 ISBN : 978-979-792-774-5

Implementation of Generative Teaching Model to Improve Junior High School Students' Mathematical Problem Solving Ability

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ABSTRACT

The background of this study was the fact that students' mathematical problem solving ability which was still low. The objectives of this study were: (1) determining whether the problem solving abilities of students under generative; teaching model were better than students under scientific teaching model or not; (2) determining quality of problem solving abilities of students under generative teaching model. A quasi-experimental with nonequivalent control group design was used as the research method. The participants of this study were 62 eighth graders of a junior high school in Bandung. The samples were two classes of students of the school; one class as the experimental group which was given generative teaching model, and the other as the control group which was given scientific teaching model. The data were obtained from mathematical problem solving test and observation. The results showed that: (1) the improvement of students' mathematical problem solving under generative teaching model was better than students under scientific approach teaching.; (2)) the quality of students' problem solving abilities under generative teaching model and scientific teaching approach is middle.

***Keywords**: Generative teaching model, Mathematical Problem Solving*

Introduction

The development of mathematical ability in mathematics learning is expected to be used to improve students' quality, so that the students are able to compete in facing global problems. According to Suherman (2008) the competence or cognitive ability that can be developed through mathematic learning is "the ability of understanding, reasoning ability, application ability, analytical ability, observation ability, identification ability, investigation ability, exploration ability, connection ability, inquiry, hypothesis ability, conjectural ability, generalization ability, creativity ability, and problem-solving ability ". Starting from a good mathematical problem solving ability, it is expected to train students' thinking manner in solving all problems encountered because the students will be trained to make problem-solving plan by using the most appropriate strategy in the development of mathematical problem solving ability. Then, they implement the problem-solving plan designed. After that, the students re-examine the results of what has been planned and implemented to solve the problem in order to get the best results. It is in line with Polya's statement (Suherman, 2001) that the ability to solve mathematical

 ISBN : 978-979-792-774-5

problems is "to make a plan of resolution, to carry out a plan of resolution, and to verify the results" and Prabawanto (2013) also stated that the mathematical problem-solving ability is "the ability to solve various mathematical problems using the appropriate". Based on the definition of solution stated by the two experts above, it can be said that students' mathematical problems ability is the ability to solve mathematical problems by using the appropriate strategy by making the solution plan first, then implement it, followed by checking the truth of the plan's results implemented.

In fact, many students are still weak in preparing problem-solving plans. So, they find it difficult to be asked to check the results of the results obtained. Especially in junior high school students, many events showed that the problem solving ability of junior high students are still inappropriate with the standards established and agreed by some experts. As a preliminary study through the test of students' mathematical problem-solving ability, the writer did to some students of the 9th grade of SMP Negeri 1 Bandung of academic year of 2014/2015. The test given was a question about Pythagoras material. Preliminary study results showed that students' mathematical problem solving ability was low. This was indicated by the results of tests given to 34 students, it was found that only 3 students answered the question correctly even though the reason was inappropriate, 8 students did not answer the question, and 23 students wrote wrong answers. In addition, the results of a research conducted by Nurhadiyati to junior high school students in Bandung showed that "generally, the results of mathematical problem solving ability of junior high students has not been satisfying, it was only about 30-50% of the ideal score" (Anriani, 2011). Then research conducted by the Research and Development Agency reported that the results of the Trends International Mathematics and Science Study (TIMSS) showed that the 8th grade students' achievement in Indonesia is 0n the 36th out of 39 countries, with the score 397, this score is still far from the average score. Meanwhile, the international average is 500 '(Nurdin, 2012). The results of Kherunnisa's research on the 8th grade students MTsN 1 Serang and MTsN 1 Cikeusal showed that 'students are weak in using their problem solving ability' (Khaerunnisa, 2013).

There are several efforts that can be used to improve students' mathematical problem solving ability, which is applying student-centered learning process. This is in line with Syaiful's (2012) statement: "the low mathematical problem-solving ability is the result of a teacher-centered learning process". It means that more students expect an explanation from the teacher and they do not accustomed to train themselves in solving the problems. This is supported by a statement stated by Bahri and Bukhori (2013) that "problem solving ability in mathematics needs to be trained and familiarized as early as possible with students". Generative learning model is a learning model that the learning process is centered on the students. In addition, there are stages that familiarize students in solving non-routine problems in the process of generative learning, exactly in the challenge stage.

