ENHANCING STUDENTS' MATHEMATICAL CREATIVE PROBLEM SOLVING ABILITY THROUGH SITUATON-BASED LEARNING IN ELEMENTARY SCHOOL

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ABSTRACT

This research is focused on students' mathematical Creative Problem Solving (CPS) ability in Elementary School. The purpose of this research is to comprehensively describe the enhancement of students' mathematical CPS ability as a result of SBL. This research is a quasi-experimental study that applies two learning models: SBL and conventional learning. The research results obtained are: 1) the enhancement of students' mathematical CPS ability who were taught under SBL learning is higher than those who were taught under conventional learning at the whole students and school level; 2) there is no interaction between learning model and school level on enhancement of students' mathematical CPS ability; and 3) fact finding is the highest aspect of the students' mathematical CPS ability, and the lowest aspect is acceptance finding.

Keywords: Situation-based learning, mathematical creative problem solving ability

1. INTRODUCTION

During teaching-learning activities in the classroom, however, teacher frequently asks his/her students too many questions with low level. Learning method used commonly emphasizes on answering instead of presenting problems. So, the method is not proper to develop the students' awareness on problem and competence on problem solving. Therefore, Creative Problem Solving (CPS) competence needs to be developed in learning mathematics. In this case, mathematical CPS ability consists of: 1) objective finding; 2) fact finding; 3) problem finding; 4) idea finding; 5) solution finding; and 6) acceptance finding. For every aspect of competence, students start their learning by divergent thinking activities and end by convergent ones (Ellyn, 1995; Mitchel and Kowalik, 1999; Proctor, 2007; Isrok'atun, 2012a).

In order to develop the competence, learning mathematics has to explore the students' competence on presenting and solving the problems creatively proposed by the students themselves. One of learning methods used to overcome the problems is Situation-Based Learning (SBL). SBL learning process can be applied through a set of designing materials based on situation-based

learning so that the students are able to develop their creativity and thinking productivity further. Teacher's roles here are merely as motivator and facilitator.

1.1 Research Question

The research question are: 1) what is the enhancement of students' mathematical CPS ability who were taught under SBL learning is higher than those who were taught under conventional learning at the whole students and school level (high and medium)?; 2) what there is an interaction between learning model and school level on enhancement of students' mathematical CPS ability?; and 3) how about is the students' mathematical ability CPS viewed each aspects?

2. THEORETICAL STUDIES

2.1 Situation-Based Learning

Situation-Based Learning is a strong, flexible and new learning approach intended to develop constructive learning paradigm (Tarek, Thomas, Hermann, and Maja, 2000). Lave; Lave and Wenger; Greeno, Smith, and Moore assume that there are many things student learns from a situation, like where he/she studies (Anderson, Reder, and Simon, 1996). The objective of SBL is to develop students' ability on problem posing, problem understanding, and problem solving through mathematics point of view.

Situation-Based Learning consists of four learning process stages, namely: 1) creating mathematical situations; 2) posing mathematical problem; 3) solving mathematical problem, and 4) applying mathematics, being described as follows (Xia, LÜ, Wang, and Song, 2007; Xia, LÜ, and Wang, 2008; Isrok'atun, 2012b; Isrok'atun, 2012c).

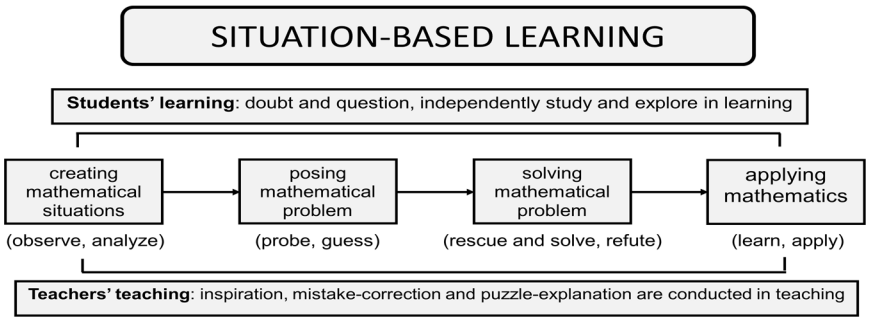

Figure 1. Situation-Based Learning

Creating mathematical situations are prerequisite. Posing mathematical problem is core. Solving mathematical problem is goal. Meanwhile, applying mathematics is the application of learning process to new situation.

