ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research, volume 200
3rd Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2018)

The Increasing of Mathematical Creative Thinking Ability and Self-Efficacy of Junior High School Students Through Open-Ended Approach

Harianisyah Parinduri
Mathematic Education Post Graduate
State University of Medan
Medan, Indonesia
Corresponding email:
harianisyah.parinduri@gmail.com

Waminton Rajagukguk
Mathematic Education
State University of Medan
Medan, Indonesia

Ani Minarni
Mathematic Education
State University of Medan
Medan, Indonesia

Abstract:**The purposes of this study are : 1) To describe the presence or absence of an increase in mathematical creative thinking skills of students taught through an open-ended approach. 2) To describe the presence or absence of an increase in mathematical self-efficacy of students taught through an open-ended approach. 3) To describe the presence or absence of interaction between learning approaches with student's early mathematical ability to increase student's mathematical creative thinking ability. 4) To describe the presence or absence of interaction between learning approach with student's early mathematical ability to increase student's mathematical self-efficacy. This research is a quasi-experimental research. The population of this research is all of students class VII Junior High School 17 Medan Semester Odd Year 2017/2018. And randomly selected two classes. The experimental class is taught with an open-ended approach and control class with conventional learning. The instruments used consisted of: tests of mathematical creative thinking ability and self-efficacy questionnaires. Data analysis was done by 2-way ANOVA test. Based on the results of the analysis obtained research results are: 1) There is an increase of student's mathematical creative thinking ability which is taught using open-ended approach. 2) There is an increase in mathematical self-efficacy of student's taught using an open-ended approach. 3) There is no interaction between learning approach with student's early mathematical ability to increase student's mathematical creative thinking ability. 4) There is no interaction between learning approach with student's early mathematical ability to increase student's mathematical self-efficacy.**

Keywords: Open-Ended Approach, Mathematical Creative Thinking Ability, Mathematical Self-Efficacy

I. INTRODUCTION

Education is a conscious and planned effort to realize a learning atmosphere and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state [1].In age that is as sophisticated and modern as it is now, when computers dominate all facets of life, all humans are required to be creative and innovative, able to adapt to life's changes very quickly. Technological advances that are increasing on the one hand and population explosions accompanied by a reduction in the supply of natural resources on the other hand, require creative adaptation [2]. Responding to the above facts which are also a challenge for the world of education, the learning paradigm must also be changed. Therefore, an educator is expected to adapt his teaching to be able to meet the needs of all students and be able to understand the nature of students who are different from other students [3].

Mathematics is a component of the development of science and technology, so mathematics is one of the requirements that must be fulfilled in order to hold advanced technology in the world of education. Freudenthal says that mathematics is a human activity [4]. In addition, according to the notion of mathematics is a human mind whose truth is universal and does not require data support [5].Based on the characteristics of mathematics, mathematics has great potential to provide various kinds of abilities, and attitudes needed by humans so that they can live smartly in their environment, and in order to be able to manage the various things in the world as well as possible [6].

From the description above it is clear that mathematics is very important and becomes a focus in improving students' ability to solve the problems they face everyday. The fact that has happened so far, some students even consider mathematics to be a difficult lesson. Mathematics for children is generally an unpopular subject, considered a difficult and complicated science, and some even think of mathematics as a frightening specter [7].Mathematics is often considered a frightening specter by most students [8]. During this time mathematics tends to be considered as a difficult lesson, because experience does not please many

Copyright © 2018, the Authors. Published by Atlantis Press.
This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

students when learning mathematics. This will indirectly affect students' interest in mathematics.

In observations conducted by researchers in Class VII Junior High School 17 Medan 2016/2017 Academic Year on Thursday, November 17, 2016, researchers found the fact that students considered mathematics a difficult lesson. Because it is considered difficult, it is also difficult to expect students to have mathematical creative thinking skills.

Creative comes from the English language create, which means creating, while the creative contains the meaning of having creativity, able to realize ideas and feelings so as to create a composition with new colors and nuances [9]. Creative thinking is the embodiment of higher order thinking. There are five forms of high-level thinking that are closely related in terms of learning achievement. The five forms are: 1) thinking about concepts; 2) thinking about problem solving; 3) critical thinking; 4) thinking about rules; 5) creative thinking [10].