The generative learning model was developed in 1985 by Osborne and Wittrock. According to Osborne and Wittrock generative learning is "a learning model that emphasizes the active integration of new knowledge using the knowledge already possessed by previous students" (Minarti, 2012). Based on the statement of Osborne and Wittrock, it can be seen that generative learning places a great emphasis on the prior knowledge or previous learning experiences. Apperception in the learning process is aimed to make learning more creative, active, innovative and fun. On the other hand, Wati (2012) defined the generative learning model as 'learning model which emphasizes its activities on each student's ability, so that students can explore their own potential and develop the knowledge already possessed by students with a new knowledge'. Based on the definition, it can be seen that the learning process involves a lot of students' active role in this learning model.

According to Osborne and Wittrock (Lusiana, 2009) the generative learning model has four stages: the preliminary step, the focus step, the challenge step, and the application step)'. The preliminary stage is the stage of exploring students' ideas on prior learning experiences or knowledge, where the learning experience and knowledge are used by students to build a new knowledge. The focus stage is the stage of constructing the concept of the material being studied by linking the prior knowledge that has been reminded in the preliminary stage with the new knowledge being studied, and at this stage involves the activities of constructing, discussing, questioning, and trying out the concepts acquired into the other contexts , so that student creativity can be developed. The challenge stage is the stage of analyzing and making conclusions on what has been learned or done in the previous stage and sharing ideas. According to Dedy et al, the challenge stage is a major part of this generative learning model, they said that 'when the views of scientists were introduced, whether in accordance with the previous understanding of students or not' (Syaiful, 2012). The application stage is the stage of using a new conceptual understanding gained in another context. In this study, the context of problem solving served in various questions.

Based on these stages, it is assumed that the generative learning model can improve students' mathematical ability. One of them is the ability to solve students' mathematical problems. It can be seen from the challenge stage and the application stage are interpreted into the form of problems that can improve students' mathematical problem solving ability. Therefore, the writer is encouraged to conduct a research to improve students' mathematical problem solving ability in a junior high school by using generative learning model.

Murtry and Humprey (2010) stated that there are five ways to solve problems. The five steps of the problem-solving plan are "gathering information, analyzing problems, summarizing what has been learned, making decisions and implementing actions". While Chang and Kelly (1998, pp. 6) stated that "there are six steps in solving the problem of defining problems, analyzing potential causes, identifying possible solutions, selecting the best solution, formulating action plans, implementing solutions and evaluating developments".

In addition, problem solving also has some indicators that must be achieved by students in the problem-solving process, as a tool to find out how far the students' mathematical problem solving abilities. In this research, the indicator used is an indicator put forward by Prabawanto (2013) that is “solving closed mathematical problems with the context in mathematics,

 ISBN : 978-979-792-774-5

solving closed mathematical problems with contexts outside mathematics, solving open mathematical problems with contexts in mathematics, and solving open mathematical problems in the context of outside mathematics". The ability to solve problems is very important to be owned by students both in learning math and everyday life. This is in line with Russeefendi's opinion that 'problem-solving skills are important not only for those who later will go into math, to also apply to those who will apply both in other fields of study and in everyday life' (Bahri and Bukhori, 2013).

Methodology

The method used in this research wasa quasi experimental method with the design was nonequivalent control group design.

The research design was:

O X O experimental class

OOcontrol class

Information:

O = pretest and posttest in the form of a mathematical problem solving test

X = learning mathematics with generative learning model.

(Taniredja and Mustafidah, 2011)

The population of this study was all students of the 8th grade students in SMP Negeri 1 Bandung of academic year of 2014/2015 consisting of 12 classes. Then,8th-2 grade was taken as the experimental class and the 8th-1 grade was taken as the control class. The study was conducted from 01 to 31 October 2014. Data collection techniques used were test instruments in the form of pretest and posttest questions and non-test instruments in the form of observation sheets for teachers and students. Data analysis techniques used descriptive analysis of pretest, posttest and Gain data and Inferential Analysis (Hypothesis Test).

