Enhancing mathematical reasoning ability and self confidence students' through realistic mathematics education approach with geogebra

C M Pertiwi[1]

[1]Master of Mathematics Education, Institut Keguruan dan Ilmu Pendidikan Siliwangi, Cimahi, West Java, Indonesia
*Corresponding author's email: citra.megianapertiwi@gmail.com

Abstract. This research aimed to analyze the role of Realistic Mathematics Education (RME) approach with GeoGebra in enhancement and achievement of Mathematical Reasoning Ability (MRA) and Mathematical Self-Confidence (MSC) of Junior High School students, and due to no research on the dependent variable and independent variable together yet. The method used was experimental research with a pretest-posttest Control Group Design. In this research, the population was all 7th graders in Cimahi City. The research sample was 69 students consisted of two classes that were randomly selected and divided into experimental and control classes in a school. The instrument used an essay test on MRA and MSC scale. The results showed that: (1) Significant enhancement and achievement of MRA and MSC for students who learned through RME with GeoGebra were better than the Ordinary Learning (OL), (2) Students achievement of MRA through RME with GeoGebra was at a strong level and for students with OL was at a sufficient level, (3) Students achievement of MSC through RME with GeoGebra and students with OL were at a good level, (4) Students MRA on the indicator explained that the model had not been achieved ideally, (5) There was an association between MRA and MSC.

Keywords: Mathematical Reasoning, Self Confidence, Realistic Mathematics Education, Geogebra

How to Cite: Pertiwi, C M. (2019). Enhancing mathematical reasoning ability and self confidence students' through realistic mathematics education approach with geogebra. In Darmawijoyo, et al. (Eds), *Modeling in Mathematics Instruction: The First Step towards Problem Solving.* Prosiding National Conference on Mathematics Education (NaCoME) 2019 (hal. 30 – 37). Palembang: Indonesia.

1. Introduction

Human activity deals with the use of mathematics so that it becomes a compulsory subject to learn at every level of education. One of the most important mathematical skills for students is Mathematical Reasoning Ability (MRA). The reasoning is translated from the term reasoning which contains the meaning of drawing conclusions [1]. Schoenfeld explains that the importance of mastering MRA is in line with mathematical vision in particular to meet future needs [2]. MRA can make students solve math problems [3]. Reasoning as a process of thinking to take conclusions is the basis of high-level thinking abilities. In general, it can be concluded that the importance of the MRA is because of reasoning itself as someone's thinking process which are logical and analytical to cope with certain condition.

The process of enhancing MRA is divided into two, namely Mathematical Deductive Reasoning Ability (MDRA) and Mathematical Inductive Reasoning Ability (MIRA). Inductive reasoning is a process of thinking of conclusions or making common statements from specific processes that have been known before. MIRA as reasoning based on the limited examples observed [4]. While the MDRA is the process of thinking from drawing conclusions or from general statements first to special parts. Deductive will be valid if the parts are particularly valuable. In line with that, Jacobs expresses deductive reasoning as a method of drawing conclusions from the facts received as something that is

perceived to be true using logic [5]. MIRA and MDRA are rotational reasoning that starts from the reality of the past in the induction by the individual and produces a theory called generalization, where the theory will be reduced to complete problems in the reality of life.

It is not only MIRA that important for students, but also the effective ability that helps to maximize mathematics learning, it is Self-Confidence (SC) as an important effective basis. In accordance with the research results of Ida, Destin, and Siti which state that confidence has a significant influence on student learning achievements, especially for mathematics lesson at the Junior level [6]. SC or confidence is a self-concept with a wide scope and an important interpersonal aspect. SC is a strong belief in individuals to do something derived from its mental situation factor [7].

However, the reality in the field of MIRA and SC students in a number of SMP is still low. Based on the preliminary study of researchers of students at SMP Negeri in Cimahi city with samples of 55 people with triangular and quadrilateral material, MIRA SMP students who become samples in the study have a relatively low MIRA. This is in line with Syahputra's research and other research which state that the reasoning ability of junior high school students in mathematics is still at a low level [8,9,10]. Likewise, with the SC, it is indicated that the students' SC is still low where students are afraid to present ideas and work on individual mathematics [11]. Furthermore, students with low SC answer math problems incorrectly [12].

Referring to the cognitive development theory of Piaget's main target of mathematics is to sharpen reasoning as an indicator of cognitive development. The development has three important things, first providing the possibility versus reality, both the use of reasoning in solving the problem, the three skills in combining ideas [13]. Therefore, a learning strategy is believed to be able to build student's competence in improving MIRA and SC students by using the Realistic Mathematics Education (RME) approach. The RME approach is oriented to the mathematical experience of everyday life and to apply mathematics in our daily lives. The RME approach has several characteristics, such as using context, using student contributions, using models, interaction in the learning process, and using a variety of interrelated learning theories, integrated with other learning topics [14]. Some research show that learning through RME has a positive impact on mathematics [15,16,17].

