



Treffinger Creative Learning Model with RME Principles on Creative Thinking Skill by Considering Numerical Ability

Sabina Ndiung

STKIP Santu Paulus Ruteng, Jalan A. Yani No 10 Ruteng, Flores, Indonesia,
punyaku79@gmail.com

Nyoman Dantes

Prof., Universitas Pendidikan Ganesha, Indonesia, dantes_nyoman@yahoo.co.id

I Made Ardana

Prof., Universitas Pendidikan Ganesha, Indonesia, ardanaimade@undiksha.ac.id

A. A. I. N Marhaeni

Prof., Universitas Pendidikan Ganesha, Indonesia, ngurah_marhaeni@yahoo.com

This study aimed at finding out the effect of Treffinger creative learning model with RME principles on creative thinking skills by controlling numerical ability. This study was conducted to the fifth grade students of elementary schools in Manggarai regency using post-test only control group design of experiment. This study involved 101 fifth grade students as sample who were selected by using random sampling technique. The instruments were numeric ability test and creative thinking skill test. Data were analyzed by using ANCOVA aided by SPSS 23.0 program. The results showed that 1) the creative thinking skill of the students who learned mathematics Treffinger creative learning model with RME principles was higher than those who learned mathematics through conventional model, 2) the creative thinking skill of the students who learned through Treffinger creative learning model with RME principles was higher than those who learned through conventional learning model, after controlling numeric ability, 3) numeric ability gives a 33,2% contribution to the students' creative thinking skill. These findings show that Treffinger creative learning model with RME principles has a significant effect on the students' creative thinking skill. Mathematics teachers are suggested to employ this model in developing students' creative thinking skill.

Keywords: creative thinking skill, elementary school, numerical ability, RME principles, Treffinger creative learning model

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INTRODUCTION

Creative thinking skills are extremely important for daily problem solving including solving mathematics problems at the elementary school. Indeed, teachers are suggested to employ the appropriate approach to facilitate students' thinking process. Meanwhile, teaching and learning that occurred only emphasize the application of mathematics formulas and procedures can lead to students' weak reasoning and logic which cannot construct their thinking process (Kusaeri & Aditomo, 2019). Today's education should have been oriented to the 21st century education. To equip the students with the competencies needed in the 21st century, which are known as "four Cs", critical thinking and problem solving, communication and collaboration, and creativity and innovation (Partnership for 21st Century Skills, 2009; Setianingsih, Sa'dijah, & Rahman, 2017). A new standard is needed for the students to have the competence to meet the requirements of the context of core areas and the theme of learning and innovation skills, such as (1) critical thinking and problem solving, that is, the students are able to use various reasons such as inductive and deductive thinking for various situations using systematic thinking; (2) communicating and collaborating, that is, the students are able to communicate clearly and collaborate with other members in their groups and (3) creativity and innovation, that is, the students are able to think creatively, working creatively and creating new innovations.

One of the approaches to the learning mathematics at elementary school that is Realistic Mathematics Education (RME). RME is an approach in the learning of mathematics that offers a learning strategy by developing concepts through re-innovating the concepts based on the students' experiences and knowledge and helping them to solve mathematical problems (Gravemeijer, 1994; Akgul & Kahveci, 2016). This is supported by Makonye (2014) who claimed that RME helps learners to see the close relationship between mathematics conceptual knowledge and mathematical procedural knowledge. RME thus helps to diminish mathophobia and thus promotes productive disposition in mathematics which is the most important strand to promote meaningful learning of mathematics. Moreover, RME is assumed to be an effective in developing challenged activities (Karaca & Özkaya, 2017; Revina & Leung, 2018). Furthermore, Heuvel-Panhuizen reformulate six principles of RME: activity, reality, hierarchy, interconnection, interaction and guidance principles. Every principle has interconnections in guiding the students in learning mathematics meaningfully (Heuvel-panhuizen & Drijvers, 2014).

The use of RME approach in the learning of mathematics has been effective to enhance students' activity and their motivation in mathematics. A study done by Arsaythamby and Zubainur (2014) claims that RME can increase student's activity in learning mathematics in which through real contexts the students can construct their knowledge well through the teacher's guidance. Similarly, a study conducted by Zakaria and Syamaun (2017) reported that RME is better than conventional learning in terms of students' activity and their thinking process. Besides that, RME helps students to increase their affective factors, such as motivation, positive collaborative relationship

among students develop harmonious relations among students and between teacher and students (Ekowati, et al., 2015; Saleh, Prahmana, & Isa, 2018).