Result and Discussion

The improvement of students' mathematical problem solving ability of experimental class is better than control class. Even though, the quality of students' mathematical problem solving abilityimprovement, both experimental and control classes were in the medium category. However, inferential test (hypothesis test) in data processing showed that the improvement of problem solving ability of students' experimental class was better than control class. Itcould be seen from the results and discussion of the research below;

Table 1. Descriptive Results of Experimental Class and Control Class

Data	Mean	Min	Max	Range
Experimental Pretest	37,32	14	74	60
Control Pretest	30,42	7	79	62

The data showed that the average and slope tended towards a small score. Itwas understandable because students had not studied the material contained in the test instrument.

Table 2. Mann-Whitney Test Results of Pretest Data

Test Statistics[a]

	Skor Pretes Siswa
Mann-Whitney U	384,000
Wilcoxon W	880,000
Z	-1,359
Asymp. Sig. (2-tailed)	,174

a. Grouping Variable: lass

Based on table 2, the experimental and control groups had the similar initial capability.

Table 3. Descriptive Results of Posttest Experimental Class and Control Class

Data	Mean	Min	Max	Range
Postes Eksperimen	73,19	28	97	69
Postes Kontrol	55,00	18	100	82

Based on table 3, it can be seen that students' posttest scores in the student experiment class tended to have a bigger direction, while the control class tended to be around the average. It means that students’ score were better than the results of pretest. It is because students have studied the material included in the test instrument.

Table 4. Mann Whitney Test Results of Posttest Data

Test Statistics[a]

	Students’ posttest score
Mann-Whitney U	264,500
Wilcoxon W	760,500
Z	-3,042
Asymp. Sig. (2-tailed)	,002

a. Grouping Variable: Class

Based on the Mann Whitney test presented in the table above, it can be concluded that students 'mathematical problem solving ability in the experimental class was better than the students' mathematical problem solving skills in the control class.

Table 5. Descriptive Gain Index of Experimental Class and Control Class

Data	Mean	Min	Max	Range
Experimental Gain	0,59	0,02	1,00	0,98
Control Gain	0,39	0,06	0,92	0,86

Based on table 5, the score of students' ability improvement in the experimental class was around the average and tended toward the larger direction, while in the control class tended toward the smaller direction.

Table 6. Mann Whitney Test Results of Index of gain data

Test Statistics[a]

	Skor Gain Siswa
Mann-Whitney U	265,000
Wilcoxon W	761,000
Z	-3,035
Asymp. Sig. (2-tailed)	,002

a. Grouping Variable: Class

Based on the analysis in Table 6, the improvement of mathematical problem solving abilityobtained that the improvement of problem solving ability of experimental class was better than the improvement of control class. It was showed by the average score of gain index of the experimental class which was higher than the average score of control class’ gain index.

Table 7.Descriptive Data of Index Gain Ability of Students’ Mathematical Problem Solving

Class	N	Min	Max	Sum	Mean	Std.Dev
Eksperimental	31	0,06	0,92	18,19	0,59	0,22
Control	31	0,02	1,00	12,01	0,39	0,28

Based on table 7, the average score of gain index of experiment class and control class showed the improvement of students' mathematical problem solving ability was

 ISBN : 978-979-792-774-5

moderate. Although the quality of students 'mathematical problem-solving abilities in both groups were moderate, the improvement quality of students' mathematical problem solving ability in the experimental group was better than the control group. It can be seen in the improvement analysis of mathematical problem solving abilities.In addition, the average score of gain index in the control group was closer to the low category.

Table 8. Recapitulation of Students' Mathematical Problem Solving Ability Improvement

Class	Range of gain*Indeks*	Inter-pretation	Number of Students	Percentage	mean
Eks	0,7 < g ≤ 1	Tinggi	10	32,26 %	0,59
	0,3 < g ≤ 0,7	Sedang	18	58,06 %	
	0 ≤ g ≤ 0,3	Rendah	3	9,68 %	
Kon	0,7 < g ≤ 1	Tinggi	5	16,13 %	0,39
	0,3 < g ≤ 0,7	Sedang	12	38,71 %	
	0 ≤ g ≤ 0,3	Rendah	14	45,16 %	

Based on Table 8, the improvement of problem-solving ability in the experimental class was more dominated by students who experienced a moderate improvement. While the improvement of problem solving ability in the control class was more dominated by students who were categorized as low improvement category. Thus, the improvement of students' mathematical problem solving ability in the experimental group had a better quality than the control class because the average score of the experimental class gain index was higher than the average score of the control class gain index.

