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The Enhancement of Junior High School Students Mathematical Creative Thinking Abilities through Generative Learning

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Abstract
Mathematical creative thinking ability is one of the important comprehensible needs of students' competency in mathematical learning. The issue of mathematical creative thinking has seemed to become a communally issue and argued to be promoted by educational stakeholders to be taken into account in the last decade. Mathematical creative thinking plays an important role mathematically in students' problem solving, and in the process of distributing ideas in mathematical learning. The importance of mathematical creative thinking ability (MCTA) is unfortunately, promoted yet in parallelism the teaching of students' mathematical learning achievement. Therefore, generative learning model (GLM) seems to be in an effort to support students' mathematical learning development. Generative learning model (GLM) became an alternative to answer the need in this research. This research was conducted by using Generative-learning model (GLM) which was predictably taught to be an effective method in trigging students' development of creative thinking ability. Through out a quasi-experiment design, this research conducted for the aim of identifying how students' MCTA would be contributively enhanced through the implementation of GM. In the total number of 191 students, second grade students from three junior high schools in Yogyakarta, were taken as the sample of this research. Each of them represent the high level, medium and low levels of school. The hypothesis of this research was tested in significant levels of 5%, using t-test, one–way ANAVA, and two–way ANAVA. This research found that: there was different attainment, the improvement of students' MCTA between class experiment and class control. There was no interaction between learning process and the school levels toward the enhancement of students' MCTA, neither in students' PMA and their learning toward MCTA. To identify the differences of students' enhancement in MCTA, SE, and SS, t-test was used while, two-way ANOVA was used to identify students' interaction in learning, school levels and PMA.
Key Word: Mathematical Creative Thinking Ability, Generative Learning.

Introduction

Creative thinking ability is an individual ability to find ways, strategies, ideas, or new concepts of how an acquire the solutions to the faced problem. Sukmadinata (2012)states that, creative thinking is a mental activity to develop an actual purity (*originality*) and an acutance understanding (*insight)*in a relatively new development of things. A creative thinking ability is as ability that needs to be existantly stressed in the implementation of mathematical teaching and learning at the school.

Mulyana & Sabandar (2008) has also equally stressed, that the students must have a critical, logical, creativity, systematical, and a communication develop in an effective creative thinking and cooperative working. This way of thinking is needed in mathematical teaching and learning, by considering the characteristics of mathematical structure and dependability in a clear coherent to the concepts, which accessible are for students to use those mentioned skills in developing their mathematical creative thinking to the problem solving.

Practically, the daily experience and there facts show that, mathematics teachers in junior high schools are rarely consider in the creative thinking ability of the students. The low mathematical creative thinking abilities at junior high school students are as importantly problematic in the mathematical education. Therefore, an accurately particular mathematical learning model is considered and accepted to the aim of developing students' mathematical creative learning ability.

Generative learning is a constructivism learning model that is stressing to a new active integrated knowledge which is synchronizing to the previous knowledge or experience of students. The generative learning model acquires student to be actively, and free in constructing their knowledge. Besides, students are also provided in an accessibility to explore their concepts and ideas, so as to be comprehensively in a self-understanding of knowledge and more, in optimalization in their learning process.

According to Osborne & Wittrock (in Hulukati, 2005),the implementation of generative learning model is a good way to identify students' thinking styles and how they understand and a goodly problem solving for further needs of teacher's teaching strategy.

For the reason, this research was conducted for the aim of considering the students mathematical creative thinking ability by using generative learning model in the three levels of schools category (high, medium, and low) in the junior high schools' students and in considering basic knowledge of students.

Problem Statements

As the statement of the problems of this research, there have been some provided options for this research as follow:

a. Would the achievement of junior high schools students' mathematical creative thinking ability be better in the implementation of generative learning the increasing of senior high school students' mathematical creative thinking ability be better in the implementation of generative learning model rather than in conventional model?
b. Is there any interactional effect between learning model and the levels of school toward the increase of mathematical creative thinking ability of junior high school students?
c. Is there any interactional effect between the learning model and students' basic knowledge of mathematics in the increasing toward mathematical creative thinking ability?

Theoretical Foundation

Mathematical creative thinking ability

The creative thinking in mathematics can be considered as the orientation or disposition in mathematics instruction, including the task of inventing and problem solving. The activity can provide students in developing a more creative mathematical approach. The function of the activity can be used by teachers to develop students' ability in terms of dimensional related activities. Krutetskii (in Hartono, 2009), "creativity is identical with the mathematical talents". Krutetskii (in Anonim, 2009), in a further states that "creativity in mathematical problem solving is as the ability to a free constructing of mathematical problem, talented and new ideas". These ideas are identical with the ideas of flexibilities and the fluencies in making new association and resulting to the related divergent activities in general. Silver (1997) states that this mathematical activity as problem solving and the facing problem are related to the creativity which covers the eloquent, flexibility, and the new things.

