

## **THE ROLE OF MODEL-ELICITING ACTIVITIES ON STUDENT'S MATHEMATICAL REASONING AND SELF REGULATED LEARNING**

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### **ABSTRAK**

Penelitian dengan *pretest-posttest experiment control group design* ini bertujuan menganalisis pengaruh *model-eliciting activities* terhadap kemampuan penalaran matematik dan *self regulated learning* siswa. Penelitian melibatkan 72 siswa kelas 8 SMP. Instrumen yang digunakan meliputi tes uraian kemampuan penalaran matematik, dan angket *self regulated learning* matematik. Hasil penelitian menunjukkan bahwa kemampuan penalaran matematik siswa yang mendapat pendekatan *model-eliciting activities* meningkat lebih baik dari pada siswa yang mendapat pembelajaran konvensional walaupun kategori kemampuan penalaran matematik siswa pada kedua kelas tergolong sedang. Sementara itu, *self regulated learning* siswa tergolong kategori cukup. Respon siswa dari kelas eksperimen positif walaupun siswa masih mengalami kesulitan dalam menyelesaikan soal-soal penalaran matematik. Kemampuan penalaran dan *self-regulated learning* siswa cenderung dapat diperkuat melalui *model-eliciting activities*.

**Kata kunci:** penalaran matematik, *self-regulated learning*, *model-eliciting activities*,

### **ABSTRACT**

*The study aims to analyze the role of model-eliciting activities on students' mathematical reasoning ability and self regulated learning. This study was conducted using a pretest-posttest experiment control group design. The study involved 72 eighth grade students. Instruments used were mathematical reasoning ability test, and a mathematical self regulated learning questionnaire. The study found that students who got treatment on model-eliciting activities had better grades on mathematical reasoning ability and self regulated learning than that of students taught by conventional teaching, though the students' mathematical reasoning ability grades were at medium level and the grades of self regulated learning were at fairly good level. Students expressed positive response on Mathematics Model-eliciting Activities, even though student still realized difficulties in solving mathematical reasoning task. So we conclude that students reasoning abilities and their self-regulated learning tend to increase through model-eliciting activities*

**Keyword:** *mathematical reasoning ability, self regulated learning, model-eliciting activities approach.*

## **Introduction**

Basically, mathematical reasoning ability (MRA) and self regulated learning (SRL) are mathematical hard-skill and soft-skill that should be possessed by and be improved on students. There are some reason founded on that statement, among others were: a) Those hard-skill and soft skill are included in the goal of teaching mathematics (Kurikulum 2013, NCTM, 2000); b) Mathematical reasoning includes active, dynamic, generative processes applied in solving mathematics problem and other dicipline (Schoenfeld as cited in Sumarmo, 2006).

Refering to opinion of some experts Sumarmo (2010) classifies two kinds of mathematical reasoning, those are inductive and deductive mathematical reasoning. Further, Sumarmo (2010) details inductive mathematical reasoning into some kinds of reasoning, those are: a) transductive reasoning; b) Analogycal reasoning; c) Generalization; d) Predicting solution or tendency; e) Giving explanation based on model, facts, attributes, relation or pattern; f) Applying relationship of pattern for analyzing situation, and compiling conjecture.

Deductive mathematical reasoning is deriving conclusion based on agreed rules. Some of deductive mathematical

reasoning are: a) To execute enumeration based on certain rules and principles; b) Propositional reasoning is to reason based on the rules of inference, to examine validity of an argument, to prove and to compile valid argument; c) Proportional reasoning ability is abilty to reason based on ratio between two or more components or to compose statements concerning equality of ratio among some elements is to reason based on proportion (Leongson & Limjap, 2003, as cited in Aminah 2016); d) Combinatorial reasoning ability is ability to reason based on combination of some elements; Other definition, combinatorial reasoning ability is ability to combine some different variables from entirely given variables (Bernoulli as cited in Aminah, 2016); e) Probabilistic reasoning ability is ability to reason based on probability of an event. Leongson and Limjap (2003, as cited in Aminah 2016) define probabilistic reasoning ability as ability to compare number of certain object ( $n$ ) from all objects ( $N$ ) and then to determine the chance the occurence of  $n$  objects from  $N$  objects as fraction ( $n/N$ ); f) Dugan (2003, as cited in Aminah 2016) defines correlational reasoning ability is ability to correlate two separate relationships between different situations and understand that if a case happened in a

situation so it will happen in other situation as well.

When we pay closed attention on definition and indicators of MRA, almost of them include mathematical high order thinking that for executing them an individual should have strong mathematical disposition such as high motivation, work hard willingly, and able to manage self-learning. The strong mathematical disposition among other is SRL.