In addition, to maximize the results, RME learning can be equipped with a supporting applications, one of that is GeoGebra. In this case, Geogebra is used as a learning tool or medium as well as mathematical aids to provide exposure or visualize mathematical concepts. With such a concept of problem solving in mathematics can be more easily understood by students, then each stage of completion using Geogebra shows a better effort [18].

2. Experimental Method

This research used experimental research methods with a design in the form of pretest-posttest Control Group Design. The population of all SMPN students in Cimahi with the sample subject is Class VII. From all the SMPN in Cimahi was chosen randomly and elected one of the SMPN in Cimahi as a research place. Research involving two groups, the experiment Group, and the control group. All groups were Pre-responses and post responses. The experimental group gained learning through the Geogebra-assisted RME approach as treatment and the control group received mathematical learning as usual for treatment. The research design is described as follow [19]:

A	0	X	0
A	0		0

Description:

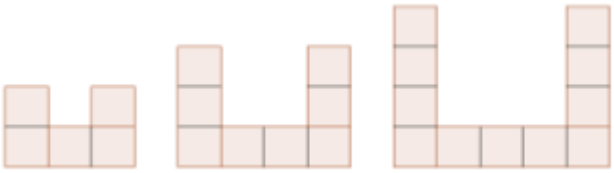
A : Sampling is done randomly by class
0 : Preseason = post response (MIRA test and SC scale)
X : Learning with a GeoGebra-assisted RME approach

Instruments on Pre-response and post response were the same instruments. The research instrument was in the form of the MIRA description test as much as 10 questions made based on the material contained in the curriculum 2013 for class VII namely the flat rectangular and triangle to be integrated with MIRA indicator, non-test Self-confidence scale with a total of 32 statements that contain positive and negative statements with a balanced amount, as well as an open questionnaire to review student barriers in achieving the success of both abilities based on their learning.

For junior high school students who still thought about the concrete study had to start with real-life reality, therefore, students had to have a MIRA. From many MIRA indicators according to the experts, the indicators used are, I) linkage between cases (transductive); II) conformity between procedures and data (analogy), III) formulating generalities; IV) predict completion, provide review of information; V) explaining the model; VI) Relationship between patterns to analyze conditions and construct conjectures [20]. In completing personal mathematics it took self-confidence in students.

Likewise with self-confidence as a person's belief in all aspects of its advantages, including Believe in self-esteem, independent in the face of the decision, positive personal concept, and dare to express Ideas [2].

2.1 Sample 1. Item of MIRA test



Picture. 1 **Picture. 2** **Picture. 3**

The picture above is an image design for a bank's waiting room SOFA. Each square field chair has an area of 1 meter^2. Determine the circumference of the sofa for the 10th image and specify the rules for determining the circumference of the n-sofa

2.2 Sample 2. Item of SC scale

No	Statement	SA	A	DA	SDA
1	I am afraid to ask mathematical material that I do not understand yet (-)				
2	I will give an opinion in class when it is hard to solve complicated triangles and quadrilateral (+)				

Note: SA: strongly agree, DA: disagree, A: agree, SDA: strongly disagree

3. Result and Discussion

3.1 MIRA and SC Data Analysis Results Based on Learning

Student grades at the mathematical inductive reasoning ability (MIRA), N-Gain MIRA, Self-Confidence (SC), were presented in table 1.

According to table 1 showed that the Prerespon average score of MIRA and SC class experiments better than the control class, but the data propagation of the Preseason grade of the control class for both capabilities was more widespread. In the Post response, the average score of the MIRA and SC experimental classes was much better than in the control class but the control class had the spread of Posresponse scoring data on both of those capabilities better. In addition, the average gain score and the data spread on the gain deviation of MIRA and SC class experiments were better than the control class. From the exposure at a glance in terms of the average value of the experiment class was better but in terms of the control class deployments was better. However, statistical tests were required to see whether the difference was significant or not.

According to table 2, statistical tests showed that the MIRA and SC early students before being given learning were the same, but MIRA's achievement, as well as the achievement and improvement of SC students after being given learning using assisted RME, approaches Geogebra was significantly better than students with regular learning. Likewise, MIRA increasing (N-gain) students with RME approaches had better GeoGebra assistance as well.

According to table 2,Pearson-Chi Square Test and ContigensiCoeffisienBetween MRA and SC, there was an association between MRA and MSC in the strongly level.