Heylock (in Hartono, 2009) states that the mathematical creative thinking ability captures the two approaches. The first approach is by paying attention to the answers of students' problem solving in which the cognitive process is acceptable to the process of creative thinking. Second approach is pointing the criteria of a product identified as the result of creative thinking or the divergent products, as Haylock (in Hartono, 2009),notes as the many efforts used to describe mathematical creativity. The first attention, "indicating the ability to look the relationships between techniques and the part of applications and designing the unrelated association with the ideas".

Tall (1991) states that mathematical creative thinking is an ability to solve the problem or the structures of thinking development by considering the deductive role of reasoning, and the connective concepts resulted to integrating the significant principles of the mathematics. Holland (in Imai, 2000) adds that the development or the enrichment of methods and the sensitivity to develop the standard methods. Singh (Mann, 2005) mathematical creativities are described as "process of formalizing the hypothesis about the effected factor that influencing in mathematics situation, examining the hypothesis and modifying and communicating the final results".

The conclusion that is possibly taken from those previous explanations, that mathematical creative thinking is considered as the ability to find and to finalize mathematiacal problem which linking to the components: fluency, flexibility, elaboration, and the originality. The appraisal to the students' mathematical creative thinking is needed to be implemented. The providing problems that leads students into problem solving is mutually implemented in evaluating mathematical creative thinking. The provided assignments for students were those which were available for guiding student into mathematics problem solving. That was the way the researchers have done for identifying the individual relativities of students, to scale those who were really creative in levels.

In enhancing mathematical creative thinking ability for the students, variety approaches are able to be dealt in learning, which is students are allowed to be developing through their creativities as coming up with the

argumentation, personally self-motivated, hardworking, and self-providences in solving particular mathematical problems. Of the two approaches, the generative learning is more profitable in enhancing students' mathematical creative thinking ability compared to the conventional approach one. There have been some other related researches as this research are as in: Hulukati (2005), Fahinu (2007), Rahaeti (2008), Lambertus (2010), Somakim (2010), and Haji (2011).

Generative Learning

Generative learning model was firstly developed and introduced by Osborne and Cosgrove (as in Wena, 2009), and comprises the four steps: (1) the introduction or the level of exploration; (2) focusing; (3) the challenge or explaining the concepts; (4) the implementation of concept. Besides, generative learning, according to Osborno and Wittrock (in Katu, 1995); Dharma, (2011), generative learning is a learning model stress to an active integration of the new knowledge and the knowledge that the student have had or basic knowledge or experiences. The new knowledge will be examined in the way of how students answer the problem or other related phenomena. When the new knowledge is being successfully answering students' faced problems, that new knowledge will be saved for the long-term memory.

Generative learning model is based on the constructivism, with its basic principle that knowledge is constructing in the students' mind. The idea is stressed by Wittrock, that the core of generative learning is the brain, the information is not received passively, but actively constructs an interpretation of the information and then making the conclusion John, accessible *(in*http://idshyoong.com/socialscience/education/225414-model-pembelajaran-generatif).

Generative learning involves the mental activity of thinking. The thinking mental of a person will be developed following the process of learning. The mental activity according to Piaget (in Hudoyo, 2001) uses the term "*skema"*which means the re-stylization of one's behavior. This is in the line with Skemp (in Fahinu, 2007), the *skema* is as the cognitive structure, that is the related conceptual links in the students' mind.

There must be a cognitive structures in the mind individually that is balancing the assimilation and accommodation. This equalization is aimed to detect the unequal and the difference on the stimulus one is accepting. The cognitive development basically is the changes from an inherent equalization of a person and the new one that the person accepts, Suherman, *et al* (2003).

From the aforementioned ideas, generative learning is a learning model that implemented to the aim of students are actively constructing an interpretation from the information and deciding the conclusion.

1.The phases of the generative learning

The phase of generative learning model used in this research, was basically referring to those that are proposed by Osborne and Wittrock (in Hulukati, 2005) comprises the five phases namely:

a. The phase of Orientation

In this part, the students were provided in a chance to discuss particular mathematical topic. The discussion topic contained the materials that related to the students' daily experiences in terms of mathematics. The activity is aimed to guide students into particular mathematical concepts in the given material for the availability to relate students' experiences and their knowledge to the problem solving informally by the topic they discussed. The process of relating the new knowledge with the inherent knowledge students have had, involving the sense of motivation, knowledge and primarily concept and resulting to reasoning and understanding of students to the new concepts.

