Differences in Metacognitive Ability of Students Through Learning Realistic Mathematics Education and Problem Based Learning in Pangkalan Susu Senior High School

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Abstract: **This research aims to: (1) There are differences in metacognitive abilities of students who are taught with Realistic Mathematics Education Learning and Problem Based Learning, (2) Interaction between learning model (realistic mathematics education and problem based learning) early math skills (high, medium, low) to students' metacognitive abilities. This research is quasi experimental. The population of this research was students class X of SMAN 1 Pangkalan Susu. The sample of this research is class X IA2 and X IA4. Analysis is done using analysis of variance (ANAVA) the result showed that (1) metacognitive ability of student who taught with problem based learning is higher than student who taught realistic mathematics education learning. It is seen descriptively obtained average group of experiment-based learning the problem is 59.77 While the average for the experimental group learning realistic mathematics education is 49.23. Based on ANOVA test results obtained significance 0.000 <α = 0.05, it can be concluded metacognitive ability of students who are taught with problem-based learning is higher than students who get realistic mathematics education learning. This shows that the learning factor also gives a significant influence on the students' metacognitive ability. (2) There is no interaction between learning model with KAM students to students' metacognitive ability. Based on ANOVA test results obtained significance of 0.876> α = 0.05 this shows no effect simultaneously donated by learning by KAM to the students' metacognitive ability. Differences in students' metacognitive abilities are caused by differences in learning used not because of KAM students.**

Keywords: RME (Realistic Mathematics Education), PBL (Problem Based Learning), Metacognitive Ability.

I. INTRODUCTION

Thinking is an ability that is owned by each individual and is very much needed but today not only is the thinking ability needed, awareness of the thinking process carried out is also very much needed. Hofer, Pintrich, Perkins, Schneider, & Lockl in Chairani [1] state that the more students know about their thinking and learning processes, the greater their awareness of their cognition, the better the learning process and the achievements they may achieve. Student awareness (control) of the cognition process is one component of the metacognitive process.

According to O'Neil & Brown in Romli, M [2] metacognition is a process where a person thinks about thinking in order to develop strategies to solve problems. According to Wellman in Chairani stated that metacognition is a form of cognition, which is a high-level thinking process that involves active control in cognition activities. According to Toit, S.D and Toit, G.D [3] stated that if using metacognitive abilities then mathematics achievement would be high. Schoenfeld in Mokos & Kafoussi [4] states that metacognition helps students to be effective problem solvers, because they are able to define their targets, monitor their thoughts, and assess whether their actions reach the target. According to Somerville [5] the metacognitive process helps students to monitor their own progress and take control of their own learning such as their reading, writing and problem solving in class. The role of large metacognitive abilities in the learning process so that the taxonomic revision of the cognitive domain conducted by Krathwohl [6] metacognitive abilities is a new dimension that is placed in the dimension of knowledge. According to Romli, M by developing awareness of metachogicism, students are trained to always design the best strategies in choosing, remembering, re-recognizing, organizing the information they face, and solving problems. Based on the opinions of the experts above the researchers concluded that it is important for students to have high metacognitive abilities, so that students' acceptance of new information is truly well understood. But at this time the assessment carried out by the teacher was only limited to cognitive assessment, this is in line opinion with Romli,M stated "currently the teacher in evaluating the achievement of learning outcomes only emphasizes cognitive goals without regard to the dimensions of cognitive processes especially metacognitive knowledge and metacognitive skills" . So it is necessary to give awareness to the teacher to strive for each student to master metacognitive abilities, because metacognitive abilities are still rarely applied in learning. Steps that can be done by using a learning model that can support students to conduct metacognitive processes in learning. Conventional learning models have not been able to load trained students in developing metacognitive abilities because conventional learning models have not made students active in building their own knowledge and conventional learning is teacher-centered learning, so that in the process students only receive learning from the teacher without getting more involved in building their knowledge hence students are not required to conduct metacognition in the learning that is done, therefore it is necessary to know the best learning model that can make students really be able to use their metacognitive abilities. Metacognitive abilities can be used when students do the problem solving process. The learning model of Realistic Mathematics Education and Problem Based Learning is learning that makes the problem the starting point of learning, where by being a problem as the starting point of learning students are automatically required to do problem solving to build their knowledge. To obtain effective knowledge it is necessary for students to include metacognitive abilities in the problem solving process.