The description of RME approach in solving creativity problem that is oriented toward students' creative thinking is also supported by a learning model to handle the same problems that is oriented toward the development of students' creative thinking skill. The model is Treffinger learning model. This model contains creative learning techniques through steps that are arranged in three levels, that is, basic tools, practice with process, and working with problem (Munandar, 2002; Nisa, 2011). Treffinger's opinion that creativity thinking is a process of learning that attempts to find a creative learning process which is the process of learning that attempts to make the learning process as communicatively as possible to transform the learning situation into a comfortable one to make the learning situation become comfortable to the students (Treffinger, 1986).

Students' success is also determined by internal and external factors. Approach and learning model as external factors meanwhile internal factor related students' numeric ability. Numeric ability is an ability to handle the computation, pattern and logical thinking and scientific (Chen & Gardner, 2009). This is strengthened by research finding (Muntiari, Candiasa, & Dantes, 2013) who claimed that there is an interaction between RME approach and numeric ability. This means that numerical ability has a vital role in developing students' mathematic achievement. Thus, numeric ability as student's internal factor which affect toward creative thinking skill which is eligible to be controlled to know the pure effect from Treffinger creative learning model with RME principles.

Although previous researchers present convincing evidence that Treffinger creative learning model could develop students' creative thinking skill for adult learners, meanwhile, as it is widely convinced that RME approach is a suitable to be applied for teaching mathematics at elementary school students, then, it is important to investigate the effect of Treffinger creative learning model with principles of RME approach is integrated. The concept of the integration between Treffinger creative learning model with RME principles has not been conducted by researchers. Due to the characteristic of mathematics is an abstract, mathematics learning at the elementary school must be done by using realistic approach, but, it is conducted with creative strategy. Hence, the integration between Treffinger creative learning model with RME principles is an essential to be considered. In this paper, the concept of this integration is highly supported.

Research Focus

The aims of this study were : 1) to analyze the difference in creative thinking skill between the students who learned mathematics through Treffinger creative learning model with RME principles and those who learned mathematics through the conventional learning model ; 2) to analyze the difference in creative thinking skill between the students who learned mathematics through Treffinger creative learning model with RME principles and those who learned mathematics through the

conventional learning model; and 3) to find out the contribution of numeric ability to the students' creative skill.

CONTEXT AND REVIEW OF LITERATURE

Treffinger Creative Learning Model

Regarding to the orientation of creative and innovative learning, Donald J. Treffinger, in his book entitled *Encouraging Creative Learning for The Gifted and Talented*, said that creative learning is learning process that attempt a communicative teaching and learning process which is possible to create enjoyable learning atmosphere for students (Treffinger,1980). The students' creative thinking abilities which are different from one another require a learning condition involving a learning experience, so that the potential of creative thinking can develop. All students of different academic abilities can develop their creative thinking skills, if the learning environment provides an opportunity for the development of these thinking skills (Yusnaeni, Corebima, Susilo, & Zubaidah, 2017). In this learning, the material is presented through a game, discussion, role-play, demonstration, and assignment. Learning model which is oriented to the building of creative thinking skill is Treffinger learning model.

Treffinger's creative learning model accommodates learning creative techniques through the learning steps which is arranged in the three stages that is basic tools, practice with process, and working with problem (Munandar, 2002; Nisa, 2011). First stage is basic tools which covers a number of techniques as the basic for creative learning. The learning activity at this stage is propose the real students' problem which is based upon their experience and knowledge level, so students involve promptly in the meaningful learning with an answer in various solutions. Second stage, practice with process, that is students are given an opportunity to employ the skill which they got from stage I in the situation practice. And third stage, working with problem, that is employ the skills they got from previous stages toward the real-world challenge. Here, students use the ability through meaningful ways for their life.

The important steps in Treffinger creative learning model are 1) accommodating a variety of new ideas and seeing as many ways as possible to solve problems; 2) using ideas that involve thinking process and feeling; 3) using the creative feeling and thinking to solve problems (Darminto, 2013). The use of Treffinger model in learning has been supported by two study findings (Alfuhaigi, 2015) who concluded that the use of Treffinger learning model gives a positive contribution to the development or improvement in the students' creative thinking and mathematical problem solving. In addition, Treffinger creative learning model can be implemented in education, starting from elementary to university.

