

Metacognitive Awareness and Its Effect on Students' Problem Solving Ability in Implementing RME Approach

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Abstract—This study aims to describe the metacognitive awareness of students who learn with the RME approach and those who learn with conventional approach; and describes the effect of metacognitive awareness on students' problem solving abilities in implementing RME approach. The subjects of this study were seventh grade students of SMP Negeri Kecamatan Luak Kabupaten Lima Puluh Kota. The research data were obtained by using a Metacognitive Awareness Inventory Junior questionnaire (Jr-MAI) and a final test designed based on indicators of problem solving abilities. Data were analyzed inferentially by using covariant and simple linear regression analysis with SPSS program. The results showed that metacognitive awareness of students who learn with the RME approach is better than those who learn with conventional approach; and there is a positive effect between metacognitive awareness on students' problem solving abilities and the application of RME approach.

Keywords—*metacognitive awarenees, problem solving ability, RME approach*

I. INTRODUCTION

Mathematical learning involves thinking processes and self-regulation during problem solving. Metacognitive includes students' awareness of their thinking processes, checking their thinking processes, and regulating their thinking processes [19]. Metacognitive plays an important role in learning so that it becomes a determinant in the academic success of students [6, 9]. This was confirmed by Minister of Education and Culture Regulation No. 20 of 2016 reveals that metacognitive is one of the graduate competencies that must be possessed by students in the dimension of knowledge [14]. Thus, metacognitive includes students' awareness of their own strengths and weaknesses in their thinking processes, re-checking their thinking processes, and managing their thinking processes while solving a problem.

One component of metacognitive that is needed in solving problems is metacognitive awareness. Metacognitive awareness is defined as the ability of students to reflect what is known and what is not known, understand how they learn from the context of learning and be able to control themselves in learning [9]. Metacognitive awareness is a person's awareness of what is known and what will be done in their own learning process [18]. The condition of students'

metacognitive abilities based on expert research that shows students are not able to separate what is thought and how it thinks, and students do not have the awareness of thinking as a process [16].

Metacognitive awareness can be traced by applying an approach to learning that involves students directly. Metacognitive awareness of students can be empowered by using learning strategies that have the characteristics of student centers [5]. Direct involvement of students is expected to improve thinking and regulate systematic thinking steps in solving mathematical problems. One learning approach that is thought to be able to maximize students' metacognitive awareness is the Realistic Mathematics Education (RME) approach.

The RME approach provides steps that can involve cognitive learners in the learning process. Steps for implementing the RME approach in learning was understanding the contextual problems provided, explaining contextual problems, solving problems, comparing answers, and concluding. Students learning mathematics using RME must develop and apply concepts and mathematical tools in situations/ problems of everyday life that make sense to them [10]. The application of the RME approach provides an opportunity for students to be actively involved in building their own understanding of mathematics learning [3]. The application of the RME approach can involve students directly in learning so that it can improve thinking, understanding and application of the concepts learned [12]. The teacher acknowledges that there is a positive change in the behavior of students after attending RME based learning [7].

Metacognitive was revealed according to Wilburne with the aim to have a positive impact on individual attitudes in solving problems [4]. This is in accordance with Schraw and Dennison's opinion that metacognitive awareness develops from metacognitive knowledge and knowledge regulators to become metacognitive skills that encourage students to solve problems [9]. This opinion shows that metacognitive awareness affects students' ability to solve problems. Expert research shows that students who have good metacognitive awareness have good problem solving strategies and learning outcomes compared to students who have poor metacognitive awareness [1].

This study aims to describe the metacognitive awareness of students who learn with the RME approach better than those who learn with conventional approaches; and describes the effect of metacognitive awareness on students' problem solving abilities on the application of the RME approach. Metacognitive awareness will be seen using the Jr-MAI questionnaire based on the metacognitive aspects proposed by Schraw and Dennison including metacognitive knowledge (declarative knowledge, procedural knowledge, and conditional knowledge) and metacognitive regulation (planning, strategic information management, comprehension monitoring, debugging strategies, and evaluation) [9]. Problem solving ability of students are assessed based on the following indicators: a) identifying the adequacy of data to solve problems; b) formulating mathematical problems or constructing mathematical models; c) choosing and implementing strategies to solve various mathematical problems and/ or outside mathematics; and d) explain or interpret the results according to the original problems, and check the correctness of the answers [17].