A. *Metacognitive ability*

Metacognitive abilities arise from Flavell's view of the concept of metamemori. Flavell uses the term metocognition to refer to one's awareness of consideration and control of the cognitive process. So that one's metacognition process is called metacognitive ability. Metacognitive ability According to Flavell in Lestari and Yudhanegara [7] is a person's knowledge and ability to adjust to a cognitive activity in the learning process. Metacognition refers to one's understanding of his knowledge so that a deep understanding of his knowledge will reflect his effective user or clear description of the knowledge at issue. Metacognitive according to Chairani is a form of awareness of a person related to his cognitive abilities about what he knows, what he does not know based on the knowledge he already has, based on experience, process and control where students are involved in their aspects of metachogic activity

Presseisen in Yamin [8] explained that metacognition includes four types of skills, namely:

1. Problem solving skills
2. Critical decision making skills
3. Critical Thingking
4. Creative thinking skills

Based on the above it can be seen that by mastering metacognitive abilities, the student automatically has these skills. But metacognitive ability is still rarely used by students in the learning process, it happens because students are not trained in doing metacognition in the learning process, students just think in doing the problem solving without further doing the metacognition process of the thinking process that they have done. Inclusion of questions that lead students to metacognition can make students aware of the metacognitive abilities that they possess. Submitting questions is one of the simplest strategies in developing student metacognition. metacognitive questions that can be applied such as:

When you develop a problem solving plan, ask yourself

a. What will I do first to answer the question above?
b. How long will I work on this problem until it's finished?

When you are carrying out a problem solving, ask yourself:

c. How do I solve the problem above?
d. What should I do when I have difficulty resolving the problem?

After you solve the problem, ask yourself

e. Is the answer that I have made right?
f. Is the answer that I made complete or is there an error in the settlement process that I made?

After knowing what strategies can be used to train metacognitive, it is necessary to measure students' metacognitive abilities. But metacognitive abilities are abilities that are difficult to describe because the process occurs internally. Therefore we need indicators that can be observed externally as a frame of reference to explore and reveal data about students' metacognition abilities. The indicators that can be applied to observe students' metacognitive abilities are as follows:

1. Awareness of planning at each stage of problem solving
2. Awareness in monitoring and monitoring at each stage of problem solving.
3. Awareness evaluates every step of problem solving.

The above indicators are adapted from Chairani (2016: 92).

B. *Realistic Mathematical Education*

Realistic Mathematics Education (PMR) is a learning method that was first applied in the Netherlands in 1973 by Hans Freudenthal at Utrecht University as Realistic Mathematics Education (RME). According to Fathurrohman [9] PMR is a mathematics learning theory which in its learning process places and emphasizes the use of situations that can be imagined (imagineable) by students. The use of situations that can be imagined by students is situations of realistic problems which then the problem becomes a starting point of learning but a realistic problem does not have to be a problem that exists in the real world and can be found in students' daily lives. Realistic problems are problems that can be imagined (Imagineable) or real (real) in students' minds. The use of realistic problems in PMR learning is intended to make the learning process meaningful learning. The meaningful learning process only occurs if knowledge is constructed or built by students themselves, students will easily build their own knowledge if the mathematical concepts that will be received are related or can be imagined by the student.

In the PMR learning process the teacher only serves as a facilitator, moderator or evaluator who plays a role in learning is a student, where in this learning model emphasizes on process skills (of doing mathematics) students will conduct discussions, collaboration, arguing with classmates so students can find alone and can apply the knowledge gained to solve problems both individually and in groups.

C. *Problem Based Learning*

Problem-based learning was popularized in McMaster University Canada in the 1970s, the PBL method continued to develop [10]. Problem Based Learning is a learning that makes the problem as a learning material to find the concept of knowledge that you want to get. According to Dawey, learning based on problems is the interaction between stimulus and response, is a relationship between two directions of learning and the environment [11]. The environment provides input to students in the form of assistance and problems, while the nervous system of the brain functions to interpret aid effectively so that the problems faced are investigated, assessed, analyzed, and sought good problem solving which is the metacognitive ability of students. Student experience gained from the environment will be used as material and material to gain understanding or guidance in learning. According to Ratumanan in Trianto Problem-based teaching is an effective approach to teaching high-level thinking processes. This learning helps students to process information that has been formed in their minds and compile their own knowledge about the social world and its surroundings.

