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Creative Mathematical Thinking Ability Viewed from the Student Learning Styles in Treffinger Model

Yane Irna Setianingsih[1]✉, St. Budi Waluya[2] & Dwijanto[2]

[1] Universitas Muhammadiyah Magelang, Indonesia
[2] Universitas Negeri Semarang, Indonesia

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Abstract

This study aims to determine the effectiveness of Treffinger Model in achieving the student's creative mathematical thinking ability and their ability viewed from the students' learning styles. The type of study used was a mixed-method design of sequential explanatory. The first stage was quantitative data collection, and it was done using questionnaires to categorized the subject and tests. The next stage was qualitative data collection, and it was done using triangulation techniques such as questionnaires, tests, and interviews. The study population was the grade V Public Elementary School Gondangrejo, Magelang. Samples were grade VA as an experimental class with 20 students, and grade VB as the control class with 20 students. The results of this study indicated that Treffinger learning model effectively improved the ability of creative thinking viewed from the students' learning styles, this is indicated by the mathematical creative thinking ability of the experimental class students reaches the minimal past score, the mathematical creative thinking ability of the experimental class students is better than the control class, the creative thinking ability of students of divergent learning styles and convergent learning styles are at the 4th level or very creative and students' creative thinking abilities assimilation and accommodation learning styles are at 3th level or creative.

✉ Correspondence address:
Tidar No.21, Magersari, Magelang, Jawa Tengah, 59214
E-mail: yaneirna10@gmail.com

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INTRODUCTION

Tsai, and Shirley (2013) explain that in mathematics, problem-solving serves as an important forum to spark creative thinking. Siswono (2011) explains that creativity is the product of creative thinking, while creative thinking is an activity aimed at encouraging or bring creativity. Arvyati, Ibrahim, and Irawan (2015) describes that student's creativity is the ability to see the relationship between the previous objects, then able to create something new or give new ideas that can be used to solve the mathematics problems. It means that creativity is the ability to think and act unusually, a new way to solve the problems with his ideas.

According to Munandar (2014) cited by Azhari, and Somakim (2014) there are four criteria in the assessment of creative mathematical thinking ability. They are fluency, flexibility, originality, and elaboration. Siswono (2011) states that creative mathematical thinking ability level consists of five levels. They are 4^{th} level (very creative), 3^{rd} level (creative), 2^{nd} level (quite creative), 1^{st} level (less creative), and 0^{th} level (not creative).

Guilford (Munandar, 2014) argued that creativity or creative thinking is the ability to see all kinds of possible solutions to solve a problem, that is still not getting the attention in education. According to Florida, Mellander, and King (2015) from the Martin Prosperity Institute, on the creative's indicators such as technology, talent, and tolerance, Indonesia is ranked 115 of 139 countries.

According to Florida, Mellander, and King (2015) from the Martin Prosperity Institute, the research about Indonesian students' thinking skills is still low and needs to be developed. This is supported by the results of the initial creative mathematical thinking ability test given by researcher to the students of fifth grade Public Elementary School Gondangrejo, Magelang. The test showed that their ability was so low. The students were not able to complete the work, did not generate a lot of ideas, just one alternative answers, and the results of their work were unclear and incorrect.

The results of creative mathematical ability test, it indicated that the students have not creative mathematical thinking ability. The results of the interview on the students also explained that the students found the difficult to generate a lot of ideas; students tend to answer incorrectly. Students were accustomed to working on an idea without trying to think of other ways to resolve the problem.

Lack of students' creative mathematical thinking ability was also affected by errors in student learning style. Most of the students didn't know their learning style that suits their personality. Firdausi, Asikin, and Wuryanto (2018) describes that the learning style that is less suited to the personality of students resulted in students difficulties to face the mathematics problem. Felder, and Brent (Alkathiri, Alshreef, Alajmi, Alsowayan, and Alahmad, 2018) describes that the learning style is the preferred method for someone to learn about how to obtain some information.