From various sources the meaning of SRL itself is not to learn without assistance other people, but to learn which controlled by its self. Some experts (Sumarmo, 2006). Some definitions of SRL among other things are as follow: a) SRL as a process of self designing and monitoring cognitive and affective processess in solving academic task (Sumarmo, 2006); b) SRL as a human personality and ability to monitor self behavior and as human's hard-work personality (Bandura as cite in Sumarmo, 2006); c) SRL as learning process caused effect of thinking, feeling, strategy, and self behavior oriented on attaining of a goal (Schunk and Zimmerman, 1998, as cited in Sumarmo 2006); d) SRL as cycle of recursive cognitive activities consisted: to analyze task, to select, to adopt, to find strategy

approach for achieving the goal of a task, and to monitor outcome of conducted strategy.

Sumarmo (2006) summarize the indicators of SRL such as: a) to posses intrinsic learning initiative and motivation, b) to perform habit to diagnose learning need; c) to determine learning objective and target, d) To monitor, to manage, and to control own learning; e) to consider that a difficulty as a challenge; f) to use and to seek relevant sources; g) to choice and to apply learning strategy; h) to evaluate learning process and learning outcomes; i) to possess self concept and self efficacy. In mathematics teaching-learning, Kurikulum Matematika 2013 suggest that mathematical hard-skill and soft-skill should be improved accordingly and propotionally. Those arguments suggest we have to select a kind of mathematics teaching approach so that in line with those afformention arguments. One of that intended mathematics teaching approach is model-eliciting activities which expected able to improve mathematical reasoning ability and SRL accordingly and propotionally. Lesh (as cited in Permana, 2010) proposes that model-eliciting activities (MEA) is an approach for understanding, clarifying, and

communicating concepts by using mathematical model.

The superiority of MEAs than conventional teaching on attaining students' mathematical communication and problem solving abilities were reported by a lot of studies (Clark et al., 2008, Eric, 2008, Hamilton, 2009, Garfield, 2009, Yildirim et al., 2010, all as cited in Wahyuningrum, 2014, Permana, 2010, Ramdan, 2016, Suharyati, 2017, Wahyuningrum, 2014). Beside that, MEAs took better role than conventional teaching on obtaining students' mathematical disposition (Permana, 2010; Wahyuningrum, 2014), on students' creative thinking ability and habits of mind (Ramdan, 2016). Those grades of mathematical cognitive and affective learning outcomes of students getting treatment MEAs approach were at fairly good level, while the grades of students taught by conventional teaching were at low-medium level.

A lot of studies (Abdurachman, 2014, Aminah 2016, Bernard and Rohaeti, 2015, Mulyana and Hendriana, 2015, Rosliawati, 2014, Setiawati, 2014, Sumarni and Sumarmo, 2017, Rohaeti *et.al*, 2014, Wulanmardhika, 2014) reported that on MRA, students getting various innovative

teaching approaches obtained better grades than the grades of students taught by conventional teaching. However, those students' grades on MRA were vary from medium up to fairly good level, while students taught by conventional teaching attained at low grade level.

Those afforementioned argument, motivate researchers to conduct a study having a goal to analyze the role of model-eliciting activities approach on student's MRA and SRL.

## **Methods**

This study is a pretest-posttest experiment control group design having a goal to analyze the role of model-eliciting activities on increasing students' mathematical reasoning ability and self regulated learning. The study involves 72 eighth grade students. The research instruments are a MRA test, and a mathematical SRL scale. The MRA test consists of 5 items, (Hendriana and Sumarmo, 2014). The SRL scale consists of 40 items.

## **Result and Discussion**

The attainment of MRA and its N-Gain, and mathematical SRL of students were attached in Table 1.

**Table 1.** Description of Mathematical Reasoning Ability and Self Regulated Learning Of Student in both Teaching Approaches

Variable	Stat.	Model-eliciting Activities				Conventional Teaching			
		Pretest	Posttest	N-Gain	n	Pretest	Posttest	N-Gain	n
MRA (IS= 30)	$\bar{x}$	6.53	23.33	.72		7.19	12.94	.25	
	% IS	21.76	77.78		36	23.98	43.15		36
	SD	2.78	2.66	.10		2.41	3.31	.12	
SRL (IS=168)	$\bar{X}$		106				98.39		
	% IS		63.10	-	36	-	58.56	-	36
	SD		8.14				8.20		

MRA: mathematical reasoning ability

SRL : self regulated learning

The finding of the grades of MRA at good level were almost similar to the findings of previous studies that students getting treatment with various innovative teaching that attained grades at fairly good level (Abdurachman, 2014, Bernard and Rohaeti, 2015, Haerudin, 2014, Mulyana, and Hendriana, 2015, Sumarni and Sumarmo, 2017). But in other studies (Aminah, 2016, Rohaeti, et al., 2014, Rosliawati, 2014, Setiawati, 2014, Wulanmardhika, 2014) students' grades on MRA were at low-medium level. Seemingly, innovative teaching mathematics gave different result on students' grades of MRA from low level up to good level, while students taught by conventional teaching tend obtain MRA at low level. The low students' grades on MRA were found on studies with senior high school students and on intermediate mathematics course such as system of

equation of two and more variables, (Aminah, 2016, Setiawati, 2014). While for almost students getting treatment with conventional teaching, students' grades on MRA tended at low level.

