ANALYSIS OF CREATIVE THINKING MATHEMATICALAND SELF-REGULATION LEARNING IN SENIOR HIGH SCHOOL STUDENTS

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Abstract

The purpose of this study was to analyze creative thinking mathematical, self regulation learning (SRL) and the relationship between creative thinking mathematical and self regulation learning. This study is a qualitative research. The population is students of class XI SMA N 3 Klaten academic year 2016/2017. Technique selection of subjects is purposive sampling, whereas the subject is based on beginning ability, consisting of beginning ability of high, medium and low. Indicators creative thinking mathematical are fluency, flexibility, originality, and elaboration, Based on the results of learners with beginning ability of high cannot be reached indicators of originality with good. Based on the analysis SRL, learners with beginning ability of high tends SRL better than learner with beginning ability of low and middle. Learners with beginning ability of high were more ready to do the test questions for doing advance preparation earnestly in learning. Results SRL is in line with the creative thinking mathematical, it is said that the SRL affect the ability of creative thinking mathematical.

Keywords: creative thinking, mathematical, elaboration, flexibility, fluency, originality, self regulation learning.

1. Introduction

Mathematics as one of the fields study are taught in school that is expected to develop logical thinking skills, analytical, systematic, critical, and creative. Developing creative thinking mathematical very important as emphasized by Piaget (Anwar &Rasool, 2012) which states that the most important goal in education is not on how to create the same generation as the present, but how to create a generation that has the ability to create something new and be creative. According to Fatah, et al (2016) in the context of Indonesia, creativity is also the focus of applied learning in all subjects, including mathematics.

Mathematical creativity by Akgul & Kahveci (2016) emerged as a cognitive and affective factors are important. Even the United States also undertake efforts to develop the ability to think creatively mathematically. It is evident from the National Council of Teachers of Mathematic (NCTM) in collaboration with the National Science Foundation in producing curricular to develop mathematical creativity (Mann, 2005).

Munandar (2009) suggests that the characteristics of creative individual that is: imaginative, have an interest in a broad, independent in thought, full of confidence, confidence, risk-taking, opinionated and belief. Independence as one of the attitude in the development of mathematical creative thinking abilities. Learners are said to be independent if it is able to effectively manage their own learning in a variety of ways. Self-reliance can also be seen from the initiative, are responsible for their own behavior, have discipline and curiosity high, has a strong desire to learn and make changes to better yourself, able to organize time in arranging a proper learning and carry out the plan to meet the targets that have been planned. Therefore, students need self-regulation or self-regulated learning (SRL) to be able to learn discipline in regulating and controlling oneself and emphasizes self-initiative.

Based on the research background, the purpose of this study was to analyze the ability of creative thinking and self regulation mathematical learning. It is also to analyze the relationship between the ability to think creatively mathematical learning and self regulation.

2. Theoretical

Creativity in mathematics learning is always associated with problem solving (Nadjafikhah and Yaftian, 2013). Indicators creative thinking mathematically according

Pehkonen (1997), Krutetskii (1976), Haylock (1997) and Silver (1997) is fluency, flexibility and originality. Guilford (Park, 2004), (Nadjafikhah and Yaftian, 2012) mentions creativity diverging production or what is also called divergent thinking. Divergent thinking has four components, namely: fluency, flexibility, originality and elaboration. This is in line with Williams was quoted as saying by Al-Khalili (2005) and Munandar (2002) in Lince (2016) indicator of the ability to think creatively is as follows. Smoothness is the ability to generate ideas, solve problems and provide answers to the problems. Flexibility is the ability to generate ideas, provide answers varied, using a variety of strategies completion. Originality is the ability to build an unusual idea, a smart idea that different from the way in general. Elaboration of being able to explain in detail, enrich and develop ideas, add or details the situation so that it becomes more attractive.