Kolb, A. Y., and Kolb, D. A. (2005) identified four learning styles. They are divergent, assimilation, convergent, and accommodation. Divergent learning style is combinations of Concrete Experience (CE) and Reflective Observation (RO). Divergent learning styles see concrete situations from different perspectives — assimilation learning styles are combinations of Abstract Conceptualization (AC) and Reflective Observation (RO). Assimilation learning styles focus less on human. Assimilation is more interested in ideas and abstract concepts. Convergent learning styles are combinations of Abstract Conceptualization (AC) and Active Experimentation (AE). Convergent learning style is best at finding the practical utility of the ideas and theories. Accommodation learning style is combinations of Concrete Experience (CE) and Active Experimentation (AE). Learning style accommodation has the advantage of learning from direct experience.

In addition to learning styles, a learning model that can encourage creative thinking ability is a Treffinger model. Treffinger model is a way of creative learning through the basic creative functions to more complex (Wirahayu,

Purwito, and Juarti, 2018). Muhaiminu, and Nurhayati (2016) also describes that Treffinger model which help students creative thinking to solve problems, master the concepts of the material being taught and provide an opportunity to demonstrate the potential ability of creativity to solve problems. It means that through Treffinger model, students were given the freedom to resolve their problems the way they want it creatively.

Based on the description above, there are several problem formulations proposed in this study, including the following: (1) how are the effectiveness of Treffinger model in achieving the student's creative mathematical thinking ability, and (2) what are the patterns of creative mathematical thinking abilities viewed from student learning styles.

The purpose of this study to determine: (1) describe the effectiveness of the Treffinger model in achieving the student's creative mathematical thinking ability, and (2) determining the patterns of creative mathematical thinking abilities viewed from student learning styles.

METHODS

The population in grade V Public Elementary School Gondangrejo, Magelang by taking two classes as the experimental class and control class. The experimental class was the class that used Treffinger model, whereas, the control class was the class that used the Discovery Learning model. The research used mixed methods, with explanatory sequential design. Collected data by using post-test only control and using purposive sampling techniques. The qualitative research subject was taken from the experimental class with students of divergent learning style, students of assimilation learning style, student of convergent learning style, and students of accommodation learning style.

The data collection of this study consisted of a quantitative data collection and qualitative data collection. Quantitative data collection used creative mathematical thinking ability tests and questionnaires. Qualitative data collection used interviews creative mathematical thinking ability. There were two kinds of analysis data. Analysis of quantitative data consists of the normality test, homogeneity test, and median equality test at the initial data. In the post-test of creative mathematical thinking, ability consists of normality test, homogeneity test, and hypothesis testing in a matter of post-test creative mathematical thinking ability. The hypothesis of this study was the completeness test of creative mathematical thinking ability in the experimental class with one way t-test, the test of different creative mathematical thinking abilities by t-test. For the analysis of qualitative data used triangulation techniques such as questionnaires, tests, and interviews.

RESULTS AND DISCUSSION

The Effectiveness of Treffinger Model in Achieving the Student's Creative Mathematical Thinking Ability

Initial research data

Three tests were conducted for the initial data analysis, namely the normality test, the homogeneity test, and the average similarity test. Normally test results showed that the sig values of the two sample classes in the Kolmogorov-Smirnov test being 0.170 and 0.088 both greater than 0.05 so that H_0 is accepted. Therefore, the initial data are normally distributed both experimental class and control class. In the homogeneity, it was obtained that the sig value of the sample class is $0.275 > 0.05$ so that H_0 is accepted. Therefore, the initial capability data has a homogeneous variance in creative mathematical thinking ability, both experimental class and control class. In the average of two similarity test obtained a sig value of $0.393 > 0.05$ so that H_0 is accepted, which means there is no difference in the average initial creative mathematical thinking ability in the experimental class and the control class.

Grouping of students in an experimental class

Based on the results of student learning styles questionnaire experimental class students obtained the fact that each student has a different

learning style. The grouping of students based on their learning styles can be seen in table 1.

Table 1. Percentage of Students' Learning Styles Grouping

Learning styles	Number of students	Percentage (%)
Divergent	2	10
Assimilation	5	25
Convergent	7	35
Accomodation	6	30
Total	20	100

Based on table 1 it can be seen that the divergent learning styles have 10% (2 students), the assimilation learning styles has 25% (5 students), the convergent learning styles has 35% (7 students), and the accommodation has 30% (6 students). Table 1, the results of the questionnaire learning styles, students at a most convergent percentage, then the second-largest is student accommodation and student assimilation in third place, as well as divergent students at least — many fewer the number of students each learning style, signifying that each student has different characteristics.