One of the discussed topics used in this research was *linear equation system two variables* (LESTV). By the topic, students were provided in a chance to explore their concepts and ideas regarding this title LESTV. For instance, the frame of roof of a house has an equally slope, however, slope in mathematical concept in relation to the LESTV containes two different equalization. Of course, there might be the student with different ideas. Some students might be in the scientific concept of ideas as much as expected by the teacher, and some might also in the different ideas. Theoretically, this is dependent, based on students' primarily or basic experience or knowledge. The teacher was also support students with the motivation, for the aim of student would be in awaking of activities and creativities in their learning process.

b. The phase of idea

In this phase, students were provided in the chance to come up with their ideas about the discussed topic. The teacher acted as the motivator by the way of facilitating the observe questions to the students, to the aim of finding out the ideas or concept from the students or what were in the students' mind. The responds of the students would be interpreted, clarified, by the teacher to the aim of designing a strategically approach the teacher would be in, for sustaining and harmonizing the class teaching circumstance. The student realized the position of their argumentation compared to the other students. This type of class setting provides also the students personally cognitive conflict which effected to the un-satisfaction of changes.

The students' un ability towards the embedded concepts are supportively enhancing and developing students own intentional ideas, and a self inner question or discussion. The observe questions can support and help the students in evaluating their inner moral stability to reconstruct their concept in a more logical sense. Therefore, students are important to be prepared in the availability to develop their selves in small groups discussion to the aim of the development.

In this way, students are led to develop their thinking through the examples in a multi- representations as, verbal and symbolic language, diagrams, tables, charts or graphics to enlarge their concepts. Then, their understanding concepts are applicably used to give evidences to the mathematical truth as the theorems, for instance like the Pythagoras. The generative learning model suggests that students are actively developing their knowledge through learning activities, while the teachers are acting as the facilitators.

c. The phase of Challenges and Reconstruction

The activity of the teacher in this phase, is to create harmonization in the activities of students. This is when the student are provided in the chance to compare their ideas one another, the position of the teacher is in between adopt, adapt, modified students' ideas to the aim of the material setting without a sense of offending, disappointing etc., among students. For instance, teacher proposes an informal discussion title as a frame of the roof of a house, in terms of the slope that looks to be equal in shape. Mathematically, a slope contains the two different LESTV. This condition will of course create varieties of perceptions, of the embedded knowledge students have had and in the real context. For instance, a student is in finishing an exercise of LESTV in students' prepared worksheet, in front of the class, and the other students response that working result. The teacher in this case acted as the mediator, in considering students different ideas in the discussion, the teacher then leaded the class as a whole to consider the concept in mathematical perspectives.

d. The Phase of Application

In this phase, students were provided in a chance to practice their new understanding, of what they had received after learning explosively, in other situation. For instance, in this chance, students worked on practical exercises in *equal linear system two variables* variously. In another chance, and as continually, students were also manage in a hope to be able to work in an identification of the cognitive conflicts of their experiences and to what they were looking at, in an actionably practice.

e. Re-evaluation

Students were practically managed and provided in a chance to a self-evaluation of their weaknesses in an constructional understanding of new concepts. Through regularly questions from the teacher, students were guided into their memorizing, to compare their experiences and the new pictures to the new concepts or materials. In this chance, the students were as if in the situation of ice-breaking, after finishing some particular exercises, they did re-evaluation, re-checking of what had worked and thought in comparison of their experiences they had have to the new situation of finalizing the exercises in the new concepts

By the aforementioned treatments, the students were hoped to be able to have knowledge, skills and ability to construct the knowledge and to develop their understanding by themselves of the embedded knowledge they have had and to the new knowledge they received. This situation would also be hoped for the students to become new in motivation and comprehensive self-management for them to be surviving and skilled full in every mathematical problem they receive later on.

Research Methedology

This research was designed in a *quasi-experiment* approach. Throughout this approach, the research was implemented through groups experiment of pre-test, control class, and the post test. The subjects were not managed in a randomly groups but the subjects were taken in their naturally as they were. The description is in line with the suggestion from Ruseffendi (2005), this [*quasi-experiment*] research uses the two classes, the experiment and the control class, the activities were firstly managed as pointing out the sample through each of schools in the levels: high levels, medium levels and low levels. Then, the two classes were taken randomly from each of the schools for the experiments and the control classes. This design was aimed to see the influence of the targeted aspects to be measured as students' mathematical creative thinking abilities. The research designs used in this research as stated below:

O X O
O O (Ruseffendi, 1994)

The subject groups of the research were taken in a randomly way of the classes, the experiment groups was treated in generative learning model (X) and the control groups were treated in a conventional method. Each of the classes of the two categories would then be tested in the pre-test and post-test (O) this research was also

linking in the target level of schools (high, medium and low) as the students, and also students' primary knowledge.

There were 191 third class students of junior high schools taken as the subject in this research. The schools were also leveled in as mentioned above (high, medium, and low) in Yogyakarta. The three school levels were chosen in a technique of *stratified random sampling,* while the decision at each of the schools were treated in a class randomly sampling, as the result, the KAM levels of students (high, medium, and low) were found.

The *description test examination* was the instrument used in this research for the aim to find the data of students' mathematical creative thinking ability. The twice tests, pre-test was done before the treatment, and the post-test held after the treatment, with the material as; the linear equation in two variables and the Pythagoras Theorema.