Tabel 1. Statistics Description of Test Results and Non-Test Reasoning Ability of Mathematics and Student Self-Confidence

Variable		Eksperiment Class			Control Class			SMI
		Pretest	***Posttest***	***Gain***	***Pretest***	***Posttest***	***Gain***	
MIRA	$\overline{x}$	7.26	25.49	.56	6.62	20.65	.42	40
	%	18.15%	63.73%	56.00%	16.55%	51.63%	42.00%	
	S	2.944	3.023	.09	2.88	5.48	.16	
SC	$\overline{x}$	55.03	62.86	.33	53.53	59.68	.24	128
	%	68.79%	78.58%	33.00%	66.91%	74.60%	24.00%	
	S	5.47	5.65	.14	7.33	6.84	.10	

Tabel 2. MIRA Hypothesis Test, MIRA N-Gain, SC, N-Gain SC on RME with Geogebra help and regular learning

Variable	Learning	Prerespon		Postrespon		N-Gain	
		Sig.	Interpretation	Sig.	Interpretation	Sig.	Interpretation
MIRA	RME + Geogebra	.312	Initial Ability $MIRA_{RME+G} = MIRA_{PB}$	.000	Achievement $MIRA_{RME+G} > MIRA_{PB}$	.000	Increase $MIRA_{RME+G} > MIRA_{PB}$
	PB						
SC	RME + Geogebra	.446	Initial Ability $SC_{RME+G} = SC_{PB}$	.0195	Achievement $SC_{RME+G} > SC_{PB}$	.000	Increase $SC_{RME+G} > SC_{PB}$
	PB						

Tabel 3. Pearson-Chi Square Test and ContigensiCoeffisienBetween MRA and SC

Pearson Chi Square	df	ContigencyCofficient (C)	Sig.
27.846[a]	4	.677	.000

3.2 Discussion

Mathematical Inductive Reasoning Ability

Reviewing the data analysis results of MIRA class experiments and controls test scores, it could be seen that the average value of the two classes was not too different. This suggested that the second MIRA class before being given treatment was the same. But the average value of the two classes was very low because the class was not used to solve the high level of capabilities such as MIRA's problem, although basically the material about the flat build of rectangles and triangles they had learned Primary school.

After being granted prerespon, experimental students received lessons with a GeoGebra-assisted RME approach. Each meeting class setting was always in group form. Each student meeting would be given the LKS to construct the students ' knowledge until they find the concept. LKS had been integrated with the MIRA indicator and the Geogebra-assisted RME approach characteristics to provide precise geometry images. This was done so that the objectives to improve MIRA using the Geogebra-assisted RME approach could be achieved. The LKS RME approach that was collaborated with MIRA could better improve the concept of ability and mastery because it was more structured and made based on the principles of everyday life.

While the control class would accept learning as usual according to the applicable curriculum, the LKS used in the control class was the learning phases already in the student's book. The student's book had already loaded a concept discovery with a scientific approach characteristic. The assessment and evaluation tools provided in the control class were the same as the experiment class. Researchers assessed the LKS used to directly enter formal mathematics and mathematics learning was limited to finding formulas but students were lacking in learning mathematics.

After receiving the learning according to each approach, at the end of the meeting the second class carried out post response to see the development of the students after being given treatment. From the results of the analysis, the average of the MIRAposttest values of both classes was improved, but the experiment class was much better than the control class. Statistical test results also indicated that the experiment class was better than the control class. It then could be concluded that MIRA SMP Negeri in Cimahi who used the RME approach with Geogebra help was better than those who gained regular learning.

From the pretests and posttest data obtained, the normalized gain test was carried out. The analysis results showed an experiment class gain value better than the control class. The results of the data processing show that the mathematical reasoning ability of the experimental class increased significantly as learning using the Geogebra-assisted RME approach was better than using regular learning. This was in line with other studies that suggested that learning using the RME approach was better than using regular learning [21,22]. Then the student gave a positive response to the realistic mathematical learning assisted by Geogebra[16].

From the description, the research hypothesis was answered in accordance with the expectations of researchers. Success in this research, because researchers did the research in accordance with the procedures, characteristics of students who could be invited to cooperate, the implementation of teaching-learning activities according to the demands characteristic of RME approaches, were supported by Geogebra. Mainly because there was conformity between indicators of mathematical reasoning ability with the characteristics of RME approaches, and data processing in accordance with data processing procedures.

Self-Confidence

At the first meeting, the students were given the SC scale. The average student poll value was calculated using the Likert scale and indicated that the SC class experimentation was larger than the control class although it did not differ considerably. Statistical test results also showed no differences in the initial capabilities of the two classes of SC. During the teaching and learning activities, researchers were not only trying to improve students ' cognitive abilities, as they improved their effective ability to become educators ' tasks in balancing soft skills and students ' hard skills.