II. METHOD

This study used covariant analysis aimed at analyzing the metacognitive awareness of students who learn with the RME approach better than those who learn with conventional approach; and simple linear regression analysis was aimed at analyzing the effect of metacognitive awareness on students' problem solving abilities on the application of the RME approach. The study population was seventh grade students of SMP Negeri Kecamatan Luak Kabupaten Lima Puluh Kota. The research sample was taken using simple random sampling technique so that each of the 49 students was obtained for the control class and experimental class. Students in the control class learnt by using conventional learning (scientific approach), while the experimental class learnt using the RME approach. Metacognitive awareness data were taken in both sample classes at the beginning and at the end of learning, while data on problem solving abilities were taken only in the experimental class after the application of the RME approach.

Metacognitive awareness data collected using the Junior Metacognitive Awareness Inventory (Jr-MAI) questionnaire compiled by Sperling, et al. which has been translated and modified consisting of 30 statement items [13]. Questionnaires using four Likert scales are strongly agree, agree, disagree, and strongly disagree. Ordinal data on the questionnaire must be transformed into interval data using the Method of Successive Interval (MSI) before being analyzed. Data problem solving abilities were collected using a final test designed based on indicators of problem solving abilities. The final test results are assessed based on the rubric of problem solving abilities [8]. The question of posttest used has been tested for validity, differentiation index, index of difficulties and reliability of questions which indicate that the classification of questions can be used to perform metacognitive skills and problem solving skills of students. Metacognitive awareness data were analyzed using covariance analysis, while to see the effect of metacognitive

awareness data on problem solving abilities were analyzed using simple linear regression analysis. The analysis was done with the help of SPSS program with real level ($\alpha = 0,05$).

III. RESULTS AND DISCUSSIONS

The results of the metacognitive awareness questionnaire that has been transformed into interval data using Method of Successive Interval (MSI) were first tested for normality, variance homogeneity test, and linearity test. The results of the normality test showed that all students' metacognitive awareness questionnaire data in the sample class had normal distribution; the results of the homogeneity variance test showed that the metacognitive awareness questionnaire data of the sample class students had homogeneous variances; and the results of linearity test showed that the metacognitive awareness questionnaire data of the sample class students had a linear regression model. The results of the prerequisite test indicate that the data can be analyzed using covariance analysis.

Covariance analysis was carried out by controlling the pretest conditions before the study. The pretest questionnaire data of students' metacognitive awareness as covariable, while the posttest questionnaire data of students' metacognitive awareness as dependent variable. The results of hypothesis testing the metacognitive awareness of students who learn with the RME approach better than those who learn with conventional approaches using covariance analysis as follows:

TABLE I. COVARIANCE ANALYSIS METACOGNITION AWARENESS OF STUDENTS WHO LEARN WITH THE RME APPROACH COMPARED TO THOSE WHO LEARN WITH THE CONVENTIONAL APPROACH

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9322,338	2	4661,169	15,178	0,000
Intercept	17997,357	1	17997,357	58,602	0,000
Pretest	6689,550	1	6689,550	21,782	0,000
Class	3359,902	1	3359,902	10,940	0,001
Error	29175,394	95	307,109		
Total	1233986,443	98			
Corrected Total	38497,732	97			

The test results of the metacognitive awareness questionnaire hypothesis of the sample class students using covariance analysis in Table I shows that the price of F for the sample class is 10.940 with a significance of 0.001, so that the value of Sig <0.05 then reject H_0 . Thus, the average metacognitive awareness data of students in the experimental class learning with the RME approach is better than the control class that learns with conventional approaches by controlling the pretest conditions before the study.

Metacognitive awareness arises in the application of the RME approach including students can reflect on what is known and what is not known, understand how they learn from a learning context and are able to control themselves in trying to think of their own ways of solving problems. RME is designed to help students complete the rediscovery activities that occur when students try to think of their own

ways to work through mathematical concepts [11]. Students who have good metacognitive awareness have good strategies and learning outcomes compared to students who have poor metacognitive awareness [1]. Good metacognitive awareness gives a good effect in the learning process. Thus, it can be concluded the metacognitive awareness of students who learn with the RME approach better than those who learn with conventional approaches.