The Florida Department of Education suggests that creative thinking in mathematics is using and giving reasons for different calculation strategies in real-world problem situations and determining the results of calculations that make sense in a given problem situation [11].

From the description above it can be concluded that the ability to think creatively mathematically plays an important role and needs to be improved in mathematics learning. Some aspects of students' mathematical creative thinking skills that are measured in this study are as stated by Treffinger, et al [12] such as the ability of students that reflect aspects of fluency, flexibility, and the ability to elaborate an idea (elaboration) and originality in thinking to find answers or varied solutions that are new in solving mathematical problems.

From the description above, it can be concluded that the ability to think mathematically creative plays an important role and needs to be improved in learning.However, the facts on the ground show that students' mathematical creative thinking ability is still very low.

To see students' mathematical creative thinking skills, the researcher gave students a mathematical creative thinking ability test on the sub-subject matter fractions to 35 class VII students of Junior High School 17 Medan. The questions the researcher gave were:

A mother has 2 daughters. This mother intends to distribute a rectangular silk fabric. Each daughter gets the same share.

a. Draw a picture of the way you know to divide the fabric so that each daughter gets the same part. (Fluency)
b. Is there another way to divide the cloth so that each daughter gets the same share? (Originality)
c. Which division of fabric is most useful? Why are the cloth divisions chosen? (Elaboration)
d. Change the parts obtained by each daughter into percent and decimal forms. (Flexibility). (*Fluency*)

To answer the questions above, it requires mathematical creative thinking skills. Following this, the researcher gives an example drawing of students 'answers to a limited test of students' creative thinking ability.

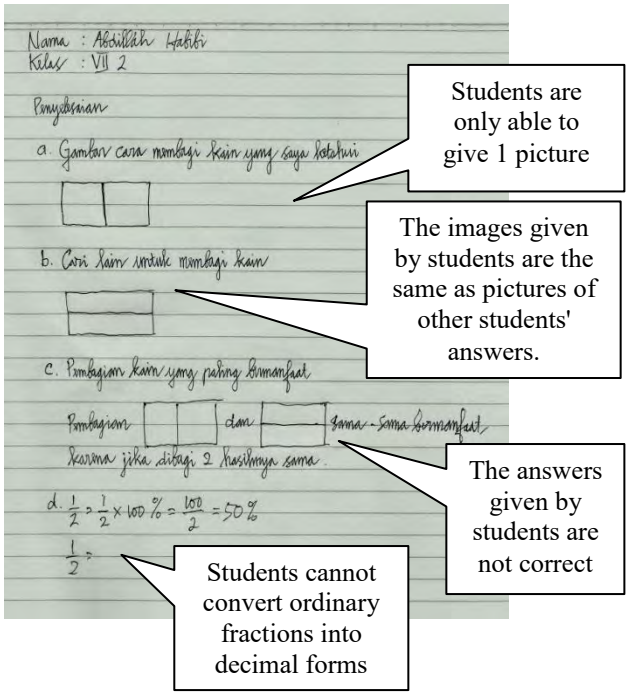


Fig 1.1. Examples of Student Answers

From the answers given by students, it appears that students are not able to fulfill aspects of the ability to think creatively. So it can be concluded that the creative thinking ability of students in Junior High School 17 is still very low and needs to be improved.

In addition to mathematical creative thinking skills, what needs to be developed is also the attitude as contained in Permendikbud Number 54 of 2013 Graduates Competency Standards (SKL) of Primary and Secondary Education, students must have behaviors that reflect noble attitudes, knowledgeable, confident and responsible in integrate effectively with the social and natural environment within the range of relationships and their existence [13]. From SKL, one aspect that needs to be developed in mathematics learning is self-efficacy.

Self-efficacy is a person's belief about the ability they have in carrying out and completing tasks so that they can overcome challenges and can achieve the expected goals [14]. Self-efficacy as an evaluation of a person's ability or competence in carrying out a task, to achieve a goal, or to overcome a problem. Confidence in self-efficacy determines how a person feels, thinks, and motivates himself [15].