The research Findings

The data analysis of the attainment of students' mathematical creative thinking ability

The data analysis of students' mathematical creative thinking ability was gathering from post-test scores students with the generative learning class treatment and those with the conventional as follows:

Table 1

The data result of the analysis of students' mathematical creative thinking ability (the total of entirely data) group learning

Learning	Creative thinking ability (CTA)			
	The total average of Post-test	Mann-Whitney U	Sig. (*2-tailed*)	H_o
GLM and CLM	**23, 358>15, 354**	**- 9,102**	**0,000**	Reduced

H_o: there was no difference of creative thinking ability achievement of the two categories (experiment and control) groups.

From Table 1, it is obviously that the average score of students' achievement in generative learning is a higher than those which was in conventional. The table lists clearly that the average score of the two groups of generative learning and the conventional one as: 23,358>15,354, so that, the conclusion could be, the achievement of teaching and learning by using generative learning was significantly higher or better compared to that by using the conventional method.

The Data Ddescription of Students' Mathematical Creative thinking Ability Based on the Learning and the Level Category of Schools

From pre-test and post-test score, the *Gain Normalization* (N-Gain) of mathematical creative thinking ability was counted in the experiment group and the control group. The average score of *Gain Normalization* (N-Gain) which was in this quantification was accepted as the showing data of the increasing of student's creative thinking abilities in the two approaches, generative and conventional by using the average score of N-Gain to the experiment and the control group. The detail data is as showing in the following table:

Table 2

The description of the N-Gain data of mathematical creative thinking ability based on the treatment groups

Group category		Average	Standard deviation (SD)	Min	Max
Experiment Group of generative Model (GLM)	95	0,381	0,125	0,115	0,685
Control Group of Conventional Learning Model (CLM)	96	0,139	0,127	-0,13	0,50

The Table 2 shows that, the average score comparison of N-Gain, and the standard deviation of students' mathematical creative thinking ability of the experimental and control group were as; the GLM was in 0,381, higher than the CLM which was in 0,139.This was clearly identifiable that the increasing of students' mathematical creative thinking ability of the experiment group (GLM) higher or better than learning by using conventional (CLM).

The Description of Mathematical Creative Thinking Ability of the School Levels and the Students

The description and analysis of the PAS (primarily ability of Student) was designed as: the high, medium, and low levels of students and the high, medium, and low of the schools. The N-Gain, the average, and the standard of deviation of students' mathematical creative thinking ability from the three mentioned levels are stated as follows:

Table 3. The N-Gain data of students' mathematical creative thinking ability of the treatment, level of schools and the PAS (primarily ability of Students)

Levels of schools	PAS	Generative Learning Model (GLM)					Conventional Learning Model(CLM)				
		n	Stat	Pre-test	Pos-test	N-gain	*n*	Stat	Pre-test	Pos-test	N-Gain
High levels	High (H)	18	$\bar{x}$	13,28	25,72	0,39	6	$\bar{x}$	15,17	19,83	0,16
			s	4,95	4,36	0,13		s	1,6	4,54	0,17
	Medium (M)	13	$\bar{x}$	10,96	21	0,302	18	$\bar{x}$	11,11	15,83	0,13
			s	4,6	12,73	0,15		s	4,46	4,74	0,10
Medium Levels	Low (L)	1	$\bar{x}$				7	$\bar{x}$	10,29	12,43	0,06
			S					s	2,49	3,26	0,06
	High (H)	10	$\bar{x}$	11,3	24,7	0,415	0				
			S	3,92	4,99	0,121					
	Medium (M)	19	$\bar{x}$	9,8	21,85	0,354	20	$\bar{x}$	9,35	14	0,12
			S	8,02	5,53	0,144		s	3,76	4,04	0,11
Low levels	Low (L)	4	$\bar{x}$	7,67	20,33	0,352	13	$\bar{x}$	10,85	15,31	0,08
			S	2,52	5,03	0,093		s	4,28	5,09	0,12
	High (H)	4	$\bar{x}$	7	21,25	0,385	6	$\bar{x}$	9,5	15,5	0,17
			S	3,16	4,5	0,108		s	3,21	3,62	0,11
	Medium (M)	25	$\bar{x}$	9,25	22	0,354	23	$\bar{x}$	8,87	16	0,19
			S	2,59	4,01	0,106		s	2,42	4,82	0,15
	Low (L)	2	$\bar{x}$	10	23	0,384	3	$\bar{x}$	11	16	0,15
			S	1,41	4,24	0,099		s	2	6,25	0,19
The total of (H, M, L)		95	$\bar{x}$	10,05	22,32	0,361	96	$\bar{x}$	10,76	15,61	0,14
			S	3,501	5,044	0,105		s	3,03	4,54	0,13

Note: **the Maximum ideal Score = 44**

Table 3 shows that students' mathematical creative thinking ability in the implementation of the GLM is higher or better than using the CLM. This is identifiably shown in the average score attainment as 22,32, and students' N-Gain from the GLM group as 0,361 higher, compared to the average score attainment post-test as 15,61 and the students' N-Gain average score of group CLM as 0,14.