In an experimental class that used the Geogebra-assisted RME approach, there were times when groups of meetings were always revamped. The goal was for students to be able to interact with anyone and had confidence that did not depend on close friends. Researchers tried to familiarize students with being confident in their own abilities. While in the control class using the PB setting learning was the same as usual with the group of students remained the same from the beginning of the meeting to the end. The two characteristics of such learning could essentially improve the SC students.

At the end of the meeting, students were given the SC scale to see student responses after treatment. The average experiment classPosttest poll score was larger than the control class. The test results of two average differences showed the achievement of SC students who gained learning using the Geogebra-assisted RME approach better than the students who gained regular learning. Likewise, with the results of the normalization of SC students, the average gain score normalized experiment class was greater than the control class. The results of the statistical test analysis showed the improvement of students' SC experiments classes better than the control class. So with such exposure could be concluded that the research hypothesis was true in line with similar research results [15].

Students' Difficulties in Resolving a Mathematical Inductive Reasoning Ability

Students' difficulties in solving MIRA's problem were defined as the cause of the achievement of goals. Based on the percentage of student response calculations for each indicator of the mathematical

reasoning capability used, the experimental class students have attained a better level of control than the class. Study the results of the percentage of the mathematical reasoning test answers on the indicator provided an explanation of the existing model, fact, properties, relationships, or patterns for the control class of 32.35% at a weak level and an experimental class of 42.14% in Considering that the favorite index was difficult. The overall MIRA experimental class of 63.71% was on a strong level. However, the overall control class of the average percentage was 51.62% being at a considerable level. From the open-ended poll, the difficulties of the two students alike lied in the understanding of problems and difficult calculations. And the solution of students working on the matter was to use logic and answer it. This showed that the question was true about MIRA.

Tabel 4. Recapitulation on Average Poste's Value of Each MIRA Indicator

Indicator	Eksperiment Class	Control Class
Relations between cases (transductive)	76.07%	63.24%
Conformity between procedures and data (analogy)	61.07%	53.68%
Formulating generalization	62.50%	47.79%
Predict completion, review of information	62.14%	47.79%
Explaining the model	42.14%	32.35%
Inter-pattern relationships to analyze conditions and compile conjectures	71.43%	58.82%
Overall Average	63.71%	51.62%

Overall the two classes overcame the difficulty of solving the problem using this logic indicated that the problem used was true about the ability of mathematical reasoning. As well as the findings above in accordance with the results of similar research that indicated that students were still struggling in giving arguments and students were not able to solve the problem because they did not understand the purpose of the question well [23]. And students struggled to use models, applying facts, concepts, and mathematical procedures

Students' Difficulties in Developing Self-Confidence

From the analysis of the percentage of self-confidence poll on a per-indicator basis, overall the average percentage of self-confidence class experiments of 78.57% was on the strong criteria students have had good self-confidence, but needed to keep Enhanced or maintained. The barriers to self-confidence experiment classes were largely constrained by the embarrassment, nervousness, and other negative thoughts this remembers because of the learning settings that continued to be made on a personalized basis. But students ' solutions were almost entirely by self-motivation and self-strengthening by praying. For the overall control class, the average percentage of the self-confidence control class was 74.56% meaning that the control class had strong self-confidence as well. The obstacle control class lied in the unconfident because it worried the answer wrong. The student solution was the same as the experimental class that had positive self-esteem by self-motivation and prayer.

Tabel 5. The Average Percentage of Postes each Self-Confidence indicator

Indicator	Eksperiment Class	Control Class
Trust yourself	75.95%	73.65%
Act independently in making decisions	78.75%	72.79%
Have a positive self-concept	81.86%	77.21%
Dare to express opinion	78.29%	74.41%
Overall Average	78.57%	74.56%

Overall the two classes overcame the difficulty of solving the problem of using the confidence that grew in him positively. The results of the achievement percentage clearly showed the self-confidence class experiment was better than the control class.

4. Conclusion

The achievement and improvement of MIRA and SC Junior high school students with a Geogebra approach were better than those who used regular learning. Implementation of learning with a Geogebra-assisted RME approach was carried out with five phases, using context, model, utilization of student construction, interactivity and association. Where students learned the material with stages of understanding contextual issues, explaining contextual issues, resolving contextual issues, comparing and discussing contextual issues and concluding contextual issues. In general, learning with Geogebra-assisted RME approaches had a positive impact on students ' cognitive and affective abilities, learning feels more interactive and meaningful.

The students ' difficulties in working on the mathematical reasoning ability were largely in the indicator providing an explanation of the model, fact, properties, relationships or patterns that existed because their favoriteindex was difficult. MIRA students whose studies used the Geogebra-assisted RME approach were at a strong level whereas students who used ordinary learning were at a considerable level. In addition, the students had had a good SC with an equivalent of 70% of the SC meant that the students were strong.

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