These beliefs produce diverse effects through four processes, namely cognitive, affective, motivational, and the selection process [16]. In other words, self-efficacy

determines one's success in learning, in this case achieving academic achievement. Self-efficacy is one of the predictors of academic achievement. The aspects of self-efficacy measured in this study are (1) level, (2) generality, (3) strength [17].

Based on the results of the interview, the researcher with mathematics teacher at Junior High School 17 Medan, namely IbuLastri, S.Pd, found that students were still reluctant or not confident to ask questions about material they did not understand. They may be afraid of the teacher being angry or afraid of being laughed at by friends. Students are also not confident to convey ideas or opinions in discussion forums. These conditions can affect their learning achievement.

One of the factors that influence the achievement of student learning outcomes is the approach or method used by the teacher in the learning process. Teachers need many approaches to meet their goals with a diverse student population. A single approach or method is no longer sufficient. With enough choices, the teacher can choose the approach that can best achieve certain goals, the approach that best fits a particular class of students, or models that can be used to increase student motivation, involvement, and achievement [18].

During this time most teachers still apply ordinary learning where the teacher is the only source of knowledge and learning resources that act authoritarian and dominate the class without involving students actively in the learning process.Conventional learning methods are traditional learning methods or also called lecture methods, because this method has always been used as an oral communication tool between teachers and students in the learning and learning process [19].

Responding to the problems that arise in school mathematics education, especially those relating to the importance of developing self-efficacy and mathematical creative thinking skills, as well as other mathematical abilities, an approach that has high quality is needed that can accommodate the improvement of these abilities.

One approach that can be used and will be in line with the mathematical characteristics and expectations of the current curriculum is an open-ended approach. The open-ended approach was one of the innovations in mathematics education which was first carried out by Japanese mathematics education experts [20]. This approach was born twenty years ago from research conducted by Shigeru Shimada, Yoshiko Yashimoto, and Kenichi Shibuya. An open-ended approach is a learning approach that starts from the introduction or exposes students to open-ended problems [21].

Noer's study of Class VIII students in Bandar Lampung Middle School 4 and Bandar Lampung Middle School 12 shows that in general students who follow learning through an open-ended approach show better results in mathematical creative thinking skills when compared to students who learn conventionally [22].The provision of open-ended assignments can help students to develop creative thinking in mathematics [23].

Things that still need to be revealed further are related to mathematics learning based on students 'initial mathematical abilities that are divided into high, medium, and low groups towards improving students' creative thinking skills. As Adams and Bruce said [24] that understanding is the use of prior knowledge to create new knowledge. The initial ability of mathematics can be classified into three levels, namely low, medium and high [25].

Each student has different abilities, there are smart students, some are less intelligent and some are mediocre [26]. The ability of students is not solely the inheritance of birth (heredity), but can also be influenced by the environment. Therefore, the choice of the learning environment especially the approach becomes very important to consider, meaning that the selection of an approach must be able to improve the mathematical abilities of heterogeneous students.

Based on the above problems, researchers conducted research on whether open-ended approaches can improve mathematical creative thinking skills and student self-efficacy which will ultimately improve students' mathematics learning outcomes.

II. METHODS

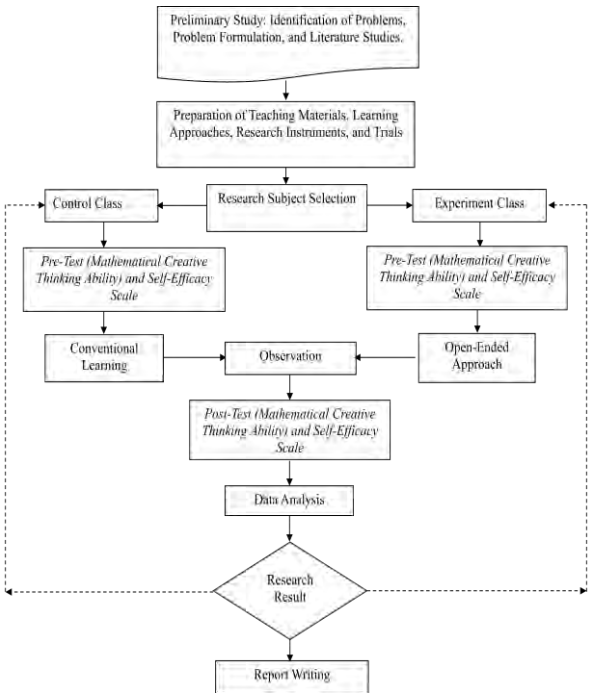
This research is a quasi-experiment. The sampling technique in this study is random sampling. One way to choose a sample representing its population is random sampling, that is, if each member of the population has the same opportunity to be chosen as a sample [27]. This study was carried out in three stages, namely the implementation of pre-test, implementation of learning and post-test implementation. This research was conducted in even semester in Class VII Junior High School 17 Medanfrom November 23, 2017 until December 9, 2017. Of all classes, 2 classes were chosen randomly, so that class VII-7 was selected as the experimental class and class VII-6 as a control class.

