more students in examining the material covered in a lesson.

Ibrahim (2000) suggests three goals to be achieved in NHT cooperative learning model that is the result of structural academic learning, recognition of diversity, and the development of social skills. The steps in NHT learning include: 1) Numbering, 2) Questioning, 3) Thinking together, and 4) Giving answers.

3. Research Methods

This type of research is quasi experimental research. This study aims to examine differences in metacognition and Mathematical Communication ability of junior high school students who have learned problem-based learning and NHT cooperative learning. The population of this study is all students of class VII SMP Kartika I-2 Medan. While the samples in this study were chosen randomly so that the experimental class I and experimental class II is VII-2 and VII-4, each of 32 students.

The data collection procedure in this research is to prepare the test device of metacognition ability and mathematical communication of the students. Another factor that became the focus of this research is the early ability of mathematics students. In this study the test is divided into pretest tests to determine the students' early ability, as well as the final test (posttest) to determine Metacognition Ability and mathematical communication of students after learning activities. The research design in this research is can be seen in Table 1 below:

Table 1. Research Design

Treatment Group	Treatment	Posttest
PBL (eksperimen-1)	X_1	Y
NHT (eksperimen-2)	X_2	Y

Explanation:
Y : Posttest
X_1 : Treatment by using PBL model
X_2 : Treatment by using NHT cooperative learning model

At the data analysis stage, the metacognition ability test data and mathematical communication ability of the students were analyzed quantitatively by using the ANOVA two-way test with the application of Syahputra (2016) statistical model.

4. Result

The results are reviewed based on pretest and posttest of metacognition ability and mathematical communication ability given. The pretest result is given to see students' initial ability. While posttest results are used to see the results of experimental hypothesis testing. But before the hypothesis test is done by using ANOVA two-way, prerequisite test is done which consist of normality test and homogeneity at each posttest result of metacognition and mathematical communication ability.

The result of normality test of students metacognition ability in both experimental classes was analyzed using Kolmogorov-Smirnov presented in Table 2 below:

Table 2. Posttest Normality Test Results of Students' Metacognition Ability

Class	N	D_0	D_{table}
Problem Based Learning	32	0,161	0,240
NHT Cooperative Learning Model	32	0,153	0,240

From Table 2 it can be seen that each class indicates a value of $D_0 < D_{table}$, so H_0 denoting normal distributed data is acceptable. So the posttest data of students' metacognition ability for problem-based learning class and numbered head together learning class have normal distributed data.

For homogeneity test results based on posttest result of students metacognition ability in both classes were analyzed by using F test presented in Table 3 below:

Table 3. Posttest Homogeneity Test Results of Students' Metacognition Ability

Class	Variances (s^2)	F_{count}	F_{table}
Problem Based Learning	44,28	0,73	1,82
NHT Cooperative Learning Model	32,44		

From Table 3 it is seen that the value of $F_{count} < F_{table}$ (0,73 < 1,82) so that H_0 denotes no difference of variance between groups of data is acceptable. This shows that both groups of posttest data of problem-based learning class and model of learning model numbered head together have homogeneous data variance.

Then to test the data hypothesis based on posttest result of metacognition ability, ANOVA two-way test was done with summary result as in Table 4 below:

Table 4. Summary of ANOVA Two-way Test of Students Metacognition Ability

Source of Variances	Fo	F_{tab}, α = 0,05
Learning Model	4,145	4,004
Early math ability	46,225	3,153
Interaction of Learning Model * Early math ability	4,270	3,153

Based on Table 4, the value $F_0 > Ftable$ (4,145 > 4,004), means H0 is rejected. So it can be concluded that there are differences in metacognition ability of students who are taught with problem-based learning model and NHT cooperative learning model.

Based on Table 4 for early math ability category obtained value $F_0 > Ftable$ (46.225 > 3.153), means H0 is rejected. So early math ability category has an effect on students' metacognition ability. For the category of learning model interaction and early math ability obtained value $F_0 > Ftable$ (4.270 > 3.153), means H_0 rejected. Thus there is an interaction between learning model and early math ability on students' metacognition ability. It can also be interpreted, there is a mutual influence given by the learning model and early math ability to the students' metacognition ability.

