

**DEVELOPING TEACHER PERFORMANCES TO IMPROVING STUDENTS
CREATIVE THINKING CAPABILITIES IN MATHEMATICS**

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Abstract

Teacher performances to improving students creative thinking is still weakness. The research report finds out those 130 elementary teachers could not impress and direct students developing students' creative thinking. Therefore, it is needed a strategy to develop teacher professional intensively. The purposes of this research were to describe mathematics teachers in developing learning strategy that improving student's creative thinking and to figure out capabilities of teachers' creative thinking and abilities to planning and implementing the teaching model of mathematical problem solving and problem posing. Participants of this research were six elementary school teachers at the third, fourth, and sixth grades respectively two schools at Sidoarjo. The results points out those teachers have good level of creative thinking in solving and posing a problem and they could design and implement their planning using model of solving and posing problems.

Keywords: creative thinking; problem solving; problem posing

INTRODUCTION

Teachers have an important role in learning. Soedjadi (2000) describes the learning process in the classroom interaction between students, teachers, teaching materials, facilities and infrastructure. Teacher is one of the factors that determine the success of students. Llinares & Krainer (2006) stated that the teachers play the role in that learning process. They are regarded as active constructed of them knowledge and encouraged to reflect of their practice and to change it where it is appropriate. Even, Lee (2010) said that a reform can move only as fast as teachers can move. It is means the direction and the curriculum goal will be success if the teachers have a role actively to contribute and support it. One of the goals in the Indonesian National Curriculum (2006, 2013) is to encourage creative thinking abilities. In fact, based on the results of research Siswono, Abadi, & Rosyidi (2008) to 130 primary school teachers were given questionnaires showed that the teachers do not emphasize the learning that leads to creative thinking ability of students. The results showed 13.8% of teachers never ask students create their own questions and 42.3% of teachers rarely perform that activity. In addition 10.8% of teachers did not teach students to solve problems in many ways, and 41.5% rarely do that activity. Additional Information 55.4% of teachers never asked students to develop imagination. This means that teachers do not emphasize on creative thinking. It required an effort to encourage teachers to improve students' ability to think creatively. Moreover, based on the results of research Siswono, Abadi, & Rosyidi (2008) to 202 fifth grade students from five

elementary schools in Sidoarjo showed that elementary students' ability to think creatively is still low. This is evident from the data that the students' ability to solve problems that demonstrate fluency by 17.8%, 5.0% novelty and flexibility of 5.4%. Also pose problems in 25.2% of students are fulfill fluency, 10.4% which fulfill the novelty and 2.0% which fulfill flexibility. This condition requires role of teachers increase students' creative thinking. Therefore, the aims of this research were to describe mathematics teachers in developing learning strategy that improving student's creative thinking and to figure out capabilities of teachers' creative thinking and abilities to planning and implementing the teaching model of mathematical problem solving and problem posing.

CREATIVE THINKING, PROBLEM POSING, AND PROBLEM SOLVING

Creative thinking is defined as a mental activity that is used to construct an idea or notion of the "new" (Ruggiero, 1998; Evans, 1991). Bishop (in Pehkonen, 1997) explains that a person requires two complementary models of thinking in mathematics that creative thinking is intuitive and analytic thinking is logical. This view is more to see that creative thinking as a thought is intuitive rather than logical. This notion suggests that creative thinking is not based on logical thinking but more as a thought that suddenly appears, unexpected, and unusual. Pehkonen (1997) looked at creative thinking as a combination of logical thinking and divergent thinking which is based on intuition but still in consciousness. When a person applies creative thinking in problem solving, divergent thinking is intuitive then generates a lot of ideas. This is useful in finding the solution. This understanding explains that creative thinking involves logical thinking and intuitive to generate ideas. In this article, creative thinking is viewed as a whole or a combination of logical thinking and divergent thinking to produce something new.