The instruments used in this study were learning devices, test instruments, and non-test instruments. The test instrument used is the students' initial ability test which aims to determine the students' high, medium and low initial mathematical abilities before learning is carried out and the test of mathematical creative thinking skills to measure students' creative thinking skills, while the instrument is a non-test type to measure level self-efficacy of students.

KAM is measured by using multiple choice objective tests of 20 questions adapted from the 2013-2016 UN questions. The creative thinking ability test instrument was developed from the subject matter of linear equations and inequalities of one variable. The test instrument consists of 4 items about the description form. The allocation of time to solve this problem is 80 minutes.To measure self-efficacy, a self-efficacy scale is used. The measurement of self-efficacy

includes three (3) dimensions, namely magnitude / level dimensions, strength, and Generality dimensions

The data obtained are grouped according to learning groups (open-ended and conventional approaches) and initial mathematical abilities (high, medium, and low). Beginning with testing the statistical requirements needed as a basis for testing hypotheses, including calculating normalized gain, normality test, and homogeneity of variance. Furthermore, two-way ANOVA test was carried out.



III. RESULTS AND DISCUSSIONS

In this section, a discussion of research will be described. Description and interpretation is carried out on the ability to think mathematically creative and self-efficacy in solving the given problem.

A. The Increasing of Students' Mathematical Creative Thinking Skills

As previously explained what is meant by mathematical creative thinking ability is an ability that can produce ideas that a person has by combining or reapplying existing ideas, or the ability of students to produce many possible answers and ways to solve mathematical problems . The aspects of self-efficacy measured in this study are (1) level, (2) generality, (3) strength.

From the calculation results, there is an increase in students' creative thinking skills given an open-ended approach. Students who follow learning with an open-ended approach are accustomed to being active in solving problems thinking individually to get concepts. Because the learning process is not just transferring knowledge from the teacher to students, but a process that is conditioned or sought by the teacher, so that students are active in various ways to build their own knowledge. In line with Piaget's emphasis on the importance of motivation and facilitation of students by teachers. In order for children's intellectual development to take place optimally, they need to be motivated and facilitated to build theories that explain the world around. In the open-ended approach the teacher is required to facilitate and encourage students to be actively involved in the learning process so that they are able to construct knowledge for themselves.

Based on the results of data analysis on the average score of the pre-test and post-test, then the increase is calculated (N-Gain), the class given an open-ended approach obtains an average N-Gain score of 0.731 with a standard deviation of 0.080. The results of this study are in line with Sari's research in her thesis research which shows that there is an increase in the ability to think creatively by using an open-ended approach at Junior High School23 Medan on rectangular and kite material [28].

B. The Increasing of Self-efficacy

As already explained, what is meant by self-efficacy is a person's belief about the ability they have in carrying out and completing tasks so that they can overcome challenges and can achieve the expected goals, and in this study some aspects are taken that include aspects of level, strength, and generality.From the calculation results, there is an increase in self-efficacy of students who were given an open-ended approach. Students who follow the learning of an open-ended approach are accustomed to being active in solving problems thinking individually to get concepts. Because the learning process is not just transferring knowledge from the teacher to students, but a process that is conditioned or attempted by the teacher, so that students are active in various ways to build their own knowledge so that their confidence increases.