The problem presented in learning is a problem that has context with the real world (authentic) as the first step of learning, where from these problems students gather and integrate their knowledge and experience into a concept of mathematical rules. From the problems given by students working together in groups, trying to solve them with the knowledge they have, and at the same time looking for new information that is relevant for the solution. Where students critically identify relevant information and strategies and conduct investigations to resolve the problem. Through the process of resolving these problems students acquire and build certain knowledge and simultaneously develop critical thinking skills and problem solving skills. In the PBM learning process, the teacher is only a facilitator who directs students to find and find solutions that are needed and at the same time determine the criteria for achieving the learning process. In the process the teacher must also focus on helping students achieve good self-skills.

II. METHOD

This study aims to determine differences in students' metacognitive abilities through learning Realistic Mathematics Education and Problem Based Learning

A. *Research Desing*

The type of research used in this study is quasi-experimental. The instrument test plan in this study uses the initial test and final test (one group pretest-posttest). The design of this research design is illustrated in the table as follows:

TABLE 1. Research Desing

Group	Pre-test	Treatment	Post-test
PMR	T1	X1	T2
PBM	T1	X2	T2

Keterangan:
T1: Experimental group pre-test
T2: Experimental group post-test
X1: Treatment of mathematics learning with PMR
X2: Treatment of mathematics learning with PBM

B. *Research Instruments*

This study uses a test instrument, in the form of initial ability tests and metacognitive ability tests.

C. *Instrument Test*

Before the research instrument was used, the contents of all test devices were validated and analyzed by three lecturers and two teachers of mathematics. Content validity is determined based on the suitability between the question grid and the item.

After expert validation of the research instrument, then the instruments with adequate content validity were tested on students outside the research sample. This is done to see the validity, reliability, distinguishing power and level of difficulty of the item.

D. Descriptive Statistical Analysis

1. Descriptive Analysis of Students' Initial Mathematical Ability

The data of the Students 'Initial Ability Test (KAM) obtained through the tests given before the research is carried out will be analyzed descriptively to find out the description of the students' initial mathematical abilities. Based on the KAM score acquisition, students are divided into three groups, namely high, medium, and low ability group students. The steps of grouping students conducted in this study are based on the steps of grouping students in 3 (three) ranks (Arikunto, 2012: 299) [12] that is:

1) Sum up the scores of all students
2) Search mean and standard deviation
   a. Search Mean ($\bar{X}$)

$$\bar{X} = \frac{\sum X}{N}$$

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Keterangan :
$\bar{X}$: mean
$\sum X$: total data
N : lots of data

b. Search Standard Deviation

$$SD = \sqrt{\frac{\sum X^2}{N} - \left(\frac{\sum X}{N}\right)^2}$$

Keterangan :
SD : standar deviation
$\frac{\sum x^2}{N}$ = (each score is squared then summed then divided)
$\left(\frac{\sum x}{N}\right)^2$ = (all scores are summed, divided by N and then squared.)

3) Determine group boundaries
Grouping criteria based on mean ($\bar{X}$) and standard deviation (SD) are presented in table 2 below:

TABLE 2. Grouping Criteria for Students' Ability Based on KAM

Ability	Criteria
High	$KAM \geq \bar{X} \geq \bar{X} + SD$
Medium	$\bar{X} - SD \leq KAM \leq \bar{X} + SD$
Rendah	$KAM < \bar{X} - SD$

Keterangan :
$\bar{X}$: Average value of KAM
SD: Standard devition value of KAM

2. *Descriptive Analysis Metacognitive abilities*

The results of the final metacognitive chemistry test results of students were analyzed descriptively with the aim to describe the level of students' metacognitive abilities in problem solving after the implementation of PMR and PBM learning. Metacognitive ability assessment scores obtained by students based on the table of metacognitive ability scoring will be searched for the mean (mean), and the competency standards are then categorized based on the following ability category tables:

TABLE 3. Metacognitive Ability Category

Interval	Category
$SKM \geq \bar{X} + (1,5)SD$	Very high
$\bar{X} + (0,5)SD \leq SKM < \bar{X} + (1,5)SD$	high
$\bar{X} - (0,5)SD \leq SKM < \bar{X} + (0,5)SD$	medium
$\bar{X} - (1,5)SD \leq SKM < \bar{X} - (0,5)SD$	low
$SKM < \bar{X} - (1,5)SD$	Very low

