

## Mathematics Creative Thinking Skills Reviewed from the Students' Self-Confidence by Implementing the Treffinger Learning Model Assisted by Geogebra

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### Abstract

Creativity and self-confidence play important roles in learning mathematics. Treffinger learning model was believed to facilitate the strengthening of both aspects. This learning model theoretically will be more meaningful if it is supported by software that can help visualize the mathematics concept. That choice is the Geogebra software. This research aimed to describe the mathematics creative thinking skills reviewed from self-confidence aspects of 7<sup>th</sup> grade students. The study was mixed-methods research with a sequential explanatory design. There were 30 students involved in this study. They were taken based on three self-confidence categories: high, moderate, and low level. The quantitative data collection technique used creative thinking test and the qualitative data collection techniques were questionnaire and interview. The findings shown that (1) the learning outcome by implementing Treffinger assisted by Geogebra was effective, (2) in terms of mathematics creative thinking skills process aspect, the students with high self-confidence could master all indicators well. Students with moderate self-confidence only could master three aspects. They were fluency, flexibility, and elaboration. The low self-confidence students only mastered fluency and elaboration aspects. Based on the findings, it can be concluded that Treffinger learning model could improve the students' mathematics creative thinking skills reviewed by their self-confidence

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## INTRODUCTION

The education process in this era should be developed to create a well-prepared generation that could engage the era advancement and dynamic challenges. Mathematics is an important science in developing science and technology.

One of the educational objectives to be developed, according to the Regulation of Education and Culture Ministry (2016) is a creative thinking skill. Creativity is a required skill in the 21<sup>st</sup> century. It is also stated in the 2013 curriculum. It requires the students to apply a concept individually with the expectation to develop their creative thinking skills through the obtained learning experience. Creative thinking is important to have for students. It is to compete with the advanced world. Therefore, creativity is the capital to face the challenge and should be mastered by students (Atikah, 2018 & Utami, 2018).

Creativity is an interactive process among individuals in an environment. It takes form into the concerned individual's skills to create a notion or an idea to solve mathematics problems (Munandar, 2012). According to Manurung (2018), creative thinking skill is an individual's skill to find a solution, strategy, or new idea to solve a certain problem. According to Munandar, as quoted in Azhari and Somakin (2013), there are 4 assessment criteria of mathematics creative thinking skills. They are fluency, flexibility, originality, and detail. Mathematic creative thinking skill is strongly required because it has structures and strong connections among the concepts. Thus, it allows students to habituate in developing creative thinking skills to solve problems.

According to the Program for International Student Assessment (PISA) in 2018, the mathematics creativity of the Indonesian students was in the 72<sup>nd</sup> rank out of 78 participating countries. Meanwhile, according to Trends in International Mathematics Science (TMSS) in 2015, the Indonesian students' achievements were in the 45<sup>th</sup> rank out of 50 participating countries with a

point of 397. Such low result, according to TIMSS in Indonesia, shows the low levels of the students' creative thinking skills. According to Puspitasari (2019), there is a significant correlation between creative thinking skills and students' learning achievements.

Based on the findings, the students' mathematics creative thinking skills in Indonesia need to be developed. Another finding to support this finding could be seen on the seventh graders of Kedungwuni 02 Junior High Schooln(JHS), Pekalongan municipality. They still had difficulties in working on problem-solving skill questions correlated to creative thinking skills. The works of the students showed the students had not been able to complete the questions with the accurate problem-solving stages. They could only provide an alternative with an inaccurate answer.

Based on the students' works, it could be stated that the mathematics creative thinking of the students to solve mathematics problems had not been adequate. The interview results with the students explained that the students still had difficulties in sharing their arguments. They had not been habituated to work on essay questions in the form of problem-solving questions for more than one solution.

Mathematics creative thinking skill is also required to adjust an individual everywhere and not only in the educational setting. According to Waluya (2012), an individual's success is not only determined by the cognition but also the skill to manage himself. Self-confidence is an important part of individuals in mathematics learning because by having confidence, the learning achievement would also improve (Khun-Inkeeree, 2017).

Self-confidence is an individual's attitude to foster positive judgment either for himself or his surrounding environment (Suryani, 2018). The self-confidence of learning could be easily developed when the teacher applies an appropriate learning scenario based on the students' autonomy.

The main support of a successful process in the learning is due to the teacher's capability to apply an appropriate and varied learning

model, to teach properly, and to provide an excellent question (Rochmad & Masrukan, 2016). One of the learning models that allow individuals to learn optimally and support mathematics creative thinking skills is the Treffinger learning model. The Treffinger learning model is a learning that is directed to creative thinking skills. It is expected to develop better students' creative thinking skills (Sara et al, 2018).

This learning concept provides opportunities for students to understand the various problem-solving concept, to develop the students' skills in thinking and explaining problems, to collect data, to analyze, to create notion, and to try various problem-solving. Thus, the students could apply it in the future (Maharani, 2018). This learning model has three levels. They are basic creative thinking, moderate creative thinking, and higher creative thinking. In the first stage, students could think differently without being afraid of rejected. On the next stage, they are trained with a process. They are given a complex problem to create cognitive conflict. It allows students to give the best of their potentials to solve problems. Finally, the students will cooperate to solve

problems. It will involve their thoughts in real life and encourage them to find the solution by themselves (Alhaddad, 2018).