Based on the results of data analysis on the average pre-test and post-test scores, then the increase in N-Gain was calculated, the class given the open-ended approach obtained a mean N-Gain score of 0.587 with a standard deviation of 0.067.This research is in line with the results of research conducted by Rubiati[29] conducted in Sulang 1 Public Middle School in the second semester of 2011/2012 school year using class VII as the study population. The results showed that there was an increase in the ability of mathematical representation and self-efficacy of junior high school students who obtained learning with an open-ended approach.

C. Interaction between Learning Approach and Initial Mathematical Ability to Improve Students' Creative Thinking Skills

In this study the ability of students was also obtained based on initial mathematical abilities. Student grouping is based on high, medium, and low mathematical abilities. Mathematical initial ability factors are associated with

learning factors. From the results of the calculation analysis carried out on the learning approach with initial mathematical ability to increase mathematical creative thinking skills students indicate that there is no interaction. For learning factors related to the initial mathematical ability, it was obtained 0.837 and a significant level of 0.364. Because of the significant level of 0.364> 0.05, H0 is accepted, which means that there is no interaction between the learning approach factors and the students 'initial mathematical ability to improve students' creative thinking skills. This shows that learning has an influence on students 'mathematical creative thinking skills, whereas if associated with initial mathematical abilities do not affect students' mathematical creative thinking skills.

In line with the research conducted by Lili, et al in Junior High SchoolMuhammadiyah 03 Medan which shows that there is no interaction between learning and students 'initial mathematical abilities towards improving students' creative thinking skills [30].

D. Interaction between Learning Approach and Initial Mathematical Ability to Increase Student Self-efficacy

In this study the ability of students was also obtained based on the initial mathematical ability score. Student grouping is based on high, medium, and low mathematical abilities. Mathematical initial ability factors are associated with learning factors. The results of the two-way ANOVA calculation on the N-Gain score in the open-ended approach group and conventional learning related to the initial mathematical ability were 0.595 with a significant level of 0.444. Because significant 0.444 is greater than 0.05, H0 is accepted, which means that there is no interaction between learning factors and students 'initial mathematical ability to increase students' self-efficacy. This shows that learning has an effect on students 'self-efficacy, whereas if associated with initial mathematical abilities do not affect students' self-efficacy.

In three state junior high schools in the city of Yogyakarta showed that there was no interaction between the learning approach and students 'initial mathematical ability to increase students' self-efficacy [31].

IV. CONCLUSIONS

The conclusions of this research are there is an increase in students' creative thinking skills taught by an open-ended approach, there is an increase in students' mathematical self-efficacy afterobtain learning through an open-ended approach, there is no interaction between learning with students 'initial mathematical ability to increase students' creative thinking skills, and there is no interaction between learning and students 'initial mathematical ability to increase students' mathematical self-efficacy.

REFERENCES

[1] Sisdiknas. 2003. “Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional”. Jakarta: Sinar Grafika.

[2] Munandar, U. 2009. “Pengembangan Kreativitas Anak Berbakat”. Jakarta: Rineka Cipta.

[3] [18] Arends. R. I. 2008. “Learning to Teach (Belajar untuk Mengajar)”. Buku Satu. Yogyakarta: Pustaka Pelajar.

[4] Wijaya, Ariyadi. 2011. “Pendidikan Matematika Realistik Suatu Alternatif Pendekatan Pembelajaran Matematika”. Yogyakarta: Graha Ilmu.

[5] Ernest, P. 2013. “Philosophy of Mathematics”. Education Journal No. 27 April 2013. ISSN 1465-2978 (Online).

[6] Hasratuddin. 2015. “Mengapa Harus Belajar Matematika?”. Medan: Perdana Publishing.

[7][26] Ruseffendi, E. T. 1991. “Pengantar kepada Membantu Guru Mengembangkan Kompetensinya dalam Pengajaran Matematika untuk Meningkatkan CBSA”. Bandung: Tarsito.

[8] Sriyanto. 2007. “Strategi Sukses Menguasai Matematika”. Jakarta: Indonesia Cerdas.