E. Inferential Statistical Analysis

Inferential statistical analysis is used to test the first hypothesis in this study with inferential ANAVA statistics, after previously performed statistical prerequisite tests as a basis for testing hypotheses, including the normality test and data homogeneity test. ANAVA which is used for this research is two-way Anava [13]

III. RESULT AND DISCUSSION

A. Students' Initial Mathematical Ability

KAM data in this study were obtained from the results of the pre test. The pre test given consists of 4 essay questions with the material to be studied. The description of KAM results held in both experimental classes can be seen from the summary results presented in Table 4 below:

TABLE 4. Description of Student KAM Results Based on Learning

Statistics	Learning	
	PMR	PBM
N	30	30
Average	10.03	10.23
Standard Devition	2.220	2.012

Furthermore, based on descriptive data that has been obtained, the grouping of initial mathematical abilities (high, medium and low) is formed based on the students' KAM values.

TABLE 5. Description of Second Learning Student KAM Data for Each Category KAM

KAM Category	Statistics	Learning	
		PMR	PBM
High	N	5	4
	Average	13.4	13.5
	Standard Devition	0.547723	0.57735
Medium	N	20	20
	Average	10.05	10.4
	Standard Devition	1.145931	1.14248 1
Low	N	5	6
	Average	9.304348	7.5
	Standard Devition	0.547723	0.83666

B. Metacognitive abilities

Metacognitive ability tests are made in the form of problem solving problems by including metacognitive questions that contain 3 aspects of metacognitive components, that is: planning, monitoring actions, and evaluating an action plan. The metacognitive ability test in this study is a post test problem consisting of 4 essay questions.

Metacognitive ability tests in the experimental class 1 which were taught realistic mathematics education were followed by 30 students and in the experimental class 2 which were given problem-based learning followed by 30 students.

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TABEL 6. Description of Student Metacognitive Ability Results

Descriptives

MODEL PMBELAJARAN

Pembelajaran	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
PMR	30	49,23	7,610	1,389	46,39	52,07	37	63
PBM	30	59,77	8,173	1,492	56,71	62,82	48	74
Total	60	54,50	9,461	1,221	52,06	56,94	37	74

From descriptive data the students' metacognitive abilities are known that the average score of students 'metacognitive abilities is that the average score of students' metacognitive abilities taught with problem-based learning higher than the average score students taught with realistic mathematics education learning

TABLE 7. Analysis of the Two Pathways of Metacognitive Ability Pathways

Tests of Between-Subjects Effects

Dependent Variable: Metacognitive ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4057,767[a]	5	811,553	35,826	,000
Intercept	119256,438	1	119256,438	5264,611	,000
KAM	2358,781	2	1179,390	52,065	,000
Pembelajaran	1183,205	1	1183,205	52,233	,000
KAM * Pembelajaran	5,999	2	3,000	,132	,876
Error	1223,233	54	22,652		
Total	183496,000	60			
Corrected Total	5281,000	59			

a. R Squared = ,768 (Adjusted R Squared = ,747)

Based on the ANOVA test results in table 7 known differences in students' metacognitive abilities based on learning obtained F count 52.233 and significance 0.000. Because the level of significance value obtained α = 0,000 is smaller than α = 0.05, then Ho is rejected, this means that at the 95% level of confidence it can be concluded that there are differences in students' metacognitive abilities taught with problem-based learning with students taught learning realistic mathematics education. Based on descriptive results that the results of the students' metacognitive abilities taught by problem-based learning are higher than students who are taught by learning realistic mathematics education. Based on table 7 information is obtained that the value of F for learning interaction and KAM that is 0.132 and significance value for learning interaction and KAM is 0.876. Because the significance value obtained is 0.876 greater than α = 0.05, Ho is accepted, which means that there is no interaction at 95% the level between the learning model and KAM students towards students' metacognitive abilities.

IV. CONCLUSIONS

Metacognitive abilities of students taught by Problem-based learning is higher than students who taught learning realistic mathematics education. Descriptively obtained by the average experimental group Problem-based learning is 59.77 As for the experimental group of learning realistic mathematics education is 49.23. In this case, the average score of PBM learning higher than PMR. There is no interaction between learning models (realistic mathematics education and problem-based learning) with KAM (high, medium, low) students towards students' metacognitive abilities

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