Table 3 also shows the interrelationships of between the average score of students mathematical creative thinking abilities increasing in the entirely levels of the schools (high, medium and low) of the GML treatment higher than the entirely average score of CLM treatment. The mean score of students' mathematical creative thinking ability is structured as, the average score of students' MCTA in the high levels school in students level category of medium (M), the medium school levels of students category of high (H) and the low level school with the high (H) level students through the GLM implementation.

To identify the entire data of students' (MCTA) and the levels of schools were conducted through the test of N-Gain as stated in the following table:

Table 4. The data result of the increase of Students' MCTA based on learning and the levels of schools

	N-gain
Mann-Whitney U	804,000
Z	-9,833
Asymp.Sig.(2-tailled)	0,000

Table 4 sows that the finding result of Z_{count} = -9,833 and the result of asymp. Sig. *(2-tailed)* = 0,000 lower than $\alpha = 0{,}005$. This meant that there was the different of N-Gain students' mathematical creative thinking ability between class experiment and class control. In the other words, the entire increase of students' mathematical creative thinking ability was found in the GML, better than in the CLM, and in the whole levels of school (H, M, and L)

The Interaction Analysis Based on Learning Model and the Levels of School toward the Increasing Mathematical Creative Thinking Ability (MCTA)

The learning interaction process in (GML and CLM) of the school levels (H, M and L) in the increasing of students' MCTA was achieved by analyzing the data from the levels of school, (H, M, and L) in the GML and CML by using the test of two ways ANOVA through the GLM. The synthesis of data analysis of the interaction between learning process and the levels of the schools described in the table bellows:

Table 5. The result of test of two ways ANOVA of the Interaction Increases in MCTA Based on Learning Process and the Levels of the Schools.

Sorce	*Type III Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Corrected Model	2, 938	5	0,588	37,880	0,000
Intercept	12,914	1	12,914	832,529	0,000
Learning Process	2, 785	1	2,785	179,563	0,000
Levels of schools	0,030	2	0,015	0,966	0,383
Lear. Proess * Levl. Of Schools	0,117	2	0,058	3,755	0,025
Error	2,870	185	0,016		
Total	18,661	191			
Corrected Total	5,807	190			

The Table 5 shows that, the result of F values for the learning process was 179,563 and the value of the significance was 0,000. This means that the significance lower than the level of significance 0,05 and it can be said that there was the significant different of using the group learning process in effecting to the students'

mathematical creative thinking ability (MCTA). The table points also, that the F values for the levels of the schools was 0,966 and the values of significant was 0,383. The values of significant higher than level of significant 0,05, this has shown that the levels of the schools did not effectively influence to the students' MCTA, and further, the F values in interaction between the learning process and the levels of the schools was 3,755 and the value of significance was 0,025. This values of significance lower than level of significance 0,05 so, the conclusion could be there was significant interaction between groups of learning process in the levels of the schools toward the increase of students' MCTA. By this fact, the conclusion might have also become the statement as; the levels of schools and the learning processes both were together supportively influenced to the significant of the levels of student' MCTA and the data have been provided in the chart as:

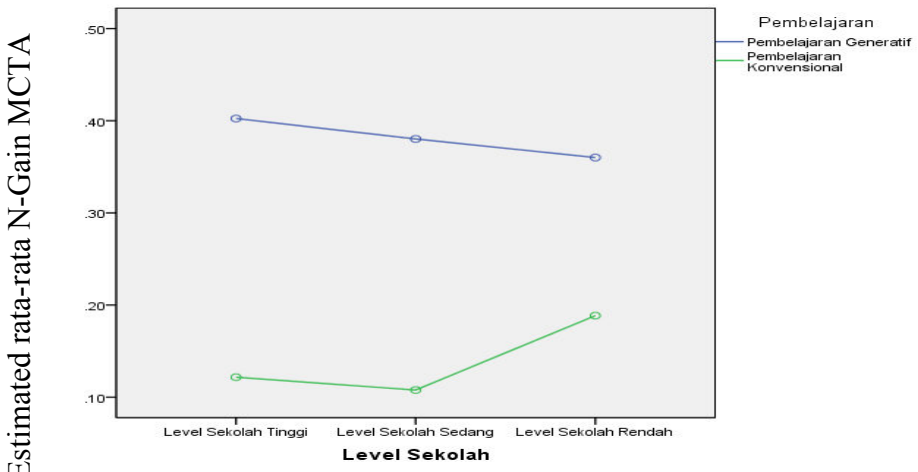

Chart 1

The Interaction between Learning and the Levels of the Schools toward The Increase of Creative thinking Ability

The chart 1 identifies that, learning by using the GLM is suitable to the all levels of students, whether in the school levels of high, medium or lower, of the students' MCTA. While the average score of N-Gain of students' MCTA with the treatment of GLM was higher than in the implementation with the CLM. The chart shows also that student from the high levels of school achieve a great benefit from the GLM compared to the medium and the lower levels. There was also the identification as shown in char 1 that there was an effective interaction between the learning model and the students' MCTA.