There are four SBL learning strategies, such as (Isrok'atun, 2012c):

a. Teacher creates situation

   Teacher creates mathematical situation. It is expected that there are some mathematical questions asked by students through activities of observing and analyzing. Here, the situation starts from firstly simple one toward more complex situation.

b. Students pose mathematical problems

By investigating and guessing, students posing mathematical problem. It is intended to increase their awareness on problems of situation they have faced. Teacher's classifying problems that proposed by students based on difficulty grades.

c. Students practice mathematical problem solving

In this step, teacher and students sort existing problem levels, whether the problems need to be followed up or not. Solved problems start from simple ones to complex ones. As learning materials, the main goal is to emerge problems that require problem solving with mathematical CPS ability, until they find the mathematical concept. In this strategy, teacher's roles are to guide, to direct, and to stimulate students by implementing scaffolding techniques.

d. Applying mathematics

The step of applying mathematics is applying mathematical concept or formula on the new situation. So students can understand that mathematical concept or formula often encountered in everyday life.

2.2 Conventional Learning

Conventional learning is teacher's learning model which limits students' roles during the process of teaching-learning activities. Teaching method is teacher-centered and learning process emphasizes more on expository method.

2.3 Mathematical CPS Ability

The ability of mathematical CPS has six aspects, each of aspect begins from divergent activity and ends by convergent activity. The aspect of mathematical CPS ability such as (Ellyn, 1995; Mitchell and Kowalik, 1999; Proctor, 2007; Isrok'atun, 2012a). Osborn-Parnes creative problem solving process:

a. Objective finding

Effort to identifying the situations to become more challenging form.

b. Fact finding

Effort to identifying all the data which is still related to the situations context, finding and identifying an important information that didn't contain in the situation, but it is important.

c. Problem finding

Effort to identifying of all possible problems, and then sorting which are important.

d. Idea finding

Effort to identifying several solutions which is possible for the statement problem.

e. Solution finding

Using a list of solutions that have been on the stage of idea finding, and selecting the best solution to resolve the problem.

f. Acceptance finding

Effort to increase the capacity, planning an action, and implementing the solutions.

The explanation about CPS thinking process, see on picture below (Isaksen and Treffinger, 1985):