Zimmerman (1989) stated that the SRL on individuals described through the level or degree of covering the activity participate either in metacognition, motivational, and behavioral effects in the learning process. SRL Component according Ormord (2004) consists of eight parts as follows. Goal Setting is the identification of desired outcomes in learning activities. Planning to plan how best to use the time available to study. Self-motivation maintain intrinsic motivation to complete the task of learning. Attention control to maximize attention on the learning task. Application of learning strategies using the proper way of processing the material to be studied. Self-monitoring evaluated periodically to see what progress goals. Self-evaluation assessing the outcome of individual effort. Self-reflection determines the extent to which the strategy has been successful and efficient learning.

3. Research Methods

This study is a qualitative research. The study population was the students of class XI SMA N 3 Klaten academic year 2016/2017. Mechanical selection of subjects in the qualitative research is purposive sampling, whereas the subject is based on prior knowledge of learners, consisting of early learners capable of high, medium and low. The ability of early learners based on the value of daily tests. Each level of the three samples taken to be analyzed creative thinking mathematical and self regulation learning.

Data analysis was performed at a stage before the field up during the analysis phase in the field. Analysis done before the field validation of research instruments. Analysis for the field is

preparing qualitatively obtained from the results of tests of creative thinking mathematically (TBKM), SRL questionnaire and interview. Qualitative data analysis to describe the mathematical ability to think creatively and SRL is done by reducing the data, presenting data, draw conclusions from the data collected, and verify conclusions.

4. Results and Discussion

The results of the study of mathematical creative thinking ability are as follows.

Table 1 Analysis of Research Ability of Creative Thinking Mathematically

Student with high prior knowledge	The fluency: learners are able to solve problems and provide answers to the problem correctly. Learners can also provide other solutions to solve the problem. Flexibility: learners able to generate ideas to solve the problems with the completion strategy vary. Learners can also find some alternative settlement solutions. Originality: the learner is able to resolve the problem by using a new strategy but the solution is still not quite right. Elaboration yet to be seen.
Student with middle prior knowledge	The fluency: students solve problems and provide answers to the problem correctly. Learners can also solve the problem with the other strategies. Flexibility: learners capable of using various strategies of completion but not yet able to provide the settlement of a variety of problems. Originality and elaboration yet to be seen.
Student with low prior knowledge	The fluency: learners are able to solve problems and provide answers to the problem, but students cannot provide another solution to solve the problem. Flexibility, originality and elaboration yet to be seen

Student with medium ability was already able to show fluency in resolving problems with either. Flexibility not look good because learners are able to use various strategies completion but not yet able to provide solutions to the completion of a variety of problems. Originality and elaboration learners with prior knowledge were not yet in sight. The fluency learners with lower initial ability cannot be seen either as learners are able to solve problems and provide answers to the problem, but students cannot provide another solution to solve the problem. Flexibility, originality and elaboration learners with lower initial ability cannot be seen.

Based on the analysis of mathematical creative thinking ability, students with high prior knowledge tend to have the ability to think creatively mathematically better than on the students with low and middle prior knowledge. Fluency and flexibility of learners with high prior knowledge is already looking good. This can be seen by the learners are able to solve problems and provide answers to the problems correctly through the completion strategy and find some solutions completion. Originality learners with high early ability not look good because learners are able to resolve the problem by using a new strategy but the solution is still not quite right. Students use the strategy of solving problems recalling a familiar formula in the previous school levels. But the final execution of the settlement is still not quite right. This is caused by differences in the application of the formula problems in implementing the previous level.

Based on interviews and observations students difficulties in resolving the problems caused by the problems assessed by learners is quite complex, connecting some basic competence (KD), is very much different from the exercises that are given daily. This situation shows that creative thinking is a divine blessing, which is a gift for the man, but the emergence and development requires the development of thinking and the provision of infrastructure that led to the development of creative power line with the objectives of education centers (Nejad and Delgoshaei, 2014).

One strategy to develop creative thinking abilities mathematically is the development of strategies, methods and learning models. Sriwongchai, et al (2015) and Benlliure (2013) also stated that the need for the development of mathematical learning model to enhance creative thinking. Wessels (2014) also stated that the election model in solving important problems to develop creativity. Nejad and Delgoshaei (2014) states that the way to achieve creativity through parallel thinking method that can bring various ideas and implement the best ideas in harmony with creativity.