The interaction Analysis based on Groups of Learning and the students' Primarily Mathematical Ability (PMA) toward MCTA

The students interaction between the learning groups and the PMA in the level (H, M, and L) in increasing students' MCTA which was achieved from analyzing the PMA data in the levels of (H, M, and L) in GLM and the CLM processed in using the two-ways ANOVA through general linear model (GLM). In Table 7 bellow, contains the summary of the two-ways ANOVA test results about the interactions of learning groups and students' PMAs toward the increase of MCTA.

Table 7. The Result of Two-ways ANOVA analysis of the interaction between group learning students and their PMAs in increasing students' MCTA

Source	*Type III Sum of Squares*	df	*Mean Square*	F	Sig,
Intercept	7,097	1	7,097	448,728	0,000
PMA	0,048	2	0,024	1,508	0,224
Learning	1,548	1	1,548	97,898	0,000
PMA* Learning	0,009	2	0,005	0,90	0,749
Errors	2,926	185	0,016		
Total	18,658	191			

H_o: there was no interaction between students in the learning groups and PMA.

The evidences in Table 7 shows, F values for the students' PMA was 1,508 and the significance value was 0,224. So, the conclusion would be there was no influence in students' MCTA. The table shows also that the learning groups were affectively influenced to students' MCTA. The other finding in the data, shows that there was no significance effects between the learning and the students' PMA toward students' MCTA, and as shown in the following chart 2:

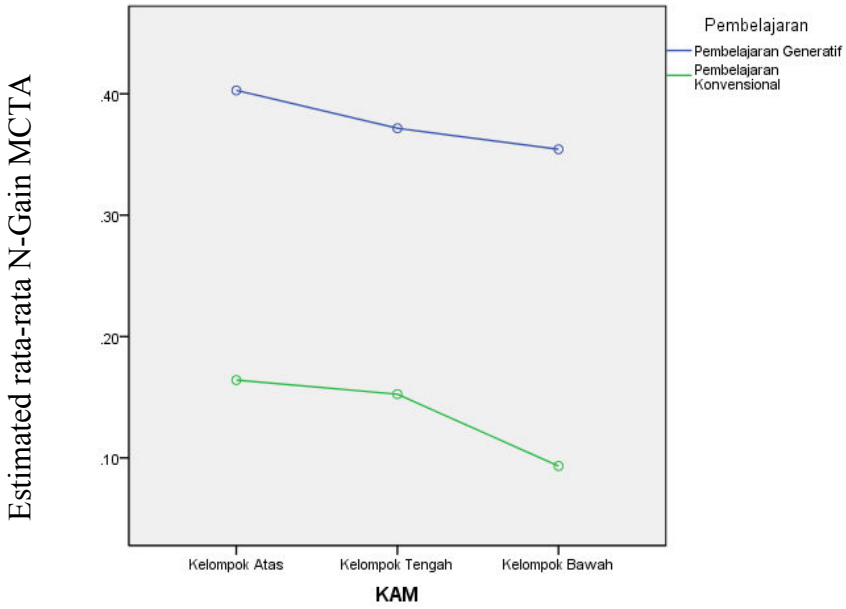

Chart 2

The Interaction between Students' PMA and the Learning toward the increase of students' MCTA

The chart 2 shows the increasing of students' MCTA based on the students' PMA, better in those who were with implementation of GLM compared to those who were with the CLM. This is identified in the average score of the increase of students' MCTA by using the GLM and better than in CLM. The chart 2 also describes that students from the PMA group generates the great benefits to the use of GLM compared to the students with the medium level of PMA and the PMA of the Low levels.

Description

The increasing of Mathematical Creative Thinking Ability (MCTA)

The result of the research shows that there was a significant difference of students' MCTA which was in the treatment of GLM and CLM. This data was shown in the average post-test score of MCTA of the experiment class and the control class, which create significant value, so that, benefitting the positive effect to student to describe students' MCTA.

Table 1 shows that the average score of achievement of MCTA for the experiment class or the class with the treatment to GLM not get the average expected of ideal score yet, that was 75%. But, the average scores of achievement have been in the level of satisfaction that was 23,36 or 53,09% from ideal score, while the average score of achievement in control class or the class with CLM in the low category that was 15,36 or 34,81% from ideal score 75%. Both of the average differences have been statistically tested and found that there was the different of MCTA with the GLM treatment better than student with the CLM. The result of the test identification indicates that the CLM did not much contributing to students' MCTA.