An effort to encourage creative thinking in mathematics is used the concept of problem in a task situation. Teacher asks students to connect the known information and information of the task, so it is a new task for students (Pehkonen, 1997). If someone recognizes actions or ways of completing the task immediately, then the task is a routine task. If not, then the task is a problem for him/her. So, the problem concept is limited by the time and individual attention. The problem for someone is personal/ individual. Problem can be interpreted as a situation or question is facing an individual or group when they do not have rules, algorithms / certain procedures or laws that can immediately be used to determine the answer. Thus the characteristics of a problem are: (1) individuals realize and recognize situations (the questions) were encountered. In other words, these individuals have the prerequisite knowledge. (2) Individuals realize that the situation requires actions or challenging to be solved. (3) Steps to solving a problem unclear but individuals already know how to solve and they have a pattern or could develop a strategy.

Mathematical problem solving could be defined as the students proces to solving a mathematical problem which steps are understanding a problem, devising a plan or strategy, carrying out the plan, and looking back or examining again (Polya, 1957) . Actually, problem solving is not a linear process and a series of steps. It was more flexible then "steps" often delineated in textbooks. The stages was dynamic and cycling (Wilson, Fernandez & Hadaway, 1993). Problem solving was thought explicitly as the goal of mathematics learning and set in at mathematics curriculum because it has some advantages. Pehkonen (1997) pointed out that

problem solving could develop general cognitive skills, encourage creativity, as a part of process of mathematical application, and motivate students to learn mathematics. So it could say that problem solving as a way to improve creativity as a product of students' creative thinking. In Indonesian standard (2006, 2013) is mentioned that problem solving as focus of mathematics teaching and learning. Problems were consisting of closed problems, open-ended problems, open-start problems, and divergent problems. Because it was involving divergent problem, so problem solving would be used to encouraging capabilities of creative thinking.

Another aspect of problem solving is problem posing. Mathematical problem posing as the task which is asking students to pose or construct a mathematical problem based on some given informations then they should find or make a solution. Problem posing could be given after or before they solve a mathematical problem. Such as a problem solving, problem posing could be used to exploring students creative thinking. Evans (1991) explain that problem formulation or problem posing and problem solving as an important themes of studying creativity. First stage of creative activity is discovering and formulating a problem. This is pointed out that capabilities of creative thinking could recognize through given a task to make a problem or problem posing. Dunlap (2001) also examine that problem posing is little different to problem solving but it was still as a valid instrument to teach mathematical thinking. Moses (in Dunlap, 2001) discuss some ways to encourage students creative thinking through problem posing approach. First, modify problems in textbooks become a problem posing task. Second, make some questions which have multiple solutions. Problem just have one solution is not empowering mathematical thinking creatively; students just apply procedural or given algorithm.

TEACHING TO IMPROVING STUDENTS CREATIVE THINKING

Teacher has a main central in orchestra of teaching and learning at classroom. He or she needs a teaching model to develop capabilities of students' creative thinking. One of models is the problem solving-posing based learning (PSP-BL). It was developed in 2008 as a research product of Siswono, Abadi, & Rosyidi (2008). This result is consisting of manual book which has some examples of lesson plan, syllabus, worksheet, and assessment sheet. This model is underlined by some theories such as Piaget theory (Byrnes, 1996). It explain that knowledge come from individual adaptation at their environments. Process knowing as a specific case of assimilation (a new situation and a new object become structuring forms) and accommodation (modifying structures become a new characteristics of objects). Intellectual development happens through an active construction of individual knowledge. Based its perspective so learning situation should give opportunity to students to construct own knowledge based on their knowledge itself. When students pose a problem actually they construct a new knowledge. Piaget (in Muijs & Reynolds, 2008) also said that to understand how a child was thinking should pay attention a qualitative development when they handle a problem. To develop that capabilities could use the problem concept as task situation through problem solving and problem posing (Pehkonen,1997).

Resarch results point out the role of problem solving and problem posing to encourage

creative thinking in mathematical learning situations. Siswono (2005) report that problem posing could improve capabilities of students creative thinking in solving problem related to line and angle concepts. Siswono & Novitasari (2007) report that capabilities of creative thinking develop steps by steps through problem solving type "What's Another Way". Capabilities in fluency and novelty point out that was increasing strictly than flexibility. Although this result is not changed fantastically but it was indicating of students creative thinking changing. Therefore it was applied continually and gradually in mathematical learning at school.