Based on the analysis of these studies shows that the overall ability to think creatively mathematical students is still relatively low. Based on research results students with high early capability have not yet been reached with the good indicators of originality. According Siswono (2011), the participants said to be creative when reaching the three indicators of creative thinking that fluency, flexibility and originality. Based on the research results of research SRL is as follows.

Table 2 Analysis of Results Self Regulation Learning

Student with high prior knowledge	Goal Setting: students able to identify desired outcomes in learning activities. Planning: students plan the best ways to use the time available to study. Self-motivation: students are able to maintain intrinsic motivation to complete the task of learning. Attention control: students are able to maximize the attention on the task of learning. Application of learning strategies students use a fairly precise way of processing the material to be studied. Self-monitoring: students rarely evaluated regularly to see the progress in achieving the learning objectives. Self-evaluation: students can reasonably assess the outcome of individual effort. Self-reflection: learning strategies used students are still poorly managed and efficient.
Student with middleprior knowledge	Goal Setting: students have not been able to identify the desired end result in learning activities. Planning: students have not been able to plan how best to use the time available to study. Self-motivation: students are able to maintain intrinsic motivation to complete the task of learning. Attention control: students are able to maximize the attention on the task of learning. Application of learning strategies students use a less precise manner in the processing of the material to be studied. Self-monitoring: students never evaluated periodically to see what progress goals. Self-evaluation: students are less able to judge the outcome of individual effort. Self-reflection: learning strategies used students unsuccessful and inefficient.
Student with low prior knowledge	Goal Setting: students are not able to identify the desired end result in learning activities. Planning: students are less able to plan the best ways to use the time available to study. Self-motivation: learners are not able to maintain the intrinsic motivation to complete the task of learning. Attention control: students are less able to maximize attention on the learning task. Application of learning strategies: students do not use the proper manner in the processing of the material to be studied. Self-monitoring: learners do not evaluate on a regular basis to see what progress goals. Self-evaluation: students are less able to judge the outcome of individual effort. Self-reflection: learning strategies used students unsuccessful and inefficient.

Based on the analysis SRL, students with high prior knowledge tends SRL better than on the students with the ability of low- and middle. Neither student who have prior knowledge SRL're likely to have better than students who have lower initial ability. Learners with high early capability was more ready to do the test questions for doing advance preparation earnestly in learning. Yıdızlı & Saban (2016) states that learners who have SRL tend not afraid to face the problems of mathematics.

SRL The results are in line with the ability of creative thinking mathematically. Where learners with high prior knowledge have the ability to think creatively mathematical and SRL are

better than students with moderate and low early capability. Therefore, it can be said that the SRL affect the ability of creative thinking mathematically. According to Sharifi, et al (2014) that self-regulation can be seen as academic skills so that learning can be achieved to improve academic achievement.

5. Conclusions and Recommendations

Mathematical creative thinking ability students is still relatively low. Based on research results students with high early capability has not yet been reached with the good indicators of originality. Difficulties students in solving the problems caused by the problems assessed by learners is quite complex, connecting some basic competence (KD), is very much different from the exercises that are given daily.

Based on the analysis SRL, learners with high prior knowledge tends SRL better than on the learner with the ability of low- and middle early. Neither students who have prior knowledge SRL're likely to have better than students who have lower prior knowledge. Students with high prior knowledge was more ready to do the test questions for doing advance preparation earnestly in learning.

SRL The results are in line with the ability of creative thinking mathematically. Where students with high prior knowledge have the ability to think creatively mathematical and SRL are better than students with middle and low prior knowledge. Therefore, it can be said that the SRL affect the ability of creative thinking mathematically. Suggestions that can be recommended in this research is to develop the ability to think creatively mathematical is developing learning strategies that encourage self-reliance education of students.

References

Akgul, S. Kahveci, N.G. 2016.A Study on the Development of a Mathematics Creativity Scale.*Eurasian Journal of Educational Research*. Issue 62, Halaman 57-76.