Realistic Mathematics Education (RME) Principles

Realistic Mathematics Education (RME) is a mathematic learning approach that has been developed by Freudenthal in Holland. According to Gravemeijer (1994) realistic mathematics education is rooted in Freudenthal's interpretation of mathematics as an activity. Gravemeijer's idea indicates that Realistic Mathematics Education (RME) has

been developed based upon Freudenthal's notion which highlights that mathematics as activities. The activities cover problem solving, find problem and organize core issue, which claimed by Freudenthal those as mathematization. RME is mathematics learning by using realistic approach which stimulate students more interest in learning mathematics due to nearby the students' real life.

In the context of this research, the steps used in the mathematics learning employed RME principles which have been developed by Marja van den Heuvel-Panhuizen. Heuvel-Panhuizen reformulate six principles of RME: activity, reality, hierarchy, interconnection, interaction and guidance principles (Heuvel-panhuizen & Drijvers, 2014). The activity principle focuses on students are treated as active participants in the learning process, the activities are dominantly done by students and the reality principle proposes the learning activity gets closer with students "real-life" problems. Moreover, the level principle underlines that learning mathematics means students should pass various levels of understanding: from informal context-related solutions, through creating various levels of shortcuts and schematizations, to acquiring insight into how concepts and strategies are related. Next, in the intertwinement principle concerns to the mathematical content domains such as number, geometry, measurement, and data handling are not viewed as isolated curriculum chapters but as heavily integrated. Students are offered lots of problems in which they can use their various mathematical tools and knowledge. Furthermore, the interactivity principle means that learning mathematics is not only an individual activity but also a social activity, then the guidance principle refers to Freudenthal's idea of "guided re-invention" of mathematics.

Treffinger Creative Learning Model with RME Principles

Treffinger creative learning model with RME principles in this study is an instruction that is deliberately designed by combining the stages in Treffinger creative learning model and RME principles. The three stages in Treffinger creative learning model and the six principles of the RME will collaborate with that result in the following integration: the basic tools stage uses reality principle and activity that will guide the students to the development of creative thinking skill in the fluency aspect. The practice and process stage uses the principle of interaction and principle of reality that directs the students to the development of creative thinking skill in the originality aspect. While, the working with problems stage uses the principle of guidance, the principle of hierarchy, the principle of interconnection that are assumed to be oriented to the development of creative thinking skill in the flexibility aspect. The syntax result of integrated Treffinger creative learning model with RME principles is the researchers own development which was not investigated previously. From the result of the collaboration a new syntax of Treffinger creative learning model with RME principles is formed with the details of its steps as shown in Table 1.

Table 1
The Syntax of Treffinger Creative Learning Model with RME Principles

The Syntax of Treffinger Learning Model	The Syntax of Treffinger creative learning model with RME principles
<i>Basic Tools</i> Starting the lesson by posing a problem (a real problem) for the students which suits their experience and level of knowledge, so that they will be immediately engaged in the lesson in a meaningful way with an answer that is more than a solution	<i>Basic Tools</i> 1. The principle of reality Posing a problem (a realistic problem) according to the context for the students which suits their experience and level of knowledge 2. The principle of activity a. The students are actively engaged, both mentally and physically in a more meaningful mathematics lesson. b. The students actively solve the problem with a solution which is more than a solution
<i>Practice with process</i> Guiding and evaluating, that is assisting the students participating in a discussion to express their ideas and at the same time to make an evaluation according to the objective which is oriented to the objective expected from the lesson Making an example of problems in the daily life	<i>Practice with process:</i> 3. The principle of interaction & principle of reality a. Forming a group discussion (small or large) to solve a problem b. Facilitating the students in problem solving in the group discussion c. Making an example of problems in the daily life d. Giving the opportunity to present a strategy for solving the problem to other members to be responded and listening to what are found by other members and their strategies to find them and responding to them e. Making an evolution of the result of the group discussion
<i>Working with real problems</i> Developing a lesson that proceeds interactively Posing a problem in the daily life Guiding the students in making questions and solving them individually Guiding the students to mention the steps in solving a problem Giving a reward.	<i>Working with real problems</i> 3. Principle of guiding a. Creating conducive learning atmosphere for the students to construct their mathematical knowledge based upon daily life problems interactively. b. Guiding the students in making questions and their solutions individually c. Giving an opportunity to the students to re-invent the questions and solutions with the help from the teacher. 4. The principle of hierarchy The students are able to find a solution to a contextual or realistic problem informally, through a schematization to gain an insight into fundamental things until they are able to find the solution to a mathematical problem formally (horizontal and vertical mathematical process) 5. The principle of interconnectivity a. To make connections of various aspects or topics in mathematics in order the students can see relations among the materials between better in such a way that they can be stored in their long term memories b. Giving rewards to the students for their work.