The interaction graph between the learning model and the students' early math ability to students' metacognition ability can be seen in Figure 4.1 below:

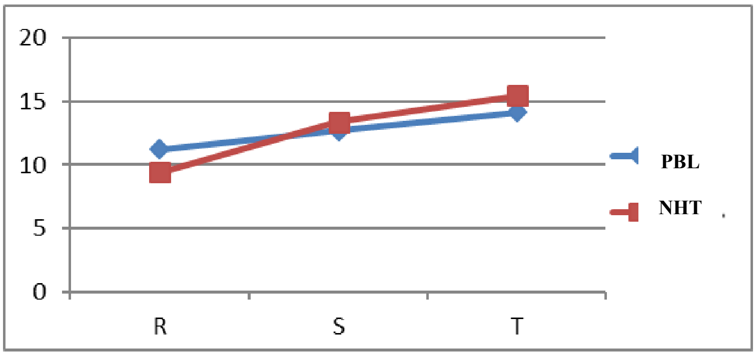

Figure 1. Interaction between learning model and early math ability to metacognition ability

The results of normality test of students' mathematical communication ability in both experimental classes were analyzed using Kolmogorov-Smirnov presented in Table 5 below:

Table 5. Posttest Normality Test Results of Students' Metacognition Ability

Class	N	D_0	D_{Table}
Problem Based Learning	32	0,120	0,24
NHT Cooperative Learning Model	32	0,161	0,24

From Table 5 it can be seen that each class indicates a value of $D_0 < D_{table}$,, so H_0 indicating normal distributed data is acceptable. So the posttest data of students' mathematical communication ability for problem-based learning class and class of numbered head together learning have normal distributed data. For homogeneity test result data based on posttest result of students' mathematical communication ability in both classes is analyzed by using F test presented in Table 6 below:

Table 6. Posttest Homogeneity Test Results of Students' Communication Ability

Class	Variance (s^2)	F_{Count}	F_{Table}
PBL Model	23,73	0,905	1,822
NHT Cooperative Learning Model	21,48		

From Table 6 it shows that the value of $F_{count} < F_{table}$ (0.905 < 1.822) so that H_0 denotes no difference of variance between groups of data is acceptable. This shows that both groups of posttest data of problem-based learning class and model of learning model numbered head together have homogeneous data variance. Then to test the data hypothesis based on posttest result of mathematical communication ability, ANOVA two-way test was done with summary result as in Table 7 below:

Table 7. Summary of ANOVA Two-way Test of Student's Mathematical Communication Ability

Source of Variances	F_o	F_{tab}, $\alpha = 0{,}05$
Learning Model	4,212	4,004
Early math ability	38,281	3,153
Interaction of Learning Model * Early math ability	5,770	3,153

Based on Table 7 we get the value $F_0 > F_{table}$ (4,212 > 4,004), meaning H_0 is rejected. So it can be concluded that there are differences in students' Mathematical Communication ability taught by problem-based learning model and learning model numbered head together.

Based on Table 4 for early math ability category obtained value $F_0 > F_{table}$ (38.281> 3.153), means H_0 is rejected. So early math ability category has an effect on student's mathematical communication ability. For the category of learning model interaction and early math ability obtained value $F_0 > F_{table}$ (5,770 > 3,153), means H_0 rejected. Thus there is an interaction between learning model and early math ability on students' mathematical communication ability. It can also be interpreted, there is a mutual influence provided by the learning model and early math ability on students' mathematical communication abilities. The graph of the interaction between the learning model and the student's early ability to students' mathematical communication ability can be seen in Figure 4.2 below:

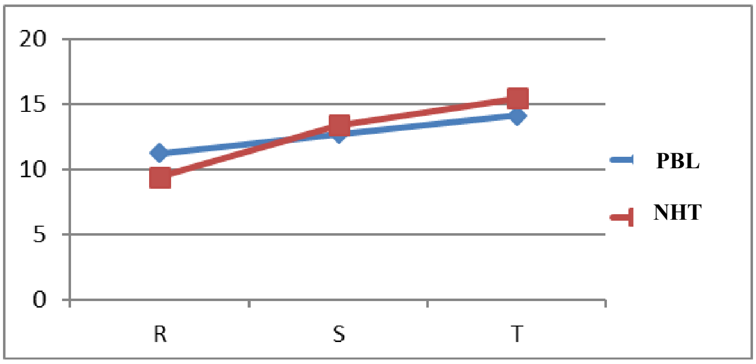

Figure 2. Interaction between learning model and early math ability to students communication ability