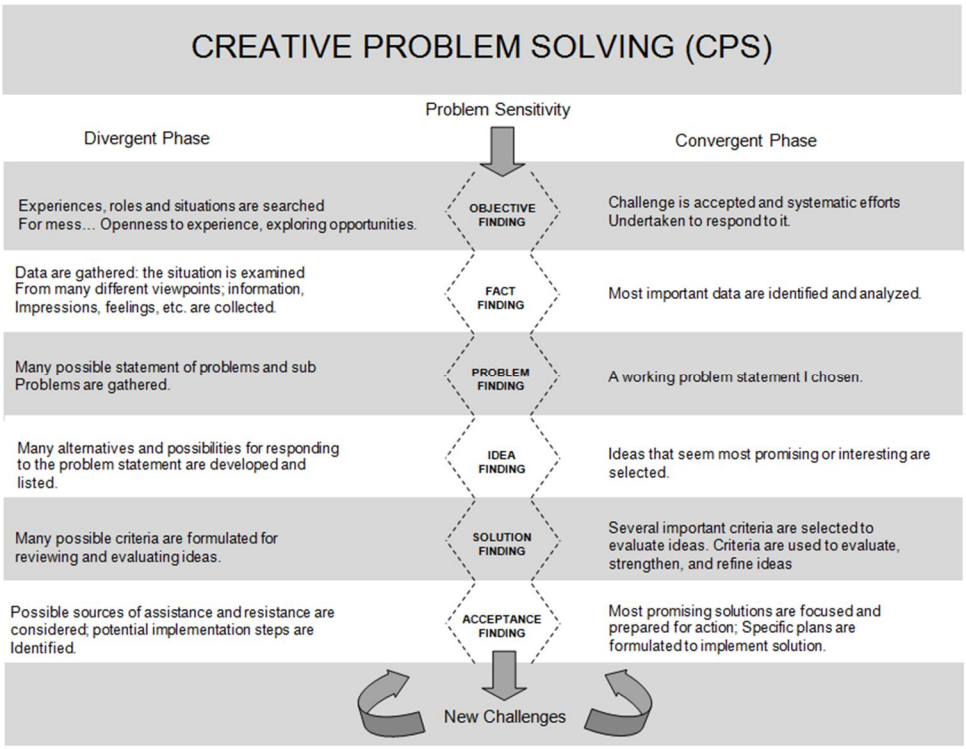

Figure 2. The Flow of CPS Thinking Process

3. EXPERIMENT

3.1 Purpose

The research aims to described: 1) what is the enhancement of students' mathematical CPS ability who were taught under SBL learning is higher than those who were taught under conventional learning at the whole students and school level (high and medium); 2) what there is an interaction between learning model and school level on enhancement of students' mathematical CPS ability; and 3) how about is the students' mathematical ability CPS viewed each aspects.

3.2 Sample and Population

Research population was all SD (elementary school) students in the Province of Banten, Indonesia. Sampling used by stratified purposive random sampling, SD N 9 Serang City represents high level school and SD N 3 Serang City represents medium level school. Two classes were randomly selected among all classes. One class was treated as experimented group (were examined using SBL learning) and the other one as controlled group (were examined using conventional learning).

3.3 Research Design

The research was quasi-experiment using experimented and controlled groups recognized as pretest-post test control group design (Fraenkel and Wallen, 1990; Ruseffendi, 1998; Sugiyono, 2011). The experimented group was treated using SBL learning and controlled group was treated using conventional learning.

4. RESULTS AND DISCUSSION

4.1 Mathematical CPS Ability

4.1.1 Mathematical CPS Ability at The Whole Students

After treated differently, one group using SBL learning and the other one using conventional learning, the research result of students' mathematical CPS ability was performed as follows.

Table 1. Mathematical CPS Ability at The Whole Students

Learning	*n*	Pretest		Postest		Gain		Gain Category
		Average	S.D	Average	S.D	Average	S.D	
SBL	89	10.91	10.34	32.55	15.47	0.29*	0.18	medium
Conventional	89	12.19	7.47	22.52	10.80	0.14	0.13	low

Note: * 0,29 ≈ 0,30

S.D = standard deviation

The students' mathematical CPS ability using SBL learning has enhanced with the average of 0.29 better than the other ones using conventional learning of which average of 0.14 for a range of values 0-1.

In order to determine which group shows the better result, whether a group of students who have been treated using SBL learning or the other one using conventional learning, statistics test is therefore employed. The statistics test is proved as follows.

Table 2. Statistical Test Summary on Mathematical CPS Ability Gain

Learning	*n*	Gain		Statistical test		Mean Difference Test (Mann-Whitney)
		Average	S.D	Normality	Homogeneity	
SBL	89	0.29	0.18	Normal	Varians not same	Both means were different
Conventional	89	0.14	0.13	Not normal		

Note: $\alpha = 0.05$

The mathematical CPS ability of a group using SBL learning (0.29) is significantly better than another group using conventional learning (0.14).

4.1.2 Mathematical CPS Ability at The School Level

The enhancement of mathematical CPS ability among four groups is shown below.

Table 3. Gain of Mathematical CPS Ability at at The School Level

School Level	Learning	*n*	Pretest		Postest		Gain		Gain Category
			Average	S.D	Average	S.D	Average	S.D	
High	SBL	47	16.32	11.58	32.91	14.38	0.24	0.16	low
	Conventional	47	16.21	7.82	24.66	9.56	0.12	0.12	low
Medium	SBL	42	4.86	2.82	32.14	16.77	0.34	0.20	medium
	Conventional	42	7.69	3.45	20.12	11.70	0.16	0.13	low

Each group experiences various enhancement of mathematical CPS ability. A group of medium's school level with SBL learning enhancing mathematical CPS ability up to 0.34 while the other three groups belong to low category.

To prove which group has much better result, whether a group of students with SBL learning or the other one with conventional learning, statistics test is then employed. The statistics test is as follows.