To be recognized the GLM is more stressing to how student be actively to construct the knowledge in their mind. The idea is in line with the Osborn and Wittrock (in Katu, 1995, Hulukati, 2005, Dharma, 2011), that generative learning model is as a learning model that stressed to the an active integration of the new knowledge and the knowledge that have embedded in the mind of students (PMA) Haji (2011) states also that, there is the different of the actual students' thinking in junior high school levels which is taught by using the generative learning model with the *open-ended* approach and the usually learning [conventional].

In relation to the levels of school, the result of data process shows that student's MCTA from the high level school, the different of average scores of post test the between experiment class and control classes were 25, 161 or 57,18% from ideal score and for experiment class were 15,84 or 36% from ideal score ideal for class control. Even though, quantitatively, the achievement score from the two group there was the different but not very significant.

The increase of MCTA

The result of the research shows that there was the different increase of students' MCTA which was receiving the generative learning (GLM) and the students who received conventional learning model (CML). This is based on the result of the research as displayed in Table 2, that the average score of students' MCTA of junior high school which receive the GLM was 0,381 (average standard), while the student who with the conventional was 0,139 (averagely low), and statistically the result shows that the increase of students' MCTA with the GLM better than those who was with CLM. The above result shows relevant as the Fahinu (2005).

The result of this research is in line with the theory of Vygotsky which was more stressing on the interaction of the interpersonal social factors, cultural histories and individual as the keys of human development Tidge & Scrimsher (in Schunk, 1012). When considering from this argument, simply to be mentioned that the theory of Vygotsky stresses on the essence of sociocultural in implementation to the teaching and learning process. Furthermore, Vygotsky (in Darwis, 2007) states that the *Zone of Proximal Development (ZDP)* is as level of child development which is rather higher than the present development of a child. The mental function is better in the groups that need to be involved in the learning activities. The suggested ideas has been treated in this research in the group of three to four students as mentioned and managed in the step 2 and three in the generative learning model (GLM)

There is another important aspect in Vygotsky theory, that is *Scaffolding* which means the student must be facilitated in quite a large assistances in the steps of learning until are able to in charge their own selves. And, this research has shown in the stage two and three, in the class learning process. This is in the suggestion of Herlen and Osborne (1985:137) that is termed as learning by others. The other finding of this research, the increasing of students' MCTA at junior high school shows there was no significant in the levels of the schools (H, M and L).

The analysis result in terms of effect of interaction between school levels and the learning as displayed in Table 5. The table identifies that the influence of interaction between learning and the level of schools found that there was significant interaction in increasing students' MCTA. The finding is ni the relevance to those of; Hulukati (2005), Somakim (2010), and Sugandi (2010).

In relation to the students' primarily mathematic ability (PMA), identified that the PMA factors and the learning was not significantly related in students' MCTA, while in a more detailed analysis, the students' PMA in the: high, medium and low level, all were being an average of students with their PMA in increasing students' creative thinking ability. This is identically related to the character of generative learning model (GML), that is the learning model which related to student' primarily knowledge and the new or the knowledge they receive.

The are some particular situation that the GLM does not effectively empower the students in their MCTA as; the students are less prepared in following the learning, student are conventionally treated till are being psychologically embedded, student are not seriously interested in the involvement of learning, and student are not situationally accustomed in the routine trained with the exercises, and *open-ended* in mathematical learning activities.

The Conclusion and Suggestion

The conclusion that might be summarized from the discussion above are: The achievement and the increasing of students' MCTA was found higher in the teaching treatment of generative learning model (GLM) compared to the treatment in the conventional model (CLM) (1); The result shows that there was the interaction found in the learning process of the schools levels (H, M, and L) toward the increasing of senior high school students' MCTA (2); The influence was not found in students' PMA and learning activities towards junior high school students' MCTA, (3); Considering some stated particular components above, there would be some proposed suggestions as: the generative learning in the school levels of high, medium, and low are expected to be developed in a reality in teaching and learning to develop students' MCTA (4).The generative learning model in a class teaching, teacher needs the challenge and supportive activity in developing material which is aimed to lead students into an *open-ended*, toward their cognitive conflict and the MCTA in the class as optimally as they can.

Bibliography

Darwis, M. (2007). *Model Pembelajaran Matematika yang Melibatkan Kecerdasan Emosional.*Dissertation of Program Pascasarjana. Unesa: Non Publication.

Dharma, A. (2011). *Pembelajaran Generatif.* [Online)]. Tersedia: hhtp://reinantaandhidharman.blogspot.com/2011/05/pembelajarangeneratif.html. Diakses Maret 2012.

Fahinu. (2007). *Meningkatkan Kemampuan Berpikir Kritis dan Kemandirian Belajar Matematika pada Mahasiswa melalui Pembelajaran Generatif.* Dissertation of SPS. UPI: Non Publication.