5. Discussion

Metacognition is thinking about thinking (Aljaberi & Gheith 2015). Metacognition ability in this research refers to three component metacognition that is formulate strategy or action plan, monitor action, and evaluate action (NCREL, 2007). Based on result of data analysis, it can be concluded that there is significant difference of metacognition ability between students who get problem based learning with students who get NHT cooperative learning. One of the factors is the problem-based learning stage gives greater influence in training and developing students' metacognition ability. This is in accordance with Suherman (2001) opinion that metacognition is an ability to realize what students know about themselves as learners, so that he can control and adjust his behavior optimally. The learning process focuses on the students to actively find something that is related to the problems faced. In line with the meaningful learning theory proposed by Ausubel (Rusman, 2012), meaningful learning is a learning process in which new information is linked to the structures of understanding that a learned person already possesses.

Teachers 'model of learning can influence students' ability to solve problems (Pimta et al, 2009). The results showed that students' metacognition ability taught by problem-based learning was better than NHT learning. The results of this study are also reinforced by research conducted Syahputra & Surya (2016) also shows that problem-based learning model can be implemented to improve the ability of high-level thinking in solving math problems. Syahputra (2013) also reveals problem-based learning to improve the ability to solve mathematical problems, diverge thinking, and improve students' mathematical creativity. Similarly, Lubis (2014) research using problem-based learning model in grade VII students of SMP Negeri 2 Medan concluded that the mathematics metacognition ability of students who are given problem-based learning is more similar than those given the expository model.

The ability of mathematical communication is an ability that can include and contain various opportunities to communicate in learning activities (Sudrajat, 2001). The results showed that there are differences in students' Mathematical Communication ability taught through problem-based learning model with students taught through NHT cooperative learning model. Many factors that led to Mathematical Communication ability of students who received problem based learning better than students who get NHT cooperative learning model. One of the factors is the stages of problem-based learning that gives greater influence in training and developing students' Mathematical Communication ability that is at the stage of assisting independent and group investigations (Arends, 2008). At this stage students try to get the right information, carry out experiments, seek explanations and solutions of the problems given.

Then in problem-based learning, when students have difficulties students can ask the teacher as a facilitator or friend who is more understanding. This is in line with Piaget's theory of cognitive development (Trianto, 2009) believes that physical experiences and environmental manipulation are important for developmental change. The results of this study is strengthened by research conducted Nasution (2013) shows that problem-based learning can improve problem solving skills and students' Mathematical Communication ability. Similarly, some research results indicate that the application of problem-based learning can improve the thinking ability of high-level students (Syahputra & Surya, 2015; Aufa, 2016; Surya & Syahputra, 2017; Mustafa et al., 2017).

The result of the research also shows that there is interaction between the learning model with the students' early math ability to metacognition and mathematical communication ability of the students. Factors causing interaction because of the influence together by the learning model and the students' early ability, both on metacognition ability and mathematical communication of the students. This suggests that one of the learning models is unable to develop students' metacognition and Mathematical Communication ability in all categories of early math skills (high, medium and low) resulting in interaction between these factors.

6. Conclusion

Based on the results of analysis and discussion in this study, presented several conclusions as follows:

1) There is a difference in metacognition ability of students taught using Problem Based Learning and Numbered Head Together cooperative learning model. The average metacognition ability of students taught using Problem Based Learning is better than the students taught using Numbered Head Together cooperative learning model.
2) There is an interaction between learning model with students' early math ability to metacognition ability. This means that the interaction between the learning model and early math ability (high, medium, low) contributes equally to the students' metacognition ability.
3) There is a difference in mathematical communication ability between students taught Problem Based Learning and Numbered Head Together cooperative learning model. The average of mathematical communication ability of students taught using Problem Based Learning model is better than students taught using Numbered Head Together cooperative learning model.
4) There is an interaction between learning model with student's early math ability to mathematical communication ability. This means that the interaction between learning model and early math ability (high, medium, low) contributes equally to the students' mathematical communication abilities.

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