Post-test of research data

Before testing the hypothesis, a prerequisite test was first performed, namely the normality test and the homogeneity test, to determine the statistical test that will be used in the parametric test hypothesis or the nonparametric test.

Normally test results showed that the sig values of the two sample classes in the Kolmogorov-Smirnov test being 0.200 and 0.200 both greater than 0.05 so that H_0 is accepted. Therefore, the post-test are normally distributed in creative mathematical thinking ability, both experimental class and control class.

In the homogeneity, it was obtained that the sig value of the sample class is 0.460 > 0.05 so that H_0 is accepted. Therefore, post-test data has a homogeneous variance, both experimental class and control class.

The next is a hypothesis test, t-test result of completeness ability to thinking creatively in experimental. The test result showed that t_{value} = 0.522 with a significance level of 5% = 0.05, and t_{table} = 0.172. So then $t_{value} \geq t_{table}$, H_1 is accepted, which means the students' creative mathematical thinking ability in the experimental class meets the minimal pass score, which was ≥ 70.

The next hypothesis is the average difference test done using a t-test to test the average creative mathematical thinking ability of the experimental class compared to the control class. From the calculation results obtained $t_{value} = 0.84 \geq t_{table} = 0.202$ with a significance level of 5%, then H_0 is rejected and $H_1$is accepted, which means that the average creative mathematics thinking ability in an experimental class of more than average ability to control class.

The test results based on hypothesis showed that learning using the Treffinger model is effective in achieving the creative mathematical thinking ability of students. The learning's effectiveness is the benchmark in determining the success of learning. This is shown because the experimental class taught the creative mathematical thinking's steps, while control class that using Discovery Learning model did not teach any step of that.

This study is in line with Azis, Zulhelmi, and Syahril (2018) that the student's understanding using Treffinger model in the category of effective and the quality of students' creative thinking ability increased, it's proven that Treffinger model is good in improving the ability to think creatively.

Following the study of by Sari, and Putra (2015) the Treffinger models influence students' ability to creative thinking. This is because there is a possible influence of the techniques in step Treffinger model techniques learning model Treffinger compatibility with indicators of creative mathematical thinking abilities.

The Creative Mathematical Thinking Ability Viewed from Student's Learning Styles

Divergent learning style

Pratiwi, Widyarini, Yusainy, Marianti, and Rahmawati (2013) explains that diverges students learn through concrete experience, which means the students learn openly and adaptively to the change. The divergent student has the reflective observation thathelps them to learn from few perspective in the search of

something. The post-test result of divergent students can be seen in figure 1.

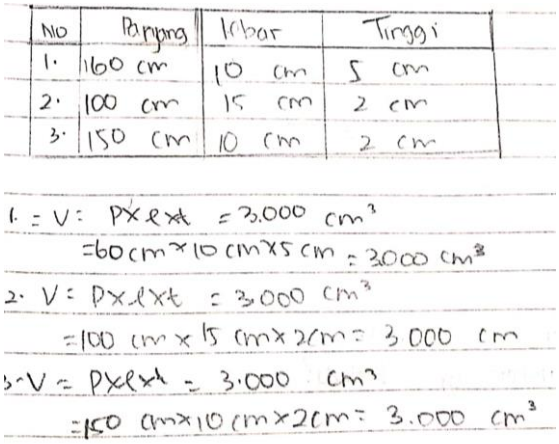

Figure 1. Post-test Divergent Learning

Based on figure 1, it can be seen that subject solved the problem correctly, find more than two alternative answers, they determine the formula correctly and doing the calculation correctly, but write the final answer incompletely. The achievement of creative mathematical thinking indicators showed that the subject has three indicators such as fluency, flexibility, originality in a very good category but good enough in elaboration. This result showed that divergent subject-categorized as 4th level in creative mathematical thinking ability.

Assimilation learning style

According to Richmond, and Cummings (2005) assimilation student learning through reflective observation, they learn to make an opinion by deeper thinking. In line with the experts, in this study, assimilation students could easily give another example to some problem that was shown by the teacher correctly. They learn through abstract conceptualization, which means they can focus and systematically plan something. Tandiayuk (2012) describes the assimilation students is good at summarizing logically and clearly. The post-test result of assimilation students can be seen in figure 2.