The results of students' metacognitive awareness analysis were also presented based on the interpretation of students' metacognitive awareness after learning with the RME approach compared after learning with the conventional approach based on the rating scale adapted by Green [2] can be described as follows:

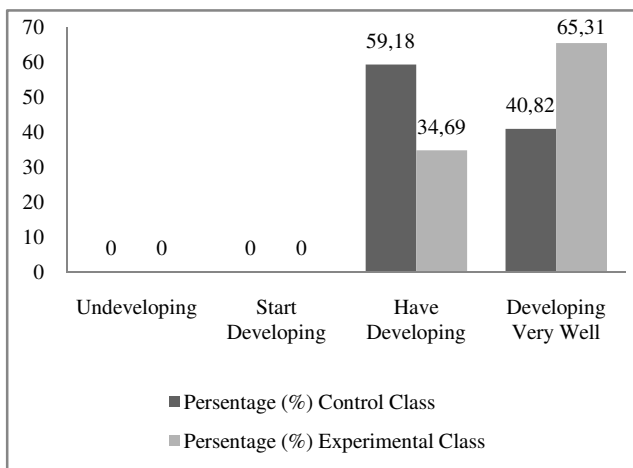


Fig. 1. Interpretation of metacognitive awareness of students after learning with the RME approach compared after learning with the conventional approach

Interpretation results in Figure 1 show that the metacognitive awareness of students after learning with the RME approach dominates the criteria for developing very well by 65.31%, while those who study with the conventional approach dominate the criteria that have developed by 59.18%. The percentage of metacognitive awareness above shows that students who learn with the RME approach are better able to understand their way of thinking, aware of being thinkers and able to differentiate the elaboration of input and output from their thinking processes; and able to regulate the process of thinking and able to learn independently, compared to students who learn with conventional approaches. Meanwhile, students who study with conventional approaches are only able to use metacognitive awareness regularly to regulate their thinking processes and learning independently; able to understand and implement various ways of thinking and various learning strategies, and can reflect their thinking processes and be able to assess themselves in learning.

Metacognitive awareness can also be analyzed based on aspects of metacognitive, namely metacognitive knowledge and metacognitive regulation. These aspects are contained in 30 items of questions in the metacognitive awareness questionnaire given. Comparison of metacognitive awareness of students learning with the RME approach with those who learn with conventional approaches can be

analyzed more specifically based on the questionnaire designed [13]. The awareness of the students' metacognitive can be analyzed as follows:

Metacognitive knowledge possessed by students can be described based on declarative knowledge, procedural knowledge, and conditional knowledge. Declarative knowledge of students learning with the RME approach seems to be more aware that factual knowledge is needed before being able to process or use critical thoughts related to the topic; required knowledge of skills, intelligence and abilities as a student; and knowledge gained through/ from demonstration and discussion presentations is needed compared to those who study with conventional approaches.

Procedural knowledge of students learning with the RME approach seems to be more aware that knowledge is needed to complete procedures or processes; knowledge of how to implement procedures (for example learning strategies) is needed; guidance is needed to know the process and also when to apply the process in various situations; and knowledge that can be obtained from/ through cooperative learning and problem solving is needed compared to those who study with conventional approaches. Conditional knowledge of students who learn with the RME approach seems to be more aware that it is necessary to determine the specific situation to be able to move the process or skill; knowledge of when and why to use procedures (learning strategies) is needed; Declarative and procedural application is needed; and knowledge that can be obtained from/ through stimulation is needed compared to those who learn with conventional approaches.

Metacognitive regulation of students can be described based on planning, strategic information management, comprehension monitoring, debugging strategies, and evaluation. Planning students who learn with the RME approach seem more aware that planning is needed; goal setting is needed; and the management of material sources is needed mainly for learning compared to those who learn with conventional approaches. Strategic information management students who learn with the RME approach are seen to be more aware that a sequence of skills or strategies is needed to process information more efficiently (for examples organizing, connecting, inferring, focusing, or determining priorities) than those learning with conventional approaches.