The PSP-BL model has a general syntax such that introduction, main activity, and closing. Introduction is phase to motivate students engaging at learning process and communicate apperceptions, goals, and prerequisites material. It based on Bruner theory that teaching process should pay attention to experiences and contexts which students could do and competence to learning or this called principal of readiness. In main activity phase based on Piaget and Bruner theory, then students need opportunity to construct knowledge actively based on their experiences or knowledge itself through problem solving and posing in regarding of intellectual development and their representation mode. Vygotsky and Bruner theory also underlined this model through giving students chance to communicate interpersonal of their understanding. Thus students need a chance to presenting their idea to other students or his/her teacher. The teacher and other students give a scaffolding to guide them to understand the level of advance knowledge. The last phase is closing that are consisting of reflection activity, deliver summary and next exercises. Reviewing a summary is activity to represent knowledge economically so that is easier to learning again and show up their understanding.

To assess their capabilities in creative thinking, teacher could use level of students' creative thinking (Siswono, 2008). Level 4 (very creative): Students satisfied all components of creative thinking or only flexibility and novelty in solving and posing problems. Level 3 (creative): Students were fluent and then they were flexible or demonstrate novelty, but not both in solving and posing problems. Level 2 (Quite Creative): Students were able to show flexibility and novelty in solving and posing problems without fluency. Level 1 (Almost not creative): Students were able to show fluency without novelty and flexibility in solving and posing problems. Level 0 (Not Creative): Students were not able to show any components of creativity. This level could be as a rubric to assess students' capabilities in creative thinking. Students demonstrate fluency in problem solving when they are able to obtain many solutions. Students were said to be flexible in problem solving when they were able to solve a problem using many different methods or express a solution in one way then in other ways. Students were said to demonstrate novelty in problem solving when they were able to examine a problem and answer with many solutions or answers, then generate another that is different. Other solutions are considered to be "different from others", when they have a different pattern or are not usual for students of this grade level, such as students can construct a combination of other shapes, or they could be finding an original solution which is not common for that student's grade or their knowledge level. Silver (1997) explained that fluency in problem posing is indicated by an ability of students to generate many problems with correct solutions. Flexibility in problem posing also refers to a student's ability to pose or construct problems with divergent solutions. Novelty in problem posing refers to a student's ability to pose or construct a problem

different from others. Students examine several posed problems then pose a problem that is different in contexts and concepts or is unfamiliar for them.

Siswono & Ekawati (2009) conduct the research to implementation model of PSP-BL to elementary school at third grade, fourth grade, and fifth grade and to junior secondary school at seventh grade and eight grade. As a teacher is mathematics pre-service student. This research produces the model and valid prototype of teaching material. Finally, we need to disseminate model of PSP-BL to real teacher that they involve in classroom daily.

RESEARCH METHOD

Participants of this research are six elementary teachers that thought at three public and three private schools. Experimental research with pretest-posttest design single group at third grade, fourth grade, and fifth grade. The schools are classified as a favorite school because it is near residential areas and they have varied students' background or heterogeneous. All teachers have enough experience because all of them already have certified and more than 10 years' experience. All teachers have not received training related experience an increase in students' creative thinking in mathematics problem solving and posing. Thus it can be said teachers have same experience in applying model of PSP-BL, so that the model can be said to be "new". Procedure is started by designing and conducting workshops for twice. Before workshop, teachers are asked to solve a task as pretest in regarding of mathematics problem solving and posing, then at last workshop is conducted posttest. After this activities teachers designing teaching materials and implemented at each school with a pretest-posttest design group single.