Table 4. Statistical Test Summary on Mathematical CPS Ability Gain at School Level

School Level	Learning	*N*	Gain		Statistical Test		Mean Difference Test	Mean Difference Test (Kruskal Wallis)
			Average	S.D	Normality	Homogeneity		
High	SBL	47	0.24	0.16	Normal	Varians not same	Both means were different	All means were different
	Conventional	47	0.12	0.12	Not normal			
Medium	SBL	42	0.34	0.20	Normal	Varians not same	Both means were different	
	Conventional	42	0.16	0.13	Not normal			

Note: $\alpha = 0.05$

At high-level school, the enhancement of a group of students' mathematical CPS ability who has received SBL learning is significantly much better than the other one's receiving conventional learning. At medium-level school, a group of students who has received SBL learning also performs significantly much better result than the other one receiving conventional learning.

4.2 Interaction between School Level and Learning Model on Enhancement of Students' Mathematical CPS Ability

Interaction between school level and learning model on enhancement of students' mathematical CPS ability was performed as follows.

Table 5. Gain of Mathematical CPS Ability Based on School Level and Learning Model

Learning	School Level			
	Medium		High	
	Average	S.D	Average	S.D
SBL	0.34	0.20	0.24	0.16
Conventional	0.16	0.13	0.12	0.12

It's graph is shown below:

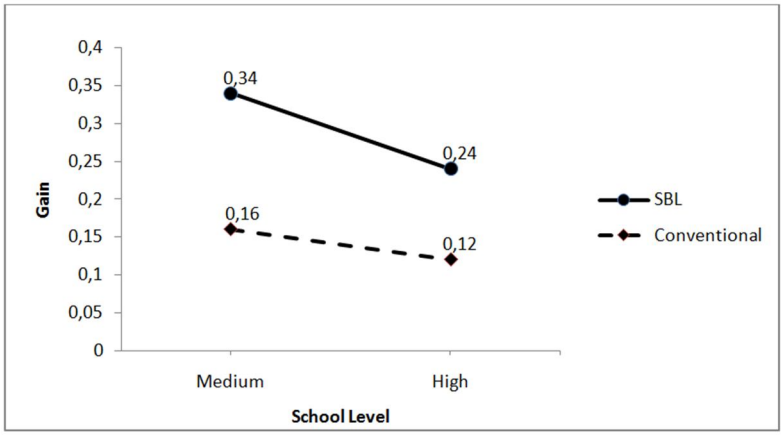

Figure 3. Plot of Interaction between School Level and Learning Model on Enhancement of Students' Mathematical CPS Ability

There is no interaction between school level and learning model on enhancement of students' mathematical CPS ability. It means that mathematical CPS ability a group of students who has received conventional learning does not exceed (surpass) the enhancement of the other one receiving SBL learning, at both high-level and medium-level schools. So, we can say that SBL learning is better at enhancing mathematical CPS ability for both students at high-level school and medium-level school.

4.3 The Students' Mathematical CPS Ability in Experimental Class Viewed each Aspects

The student's score in experimental class for viewed each aspect, describe as:

Table 6. The Students' Mathematical Ability CPS in Experimental Class Viewed each Aspect

School Level	% for CPS aspect					
	O	F	P	I	S	A
High	28	33	17	23	22	15
	the strongest aspect: *fact finding*					
	the weakest aspect: *acceptance finding*					
Medium	41	46	36	35	36	25
	the strongest aspect: *fact finding*					
	the weakest aspect: *acceptance finding*					

The strongest aspect is the fact finding aspect. Fact finding is an effort to collection of the data which related the problems and to exploring facts of situations, it's indicates an to be able to relating; to connecting about the problems and to exploring; to organizing; to caring the hiden information of situation.

The weakest aspect of mathematical CPS mathematical CPS ability is the acceptance finding aspect. It's an effort to increase the capacity of the answers obtained, planning an action to solve it, and implementing a solutions. It indicates the ability to acting the completion, considering the support acquisition the previous answers, and expressing the plan of the support answers.

5. CONCLUSION

SBL learning is a kind of learning consisting of four learning process stages, namely: 1) creating mathematical situations (prerequisite); 2) posing mathematical problem (core); 3) solving mathematical problem (goal); and 4) applying mathematics (application).

SBL learning can be one of learning alternatives in order to improve students' mathematical CPS ability. Deriving from problems proposed by students, teacher plays role to guide them solving problems by applying mathematical problem solving techniques. Therefore, students' problem posing and problem solving are well put in balance.

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