The comprehension monitoring of students learning with the RME approach seems to be more aware that it is necessary to evaluate a person's learning strategies that are being used compared to those who learn with conventional approaches. The debugging strategy of students who learn with the RME approach seems to be more aware that a strategy or step is needed to correct misunderstanding or acquisition rather than learning with a conventional approach. Evaluation of students who learn with the RME approach seems to be more aware that acquisition analysis and strategy effectiveness are needed at the end of learning activities than those learning with conventional approaches.

The interpretation also shows that the metacognitive awareness of students who learn with the RME approach

better than those who learn with conventional approaches. The activity of the RME approach has a positive impact on students' metacognitive awareness in learning. The steps in implementing the RME approach are considered to be able to involve students' metacognitive in learning mathematics, namely understanding the contextual problems provided, explaining contextual problems, solving problems, comparing answers, and concluding. Metacognitive awareness emerges in the application of the RME approach, namely students can reflect on what is known and what is not known, understand how they learn from a learning context and are able to control themselves in trying to think about their own ways of solving problems.

Better metacognitive awareness of students who learn with the RME approach, indirectly also affects students' problem solving ability in solving problems. This is consistent with Schraw and Dennison's opinion that metacognitive awareness develops from metacognitive knowledge and metacognitive regulation to become metacognitive skills that encourage students to solve problems and think high-level [9]. Thus, it is necessary to test hypotheses in the form of the effect of metacognitive awareness on students' problem solving abilities on the application of the RME approach.

Before testing the hypothesis the results of the metacognitive awareness questionnaire and posttest assessment for students' problem solving abilities after learning with the RME approach were first tested for normality and linearity tests. The results of the normality test obtained all the data normally distributed and the results of the linearity test obtained between the data have a linear regression model so that it can be carried out simple linear regression analysis. The results of testing the hypothesis there is the effect of metacognitive awareness (X_1) on the problem solving ability (Y) of students after the application of the RME approach using simple linear regression analysis as follows:

TABLE II. ANNOVA EFFECT OF METACOGNITIVE AWARENESS ON STUDENT PROBLEM SOLVING ABILITIES

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	292,529	1	292,529	5,637	0,022
Residual	2439,144	47	51,897		
Total	2731,673	48			

TABLE III. COEFFICIENTS EFFECT OF METACOGNITIVE AWARENESS ON STUDENT PROBLEM SOLVING ABILITIES

Model	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta
1 (Constant)	17,566	6,616	
Metacognitive Awareness	0,134	0,057	0,327

TABLE IV. REGRESSION EFFECT OF METACOGNITIVE AWARENESS ON STUDENT PROBLEM SOLVING ABILITIES

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,327	0,107	0,088	7,20394

Simple linear regression analysis of metacognitive awareness on students' problem solving abilities after using the RME approach based on Table II obtained the F value of

5,637 and the Sig. value of 0,022, so the value of $\text{Sig.} < 0,05$ then reject H_0 . Thus, there is an effect between metacognitive awareness on students' problem solving abilities after the application of the RME approach. The regression equation based on Table III is obtained $Y = 17,566 + 0,134X_1$, it can be used to conclude the effect of metacognitive awareness on students' problem solving abilities after applying the RME approach. The equation illustrates that metacognitive awareness contributes to problem solving abilities of 0,134 units in a positive direction with constant of 17,566.

Regression analysis of metacognitive awareness on problem solving abilities in Table IV obtained R Square of 0,107. This shows that metacognitive awareness gives an effect of 10,7% on students' problem solving abilities, while 89,3% of problem solving abilities are effected by other variables that are not examined. This percentage indicates that metacognitive awareness has a positive effect on students' problem solving abilities on the application of the RME approach with a total effect of 10,7%. If students maximize metacognitive awareness owned, then problem solving abilities will also be maximal than ever. Mastery of mathematical problem solving strategy is based on metacognitive owned or awareness of students in thinking about what is known and how to apply it [15]. Expert research shows that students who have good metacognitive awareness have good problem solving strategies and learning outcomes compared to students who have poor metacognitive awareness [1].

IV. CONCLUSION

Based on the results of the study it can be concluded that 1) the metacognitive awareness of students who learn with the RME approach better than those who learn with conventional approaches; and 2) metacognitive awareness has a positive effect on students' problem solving abilities on the application of the RME approach with a total effect of 10.7%.

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