Creative Thinking Skill

Innovations in learning practices, especially in developing creativity are still relatively rare. On the other hand, creativity is an important component in learning and helps individuals in solving their problems in daily life (Saavedra & Opfer, 2012). Torrance (Mann, 2006; Scott, 2015) relates creativity to moral commitment, self-confidence,

ability to see problems from different perspectives, and ability in finding different solutions. Darminto (2013), for example, states that creativity is an ability to find ideas and new symbols, in improvising stable ideas and symbols, reorganizing them into new ones. Similarly, Honeck (2016) argue that creativity is an effort to relate objects or ideas which were previously unrelated. Thus, creativity is able to make people think creatively. According to Hwang, Chen, Dung & Yang (Runish, Herman, & Dahlan, 2016) creative thinking is one of the types of thinking that is oriented toward the attainment of new insights, new approaches, new perspective or new ways in understanding something.

The components of creative thinking skill are fluency, flexibility, and originality (Alfuhaiqi, 2015; Honeck, 2016; Mann, 2006; Sriwongchai, Jantharajit, & Chookhampaeng, 2015; Vale & Barbosa, 2015). Fluency refers to the facility to produce many ideas during the creative thinking process. Flexibility refers to the ability to leave the old way of thinking and adopt new ideas or ways of thinking. Flexibility is also shown by the variety of the ideas developed. On the other hand, originality refers to the ability to produce unpredictable or unique ideas. Creativity and innovation will become increasingly more developed if the student has a unique opportunity to use divergent thinking (Scott, 2015). The students have to think outside of the existing habits, involving new ways of thinking, obtaining opportunities to communicate new ideas and solutions, asking uncommon questions, and attempting to give assumed answers.

Numerical Ability

Logical-mathematical intelligence involves numerous components: mathematical calculation, logical thinking, problem-solving, deductive and inductive reasoning, and the discernment of patterns and relationship. They are mathematical computation, thinking logic, problem solving, deductive and inductive reasonings and ability to differentiate patterns and relations. The components are very important in mathematics learning at school (Brualdi, 1996).

Numerical ability is the ability to handle numbers and mathematical computation, patterns and logical and scientific thinking. Gardner states that logic-mathematical ability is the ability to manage a long thinking chain. This intelligence covers the ability to process numbers, mathematics, and other things that are related to number (Roesdiyanto, 2014). Numerical ability is one of the factors that supports the attainment of the students' creative thinking skill, that is, speed and carefulness in doing the computation. All activities in learning mathematics are based on counting ability for the students with a high numeric ability they tend to be quicker in doing the counting operation than those with a low numerical ability (Pica, Marhaeni, & Dantes, 2015) Hence, in the Treffinger creative learning model with RME principles that tends to involve students actively in groups will obviously favor the students with a high numeric ability. However, in the conventional learning model, the students with a high numeric ability will feel comfortable when taught in that way. Thus, in this study it is assumed that numeric ability has a strong correlation with creative thinking skill so that it is appropriate that it is controlled to see the pure effect of Treffinger creative learning model with RME principles on the students' creative thinking skill.

METHOD

Design

This study was a quasi-experiment research with post-test only control group design. The study was aimed at investigating the difference in creative thinking skill between the experiment group and the control group. The experiment group was treated with Treffinger creative learning model with RME principles while the control group was treated with the conventional learning model. This study consisted of three stages, i.e., pre-experiment, experiment, and post-experiment. The treatment was done in eight meetings, both for the experiment group and the control group which was then ended with a posttest to measure the students' creative thinking skill.