Descriptive study was conducted by semi-structured interview to all teachers at each grade level to understand deeply how the creative thinking abilities of teachers, and how their capacity to use the model and their belief in the goal learning that enhances the ability of creative thinking. The instrument will be used in this study are: (1) Test of Creative Thinking (TCT) to determine the teacher capability of creative thinking. The tests were made different for the pretest and posttest; (2) the observation sheet to determine the ability of teachers to manage and conduct the model of PSP-BL during the learning activity; (3) the observation sheet of learning situation to determine the practicality or feasibility the learning process; (4) questionnaire to determine students' responses after following teaching and learning; (5) semi-structured interview guide as a guide in exploring creative thinking abilities of teachers, obstacles encountered, and the belief in the implementation of this learning. Descriptive analysis by comparing the level of ability creative thinking and increasing teachers' creative thinking. Qualitative analysis was conducted by reduction data, presenting data, and inference it.

RESULTS OF RESEARCH AND DISCUSSION

Capabilities in solving and posing problem creatively are prerequisite to applying model of PSP-BL because teacher must know how to design learning material including assessment. Thus it is needed to know firstly how their capabilities in creative thinking. At pre-test there are

one teacher at level 1 and the rest at level 0. After workshop there are three teachers at level 4, two teachers at level 2, and one teacher at level 3. This means that most teachers already demonstrate fluency or fluency and flexibility and novelty in solving and posing a problem. With these provisions, teachers are able to implement model of PSP-BL in their respective classes.

Designing lesson plans with model of PSP-BL includes a new thing for teachers, so how teachers understand about model of PSP-BL and implement it at classroom needs to be known. Ability of teachers were making lesson plan assess at workshop. Learning material has been made is the syllabus, lesson plan, student worksheet and the assessment sheet. Based on indicator, teacher could design learning material as good category with mean score 3.99 or more than 3.00 so learning material are available and could use at learning activity.

When in teaching situation about 2-3 terms are observed by two observers and give a situation report. The score of average teacher's ability of state school to manage the learning at third grade for two meeting is 79.79 and for private school is 79.38. The score of average teacher's ability of state school to manage the learning at fourth grade for two meeting is 84.38 and for private school is 89.79. The score of average teacher's ability of state school to manage the learning at fifth grade for three meeting is 89.03 and for private school is 84.16.

Thus based indicators, teacher are able to implement learning model of PSP-BL with category a good. These results have been overcome at least problem about teachers' weakness in developing students' creative thinking (Siswono, Abadi, and Rosyidi, 2008) and provide evidence that the model of PSP-BL used as an alternative learning strategies to improve the ability to think creatively.

Some difficulties in using PSP-BL were expressed by teachers when they interview deeply. In preparation is needed longer times for finding problem, looking for pictures, or related tasks to everyday life and designing lesson plan, worksheets, and assessment sheet. They need over 30 minutes from usual times for designing. But they feel satisfying when they look at its results. When implementations also need extra times to solve problems, difficulties using manipulative, students still cited an existing problems because problem posing is still unusual tasks. Teacher faced some difficulties in managing activities because there are about 40 students. When assessing students task, criteria of creative thinking is difficult, and to checking students answer need much longer times, because the students' answers varied and truth; assessing novelty and flexibility is unusual and need specific skills. Students still do not understand an open-ended problem.

Teacher believed that model of PSP-BL gives a good impact on students' creative thinking because encourage students more active; students could be free to create questions; using varied strategy and interesting students because they are challenged to create questions that varied, and could be applied to other materials.

CONCLUSION

Teachers' performance in creative thinking are more quite creative because there are three teacher at level 4, one teacher at level 3, and two teacher at level 2. Mean value of scoring in solving and posing problems 92.6 increasing than pre-test is 42.2. The teacher ability in designing the instruction material has scored more than 3.00 and the teacher ability to

implement model of PSP-BL at well category. All the teachers involved in the study believes that the model give a good impact on students' creative thinking, because students become active student learning, free to create questions, learning situation varied, and challenged to construct a problem. Nevertheless there are some difficulties, especially in preparing worksheets and assessment sheets to measure students' creative thinking.

Based on the results a writer could recommend to applying some prototype of learning material including others topic and level school. Teacher is wished to disseminate model of PSP-BL. Teacher should generate some examples to provide increased impact of creative thinking skills. In its application the teacher needs to anticipate the difficulties encountered in learning situation such as creating and searching questions that are not routinely but open-ended.

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