Based on figure 2, assimilation student could write their answer correctly, but too similar to one another as to how they draw the bar. It has different size but the same shape. Assimilation student complete three indicators (flexibility, originality, and elaboration) in a moderate category, but have low fluency. This result showed that divergent subject-categorized as 3rd level in creative mathematical thinking ability.

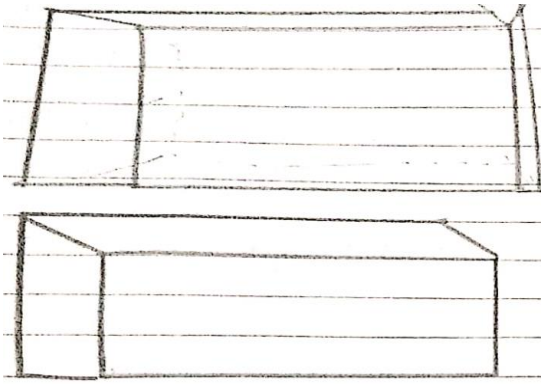

Figure 2. Post-test Assimilation Learning

Convergent learning style

According to Richmond, and Cummings (2005) state that study through a combination of abstract conceptualization and active experimentation. Students through abstract conceptualization will be learned by focusing on something systematically. A convergent student wrote an answer in a systematic, sequential, and clear way. Students learn in active experimentation convergent, and convergent student tends to be strong in the face of something new and take risks. Convergent students showed that they could provide new sample questions. The post-test result of convergent students can be seen in figure 3.

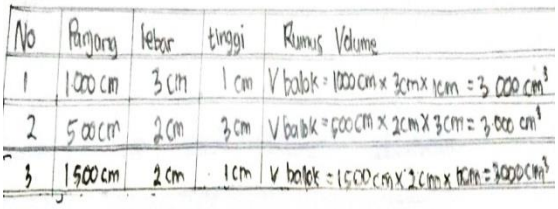

Figure 3. Post-test Convergent Learning

Based on figure 3, the convergent subject had three alternative answers. Convergent subject had their answers. From the answers, convergent student meets indicators of originality. Convergent student could develop the ability the answers. The result post-test convergent learning

can prove that convergent student has four indicators (fluency, flexibility, originality, and elaboration).

The results are consistent from research by Firdausi, Asikin, and Wuryanto (2018) the convergent student was able to have all the indicators of creative thinking. They are fluency, flexibility, originality, and elaboration.

Based on the research, convergent learning style has the advantage of creative thinking. The convergent learning style has the best convergent in finding ideas and theories. The convergent student was able to find an idea to solve the problem. This result showed that convergent subject-categorized as 4th level in creative mathematical thinking ability.

Accommodation learning style

According to Richmond, and Cummings (2005) accommodation student tends to learn through concrete experience, which means that students learn through newly gained experiences. Accommodation students learn through active experimentation, where students learn to take new actions and take risks boldly. The post-test result of accommodation students can be seen in figure 4.

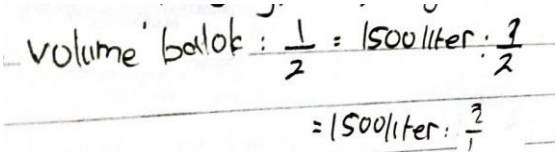

Figure 4. Post-test Accommodation Learning

Based on figure 4, accommodation subject had they're first encountered with a new problem, they could determine the formula correctly, but doing the calculation incorrectly, still, they dare to give the wrong answer. Accommodation student complete three indicators (fluency, flexibility, and originality) in a very good category, but have low elaboration. This result showed that divergent subject-categorized as 3rd level in creative mathematical thinking ability.

CONCLUSION

Based on the results of research and discussion showed that the convergent student always has the highest achievement of creative thinking, divergent student and accommodation student have a similar achievement of creative thinking. While the assimilation student has the lowest achievement of creative thinking. In this research, we obtained a new finding that divergent students and convergent student thinking ability almost have the same creativity. And for assimilation student and accommodation student have similar creativity thinking ability as well.

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