Population and Sample

The population of this study consisted of all the fifth-grade students throughout Lelak district with the total of 11 schools (n= 383). The sampling was done using random sampling technique. The sample of the study consisted of SDI Watu Weri and SDN Weri Pateng (n=101). SDI Watu Weri was used as experiment group and SDI Weri Pateng as control group. During the treatment the students solved problems, both individually and in group using student's worksheet in the topic of fraction operation.

Data Collection and Analysis

Data in this study were obtained from the scores in numeric ability and creative thinking skill of the students. For the assessment rubric (La Moma, 2015) with the 0-4 scale was used. Content validity test instruments used were validated by 5 experts with analyzed by using CVR (content validity ratio) which has been developed by Lawshe (Lawshe, 1975) and their validity and reliability have been tested using validity test and reliability test. The creative thinking skill test has 5 essay items (reliability = 0.891) and the numeric ability test has 35 multiple choice items (reliability = 0.79). The data were analyzed using the Analysis of Covariate (ANCOVA) that was preceded by the assumption tests, i.e., distribution normality test and group homogeneity variance test aided with Statistical Package for the social Sciences (SPSS) for windows version 23.0.

FINDINGS

The hypotheses tested in this study were 1) the creative thinking skill of the students who learned mathematics through Treffinger creative learning model with RME principles is higher than that of those who learned mathematics through the conventional learning model; 2) the creative thinking skill of the students who learned mathematics through Treffinger creative learning model with RME principles is higher than that of those who learned through the conventional learning model, after numeric ability is controlled, and 3) there is a contribution of numeric ability to the students' creative thinking skill. The result of descriptive statistical analysis can be seen from Table 2.

Table 2
Recap of Descriptive Statistical Analysis

Variable	Group	N	Mean	Median	Stand.De.	Var	Range	Min	Max
Numeric Ability	Experiment	51	68.78	69	7.37	54.33	34	46	80
	Control	50	68.52	69	7.29	53.15	32	51	83
Creative Thinking Skill	Experiment	51	67.84	70	10.87	18.25	45	40	85
	Control	50	58.8	60	9.98	99.55	40	35	70

Based on the data in Table 2 above, it can be said that the mean score for creative thinking ability of the students who learned mathematics through Treffinger creative learning model with RME principles is higher than those who learned mathematics through the conventional learning model. Then, assumption tests were conducted, i.e., data distribution normality test, data group variance homogeneity test, and data linearity test. Based on the result of the assumption tests was obtained that the sig values of the data are higher than 0.05. Thus, it can be said that the data have a normal distribution, homogeneous variance and have a linear regression. To test the first hypothesis T-test was used, result of variance analysis using SPSS 23.0 can be seen in Table 3 below.

Table 3
Recap of Variance Analysis

Tests of Between-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	2064.700 ^a	1	2064.700	23.794	< .001	
Intercept	404932.027	1	404932.027	4.6663	< .001	
Learning model	2064.700	1	2064.700	23.794	< .001	
Error	8590.745	99	86.775			
Total	416200.000	101				
Corrected Total	10655.446	100				

a. R Squared = 0.194 (Adjusted R Squared = 0.186)

References to analysis it was obtained that $F_{obs.} = 23.794$ and sig. value < 0.001 . Since sig < 0.05 , then it can be concluded that the creative thinking skill of the students who learned mathematics through Treffinger creative learning model with RME principles is higher than that of those who learned through the conventional learning model. The result of the testing of the second hypothesis can be seen in Table 4 below.

Table 4
Recap of the Covariate Analysis

Tests of Between-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	
Corrected Model	6772.207 ^a	2	3386.104	85.454	< 0.001	
Intercept	185.286	1	185.286	4.676	0.033	
Numeric Ability	4707.507	1	4707.507	118.802	< 0.001	
Learning Model	1927.079	1	1927.079	48.633	< 0.001	
Error	3883.238	98	39.625			
Total	416200.000	101				
Corrected Total	10655.446	100				

a. R Squared = .636 (Adjusted R Squared = .628)

Based upon data described above table, it is obtained that the Fvalue = 48.633 and sig = 0.001. By looking at the sig value < 0.05 it means that the students' creative skill of the students who learned mathematics through Treffinger creative learning model with RME principles is higher than that of those who learned mathematics through the conventional learning model, after numeric ability is controlled. The multitude of the contribution of numeric ability to creative thinking can be seen in Table 5.