[9] Echols, J. M. dan Hassan S. 2005.“Kamus Inggris Indonesia (An English-Indonesian Dictionary)”. Jakarta: Gramedia.

[10] Levine, M. 2002. “A Mind at a Time”. Jakarta: Gramedia.

[11] King, F. J., et al. 2010.“Higher Order Thinking Skills”. A publication of the Educational Services Program, now known as the Center for Advancement of Learning and Assessment.

[12] Treffinger, D. J. et al. 2012. “Creativity in the Person: Contemporary Perspectives”. Learning Landscapes, Vol. 6, No. 1, Autumn 2012.

[13] Permendikbud. 2013. “Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 54 Tahun 2013 tentang Standar Kompetensi Lulusan Pendidikan Dasar dan Menengah”. Jakarta: Kemdikbud.

[14] [16] Bandura, A. 1994. “Self-Efficacy”. San Diego: Academic Press.

[15] Fitriani, N., Subekti, A dan Aquarisnawati, P. 2011.“Pengaruh Antara Kematangan Emosi Self-efficacy Terhadap Craving Pada Mantan Pengguna Narkoba”. Journal INSAN Vol 3: Universitas Hang Tuah Surabaya.

[17] Turner, E. A. et al. 2009. “The Influence of Parenting Styles, Achievement Motivation, and Self-Efficacy on Academic Performance in College Students”. Maryland: The Johns Hopkins University Press. Journal of College Student Development, Volume 50, Number 3, May/June 2009, pp. 337-346. http://selfdeterminationtheory.org/SDT/documents/2009_TurnerChandleretal_JCSD.pdf. Diakses pada tanggal 20 Januari 2017.

[19] Djamarah, S. B dan Aswan Zain. 1996. “Strategi Belajar Mengajar”. Banjarmasin: RinekaCipta.

[20] Nohda, N. 2000. “Teaching by Open-Approach Method in Japanese Mathematics Classroom”. Japan: EDRS.

[21] Shimada, S. dan Becker J.P. 1997. ”The open-ended approach: A new Proposal for Teaching Mathematics”. Virginia: NCTM.

[22] Noer, S. H. 2014. “Kemampuan Berpikir Kreatif Matematis dan Pembelajaran Matematika Berbasis Masalah Open-Ended”. Universitas Sriwijaya. Jurnal Pendidikan Matematika, Volume 5. No.1. Januari 2014.

[23] Klavir dan Hershkovitz, S. 2015. “Teaching and Evaluating „Open-Ended“ Problem”. (online). (http://www.cimt.plymouth.ac.uk/journal/klavir.pdf). Diakses tanggal 25 Juni 2017.

[24] Lipson, M. Y. 1982. “Learning New Information from Text: The Role of Prior Knowledge and Reading Ability”. Journal of Reading Behaviour. 19 (3): 243-260.

[25] Lambertus, B. A, dkk. 2014. "Developing Skills Resolution Mathematical Primary School Students". International Journal of Education and Research. 2 (10): 601-614.

[27] Arikunto. 2010. "Prosedur Penelitian Suatu Pendekatan Praktik". Jakarta: Rineka Cipta.

[28] Sari, D. P. 2014."Peningkatan Kemampuan Berpikir Kreatif dan Self-Efficacy Matematis Siswa dengan Pendekatan Open-Ended di Junior High School 23 Terbuka Medan". Medan: Tesis. Program Pascasarjana State University of Medan.

[29] Rubiati, U. 2012. "Kemampuan Representasi Matematis dan Self-Efficacy Siswa Sekolah Menengah Pertama Melalui Pembelajaran dengan Pendekatan Open-Ended". Semarang: Universitas Negeri Semarang.

[30] Lili, dkk. 2015. "Peningkatan Kemampuan Koneksi Matematis dan Berpikir Kreatif Siswa Melalui Pembelajaran Open-Ended di SMP Muhammadiyah 03 Medan". Medan: Jurnal Tabularasa PPS Unimed Vol. 12 No. 1.

[31] Moma, L. 2014. "Peningkatan kemampuan Berpikir Kreatif Matematis, Self-Efficacy, dan Soft Skill Siswa SMP Melalui Pembelajaran Generatif". Bandung: UPI.