Al-Khalili, A. 2005.*MengembangkanKreativitasAnak*(DiterjemahkanolehUmmu Farida). Jakarta Timur: Pustaka Al-Kautsar.

Anwar, N. M.Rasool, Sahibzada, Shamin. 2012. A Comparison of Creative Thinking Abilities of High and Low Achievers Secondary School Student. *International Interdeciplinary Journal of Education,* Volume 1, Issue 1.

Benlliure, V.A. Melendez, J.C. Ballesteros, M.G. 2013.Evaluation of a creativity intervention program for preschoolers.*Elsevier Thinking Skills and Creativity*.Volume 10, Halaman112– 120.

Fatah, A. Suryadi, D. Sabandar, J. Turmudi. 2016. Open-Ended Approach: An Effort In Cultivating Students' Mathematical Creative Thinking Ability and Self-Esteem in Mathematics. *Journal on Mathematics Education*. Volume 7, No. 1, Halaman 11-20.

Haylock, D. 1997. Recognising Mathematical Creativity in Schoolchildren.*ZDM*.Vol.29, No.3.

Krutetskii, V.A. 1976. *The Psychology of Mathematical Abilities in Schoolchildren*. Chicago: The University of Chicago Press

Mann, E.L. 2005.Mathematical Creativity and School Mathematics: Indicator of Mathematical Creativity in Middle School Students. *Dissertation of Doctor ofPhilosophy*. University of Connecticut.

Munandar, U. 2009. PengembangankreativitasAnakBerbakat. Jakarta: RinekaCipta.

Nadjafikhah, M. Yaftian, N. 2013. The frontage of Creativity and Mathematical Creativity.*Procedia - Social and Behavioral Sciences*. Hal 344-350.

Nejad, Akram, S.M. Delgoshaei, Y. 2014. The Relationship between Self Regulated Learning and Creativity and Process of Resolving Problem. *International Journal of Basic Sciences & Applied Research*.Vol. 3,Hal.19-25.

Lince, R. 2016. Creative Thinking Ability to Increase Student Mathematical of Junior High School by Applying Models Numbered Heads Together. *Journal of Education and Practice*.Vol.7, No.6, Hal.206-212.

Ormrod, J. E. 2004. *Human Learning (4th Ed.)*. Ohio: Pearson.

Park, H. 2004. The Effects of Divergent Production Activities with Math Inquiry and Think Aloud of Students With Math Difficulty. *Disertasi*.

Pehkonen, E. 1997.The State-of-Art in Mathematical Creativity.*ZDM*.Vol. 29.No. 3.

Sharifi, H.P. Sharifi, N. Yalda, T. 2014. Comparing the scores of students in academic achievement, self-efficacy, Self-regulation and creativity.*Journal of Novel Applied Sciences*.Vol. 3, No. 4, Hal. 350-357

Silver, E.A. 1997.Fostering Creativity through Instruction Rich in Mathematical Problem Solving and Thinking in Problem Posing.*ZDM*.Vol.29, No. 3.

Siswono, Y.E. 2011.Level of Students Creative Thinking in Classroom Mathematics.*Educational Research and Review*.Vol. 6.No. 7. Hal 548-553.

Sriwongchai, A. Jantharaji, N. Chookhampaeng, S. 2015. Developing the Mathematics Learning Management Model for Improving Creative Thinking in Thailand.*International Education Studies*.Vol. 8, No. 11, Hal.77-87.

Wessels, H. 2014. Levels of mathematical creativity in model-eliciting activities.*Journal of Mathematical Modelling and Application*. Vol. 1, No. 9, 22-40.

Yıdızlı, H. Saban, A. 2016. The effect of self-regulated learning on sixth-gradeTurkish students' mathematics achievements andmotivational beliefs.*Cogent Education*, 3: 1212456.

Zimmerman, B. 1989. A Social Cognitive View of Self Regulated Academic Learning. *Journal of Educational Psychology*.Vol. 3, Hal.329-339.