Findings on SRL that was at medium grade level in this study was different with findings other studies such as (Aminah, 2016, Haerudin, 2014, Mulyana and Hendriana, 2015, Qohar and Sumarmo, 2014, Rohaeti, et al., 2014, Setiawati, 2014, Sumarni and Sumarmo 2017) that on SRL students obtained at fairly good grade level. The students realized difficulties in all items MRA test (Table 2). This finding was similar to findings of other previous studies (Bernard and Rohaeti, 2015, Mulyana, and Hendriana, 2015, Rohaeti, et al. 2014, Setiawati, 2014, Sumarni and Sumarmo, 2017, Wulanmardhika, 2014).

**Table 2.** Mean Score Of Each Item Of Mathematical reasoning of Students In Both Teaching Approaches

Teaching approach	Stat.Desc	No.1	No 2.	No.3	No.4	No.5	Entirely
	Ideal score	5	5	6	6	8	40
Model-Eliciting Activities Appr.	$\bar{x}$	3,64	3,39	5,72	4,94	5,64	23.33
	% out of IS	72,78	67,78	95,37	82,41	70,49	77.78
Conventional Teaching	$\bar{x}$	1,69	2,56	3,25	1,89	3,56	12.94
	% out of IS	33,89	51,11	54,17	31,48	44,44	43.15

Besides those findings, this study also found that students demonstrated more active learning during Mathematics MEAs compared to students during conventional teaching. They discussed actively in small group, to indentify problem on the students' work sheet (Figure 1) and some students presented their solution voluntary in the front of the class (Figure 2). While, in the conventional teaching student less active learning and they work individually (Figure 3).

According to Carreira (2001) some steps of model-eliciting activities such as: to identify and to simplify real problem situation, to compile mathematical model, to solve it, and to interpret the solution.

In the first step, students indentified a real world problem and presented it into a suitable form. By observing, questioning, and discussing, they identify the important or unimportant information, and then they neglect the unimportant information. In the second step, students formulate a mathematical model included relationship among information. Lesh and Doerr (as

cited in Permana, 2010) calls the second step as description step. In transformation step, students analyze and manipulate the model and then solve the problem. In interpretation step, students verify the solution into previous situation. When the constructed model is tested, then the model is called as powerful model (Lesh and Doerr, as cited in Permana, 2010).



**Figure 1.** Students discussed a problem in MEaS Teaching Approach



**Figure 2.** Students presented their solution in MEaS Teaching Approach



**Figure 3.** Students Work Individually in Conventional Teaching

Moreover, students expressed positive opinion on MEAs Approach, namely: learning process challenged students to participate in solving real problem, students active learning, students were unafraid to pose question and or ideas, and students had collected relevant information before they recieved new mathematics content. Students tended to be comfortable with the new accepted teaching approach (MEAs), despite at first they were confused to solve new kind mathematics problems. In this study, sometimes teacher faced obstruction in conducting model-eliciting activities, such as limited allocated time whereas it needed long time for students to construct their knowledge, to discuss in their group, and to present their solution in front of the class. Eventhough, in further sesions the obstruction could be handled by offering more interesting mathematics task and guidance during students working together in each small group.

Some experts clarify advantages of MEAs as follow: a) MEAs having potency to improve student' problem solving ability (Clark, as cited in Wahyuningrum, 2014); b) MEAs arouses deep concept understanding (Hamilton as cited in Wahyuningrum, 2014); c) MEAs motivates student to improve mathematical modeling and communication ability (Eric, as cited in Wahyuningrum, 2014). Beside those advantages, if we pay deep attention on the steps of MEAs, which among other thing encloses some activites such as: to formulate mathematical model, to select relevant information, to analyze and manipulate the model, to solve the model or problem, and to verify the solution, indirectly those activities involved mathematical reasoning ability to derive conclusion based on observed data and on certain mathematics rules and principles. That statement support that MEAs having potency to improve student's MRA.

### **Conclusion**

Model-eliciting activities teaching show better role than conventional teaching on improving students' mathematical reasoning ability, and self regulated learning as well. Students getting treatment with MEAs teaching approach obtained at good grade level on MRA,

while students taught by conventional teaching realized difficulties in solving all items of MRA and they attained at low grade level. On mathematical SRL students getting treatment with MEAs teaching approach obtained better grade than that of students taught by conventional teaching, eventhough those grades were at medium level.

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