Table 5
Contribution of Numerical Ability

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.582 ^a	.338	.332	5.90718

a. Predictors: (Constant), Numeric ability

Then the result of analysis shows that numeric ability gives a $0.332 \times 100\% = 33.2\%$ contribution to students' creative thinking skill. This means that a variation in creative thinking skill is around 33.2%, which can be accounted for by the numeric ability covariate, and the rest by other variables that were not investigated.

DISCUSSION

The main aim of this study was to get a description of the effect of Treffinger creative learning model with RME principles on the students' creative thinking skill with numeric ability as covariable. The result of the study shows that Treffinger creative learning model with RME principles has a significant effect on the students' creative thinking skill after the students' numeric ability is controlled. This result confirms the study done by Rohaeti and Priatna (2017); Nisa (2011) that concluded that Treffinger model can give a positive contribution to the development of students' creative thinking skill and mathematical problem solving ability.

This finding proves that Treffinger creative learning model with RME principles gives a positive effect on the development or an increase in the students' creative thinking skill. The positive effect is obviously influenced by the three stages of the Treffinger learning model that is integrated with the six principles of RME. In conformity to the study by Arsaythamby & Zubainur (2014); Zakaria & Syamaun (2017), this study concludes that Treffinger RME approach is better than conventional approach. This study result also supports Treffinger's opinion that creative thinking is a process of learning that attempts to find a creative learning process which is the process of learning that attempts to make the learning process as communicatively as possible to transform the learning situation into a comfortable one to make the learning situation become comfortable to the students (Treffinger, 1986).

At the basic tools stage that uses the principle of reality and the principle of activity, here the students are able to make a realistic problem that is related to addition and subtraction, multiplication and division of fractions with using their own ways based on the knowledge that they have. The basic tools stage by using the principle of reality and

the principle of activity can guide the students toward the development of creative thinking skill in the proficiency aspect. Here the students are able to solve problems well and when they get stuck they will ask for help from their peers who are more able or the teacher. This is in line with Vygotsky's ZPD concept that states that ZPD (zone of proximal development) is the zone in which the students cannot finish difficult tasks to be mastered by themselves, but can be mastered using guidance and help from adults or more able students. In this case, ZPD is a distance between the level of real development shown in the ability to solve problems alone and the level of the potential development ability shown in the ability to solve problems with the help from adults or by working together with more able peers (Christmas, Kudza, & Josiah, 2013; Siyepu, 2013).

Then, at the practice with process stage by using the principle of interaction, the students are able to cooperate with the team members in a large group to finish the task assigned and the problem constructed by the students themselves using different ways than the usual way. The practice with process stage directs the students toward the formation of creative thinking skill in the aspect of originality. This process refers to Vygotsky's constructivist theory in which learning is the most effective when the students can relate what they learn to the environment and by creating meanings from different experiences (Sze-yeng, Maznah, & Hussain, 2010; Zain, Rasidi, & Abidin, 2012).

While at the stage of working with real problem, this stage is integrated with the principle of guidance, the principle of hierarchy and the principle of interconnectivity. At this stage, through guidance, the students can solve the problems using more than one way. At this stage, the students are able to find a solution to a realistic problem informally, through schematization and get an insight into fundamental things until they are able to find a solution to a mathematical problem formally (the horizontal and vertical mathematizations). The emphasis here is that the students think creatively with a variety of problem solutions according to their ability, using their own ways according to the conceptual and procedural knowledge that they have. The working with real problem stage directs the students to the formation of creative thinking skill in the flexibility aspect. The process of problem solving using this stage starts from the concrete stage to the abstract. This is in conformity with Piaget's view that the elementary school aged students (7-12) are at the concrete operational phase and the knowledge is developed in the child's mind through the process of assimilation and accommodation (Richland, Frausel, & Begolli, 2016).

CONCLUSION

The research finding supported the theory and the previous researches stating that implementation of Treffinger creative learning model with RME principles effective toward students' creative thinking skills. The findings of this study showed that 1) the creative thinking skill of the students who learned mathematics through Treffinger creative learning model with RME principles was higher than that of those who learned through the conventional learning model; 2) the creative thinking skill of the students who learned through Treffinger creative learning model with RME principles was higher than that of those who learned through the conventional learning model after

controlling numerical ability; and 3) there was a 33,2% contribution of numeric ability to the students' creative thinking skill. Based upon the findings, this research strongly recommended to be continued on the subject of fraction or other materials at primary schools.

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