Haji, S. (2011). Mengembangkan Kemampuan Berpikir Asli melalui Pembelajaran Generatif dengan Pendekatan Open-Ended. *Pasundan Journal ofMathematics Education. Jurnal Pendidikan Matematika. Tahun 1. No.1. 2011.*

Hackett, G., & Betz, N. (1989). An Exploration of the Mathematics Self-efficacy/Mathematics Performance Correspondence. *Journal for Research in Mathematics Education, 20 (3), 261-273.*

Harlen dan Osborne (1985). A Model for Learning and Teaching Applied to Primary Science. *Journal of Curriculum Studies, 17(2). 133-146*.

Hartono, (2009). *Perbandingan Peningkatan Kemampuan Berpikir Kreatif dan Aplikasi Matematika Siswa pada Pembelajaran Open-Ended denganKonvensional di Sekolah Menengah Pertama*. Dissertation of SPS. UPI: Non Publication.

Herman, T. (2007). *Pembelajaran Matematika Berbasis Masalah untuk Meningkatkan Kemampuan Berpikir Kritis dan Kreatif Siswa SMP. Makalah.* Tanggal 8 Desember 2007 di UPI.

Hulukati, E. (2005). *Mengembangkan Kemampuan Komunikasi dan Pemecahan Masalah Matematik Siswa SMP melalui Model Pembelajaran Generatif.*Dissertation of SPS UPI: Non Publication.

Katu, N. (1995). *Pengajaran Fisika yang Menarik.* Makalah. Salatiga. Universitas Satya Wacana.

Lambertus. (2010). *Peningkatan Kemampuan Berpikir Kreatif dan Pemecahan Masalah Matematik Siswa SD melalui Pendekatan Matematika Realistik*. Dissertation of SPS UPI: Non Publication.

Mann, E. (2005*). Mathematical Creativity and School Mathematics:Indicators of Mathematical Creativity in Middle School Students.* DissertationUniversity ofConnecticut.(Online).Tersedia:http://www.gifted.uconn.edu/Siegle/Dissertations/Eric%20Mann.pdf. Diakses 20 Desember 2010.

Mulyana, T dan Sabandar, J. (2005). *Upaya Meningkatkan Kemampuan Berpikir Kreatif Matematik Siswa SMA Jurusan IPA melalui Pembelajaran dengan Pendekatan Deduktif–Induktif.* Makalah. Jurusan Pendidikan Matematika FPMIPA UPI.

Rohaeti, E. (2008). *Pembelajaran dengan Pendekatan Ekspositori untuk Mengembangkan Kemampuan Berpikir Kritis dan Kreatif Matematik Siswa SMP*. Dissertation of SPS. UPI: Non Publication.

Ruseffendi, H. E. T. (1994). *Statistik Dasar untuk Penelitian Pendidikan*. Jakarta: Dirjen Dikti. Depdikbud.

……..(2005). *Dasar-dasar Penelitian Pendidikan & Bidang Non-Eksakta Lainnya*. Bagi: Para Peneliti, Penulis Skripsi, Penulis Tesis, Penulis Disertasi, Dosen Metode Penelitian dan Mahasiswa. Bandung: Tarsito.

Sabandar, J. (2008). *Berpikir Reflektif*. Makalah. Prodi Pendidikan Matematika SPS. UPI.

Schunk, H. Daleh. (2012). *Learning Theory An Educational Prespective*. Sixth Edition. Teori-Teori Pembelajaran: Perspektif Pendidikan. Edisi Keenam. Penerjemah Eva Hamdiah, Rahmat Fajar. Yogyakarta: Pustaka Pelajar.

Silver, E. A. (1997). *Fostering Creativity Though Instruction Rich in mathematical Problem Solving and Problem Posing.* [online]. Tersedia: http://www.Fizkorlsruke.de/. Diakses 28 Desember 2010.

Somakim. (2010). *Peningkatan Kemampuan Berpikir Kritis dan Self-efficacy Matematik Siswa Sekolah Menengah Pertama dengan Menggunakan Pendekatan Matematika Realistik*. Dissertation of SPS UPI: Non Publication.

Suherman, E., Turmudi, Suryadi, D., Herman, T., Suhendra, Prabawanto, S., Nurjanah, dan Rohayati, A. (2003). *Strategi Pembelajaran Matematika Kontemporer*. Bandung: JICA UPI.

Sukmadinata, N, S, dkk. (2012). *Kurikulum dan Pembelajaran Kompetensi*. Bandung. Refika Aditama.

Tall, D. (1991*). Advanced Mathematical Thinking. Mathematical Education.* Library Kluwer Academic Publishers.

Wena, M. (2009). *Strategi Pembelajaran Inovatif Kontemporer. Suatu Tinjauan Konseptual Operasiona*l. Edisi Pertama. Jakarta: Bumi Aksara.

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