The learning process conducted during the research was related to mathematical problem solving ability by using generative learning model, it was implemented in groups. Each student was divided into small groups of 3 to 4 students. Then, each student got an LKS, it was expected that every student followed the learning process well. Writing results done individually, but the process of doing the LKS remained in groups. the learning process implemented was adapted to the stages of the generative learning model. There were various problem solving questions conducted in this research problem. The role of students was to solve the problems presented in the LKS. At the application stage, it was also used as an evaluation for the teacher.

Based on descriptive data analysis of pretest and posttest results, both control and experiment classes hadimproved mathematical problem solving ability. This was showed by the increasing the average score of students before and after the learning process. In the control class, the students' average score increased from 30.42 to 55.00 and the average score on the experimental class increased from 37.32 to 73.19.

The improved quality of mathematical problem solving could be seen from the gain index of each class. Based on the analysis of gain index data both in the control class and experimental class, it could be seen that the quality improvement of students' mathematical problem solving abilities in the experimental class was in the medium category with the average score of the gain index was 0.59. Meanwhile, the quality improvement of problem-solving ability in the control class was in the medium category with the average gain score of 0.39.

The quality of mathematical problem-solving abilityin the control class and experiment class were both in the medium category. However, the quality of the mathematical problem-solving abilities experienced by the control classes was moderately low, while the quality of the mathematical problem-solving abilities in the experimental class was a moderate category close to the high category.

Based on the recapitulation of quality improvement of mathematical problem solving ability in the experimental class, showedthat from 31 students there were 10 students categorized as high quality improvement, 18 students experienced medium quality improvement and 3 students experienced low quality improvement. Based on these results, it appeared that most of the students in the experimental class experienced an increase in medium and high quality while a few others improved with low quality. It was because the three students were less active in following the learning process and hesitated to ask both the teacher and other students.

In the control class could be seen that from 31 students there were 5 students experienced high qualityimprovement, 12 students experienced moderate quality improvement and 14 students experiencedlow quality improvement. These results showed that most students experienced low quality improvement. This was caused by the unused students practicing thinking to construct something new individually, so that students were just waiting for the explanation of the teacher only. In addition, there were students who did not pay attention to the teacher when giving explanations or when directing students to learn actively, this wascaused by the students'discomfort feelings with the learning process implemented.

Based on the explanation of students' mathematical problem solving abilities in the experimental class and control class, it could be concluded that different learning process would have different impact in improving students' mathematical problem solving abilities.

There was a better improvement of mathematical problem-solving ability in the classroom that obtained generative learning model. It caused by the generative learning model which was based on the idea of constructivism, so that the learning process was centered on the students and involved a very active role of the students. Then, the generative learning model could improve problem solving ability because the learning process familiarized the students to learnnot only by memorizing and training and familiarized students in solving non-routine problems. It could be seen from the stages used in learning.

Preliminary stage was the stage of exploring students' ideas on the knowledge gained previously. Then, in the focus stage, the teacher directed students to set learning goals and construct the concept, it could improve student performance. Furthermore, at the challenge stage, students were trained and familiarized with analyzing and drawing conclusions about what had been learned or done. Thus, the process of student analysis would run well, students were also trained and accustomed to solve problems faced. In addition, the stage of application stage challenge also trained and familiarized students in solving problems, but problem solving in application stage gave more emphasis on the use of knowledge obtained by students.

The use of flexible and non-text based materials could also improve problem-solving ability. In the generative learning, teaching materials could be composed by stages of generative learning and the condition of students. Thus, generative learning could be effective in equipping students' problem-solving abilities.

The learning process followed the stages of the generative learning model that had been described previously. Students were required to recall the understanding of the material they had learned before, as a condition for building the concepts to be studied. Students then set a strategy to construct a new understanding with the help of previous learning comprehension. Students then analyzed what had been constructed and applied it in other form as a proof. This was in accordance with the syntax in solving various problems. Thus, the stages in the generative learning model familiarized students in improving problem-solving abilities, both inside and outside the mathematical context as well as closed and open mathematical problems.

Conclusion

According on the results of research and analysis data and discussions that had been described, it could be concluded as follows:

1. The improvement of mathematical problem solving ability of junior high school students who gained learning by using generative learning was better than students' problem solving ability who got scientific learning.
2. The quality of problem solving ability improvement of junior high school students who obtained generative learning model and scientific learning were in the medium category.

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