Another alternative learning is using a learning medium. One of the applicable software to facilitate and improve students' creative thinking skills and confidence is Geogebra. It is interactive and dynamic software that allows students to explore a certain mathematics concept. Thus, it could stimulate their creative thinking skills in learning geometry (Atikasari, 2015). Geogebra is a mathematics software with a dynamic geometry system to construct the dots, angles, vectors, segments, areas, perimeters, and two-dimensional figures (Saputra, 2016).

One of the materials or concepts taught for the students in this research, assisted by Geogebra software, was finding out the numbers of triangle angle concepts. It had a purpose to facilitate students to find, express, and create their representations and notions thus their understanding of mathematics concepts will be more meaningful. Here is one example of the two-dimensional figure shown in Geogebra that was used to find the concept of the triangle angle numbers as in Figure 1.

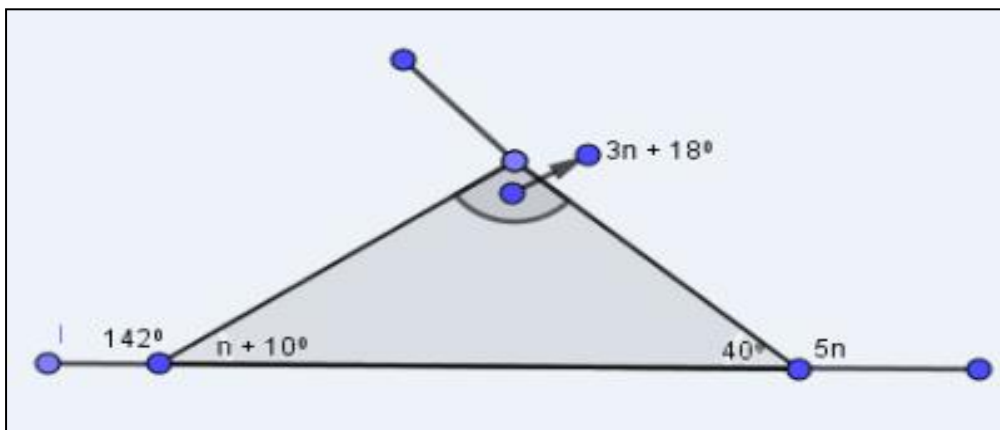


Figure 1. The Geogebra Display

Based on the background, the investigated problem dealt with the students' mathematics creative thinking skills in the Treffinger learning assisted by Geogebra, reviewed from their self-confidence. This research aims to describe the students' mathematics creative thinking skills in

Treffinger learning, assisted by Geogebra, reviewed from their self-confidence.

## METHOD

This mixed-methods research applied a sequential explanatory design. It is a research

procedure by collecting the data and analyzing the first-stage qualitative data. It is followed by the next-stage data collection and qualitative data analysis (Cresswell, 2009). This research was carried out in Kedungwuri 02 Public JHS, Pekalongan Municipality. The sample was taken from the VII E as the experimental group and VII F as the control group. The subjects consisted of 6 graders of class VII E from each self-confidence category, consisting of 2 students for each category. They were taken by purposive sampling.

The data consisted of quantitative and qualitative data. The quantitative data collection technique was done by promoting a mathematics creative thinking skill test. The qualitative data was obtained by using a questionnaire of self-confidence, interview, and documentation. Quantitative data analysis was used to examine the learning model effectiveness. It consisted of the average completeness test, the proportional completeness test, the test of self-confidence influence, and the average difference test toward the mathematics creative thinking skills. To analyze the qualitative data, it consisted of data reduction, display, and conclusion.

**RESULTS AND DISCUSSION**

Based on the analysis of the student’s mathematics creative thinking skill, the average completeness test of the experimental group was  $t_{count} = 4.47$ . It was higher than  $t_{table} = 2.04$ . It

meant  $H_0$  was denied. Thus, the average score of the students’ mathematics creative thinking skill was higher than the minimum passing grade criterion, 60.

The proportional completeness test obtained a score of  $z_{count} = 1.8973$ , with a significant level of 5%, and  $z_{table} = 1.64$ . It means the  $z_{count} \geq z_{table}$ , thus  $H_0$  and was accepted. Thus, the proportion of the students’ completions of Treffinger learning assisted by Geogebra had reached the completeness with a percentage of 75%.

The statistical test of the average difference test on the normalized gain data was used to find out the improvement of the students’ mathematics creative thinking skills for both groups. It was obtained  $t_{count} = 4.047$  with a significant level of  $\alpha = 5\%$ , the score of  $t_{(1-0,05;n-1)}$  was 1.99. Thus,  $t_{count} > t_{(1-0,05;n-1)}$  so  $H_0$  was denied and  $H_1$  was accepted. Thus, it could be concluded that the difference in the average for the experimental group was higher.

Based on the statistics test, the influence test of self-confidence with the creative thinking skill on the Treffinger learning obtained this regression equation  $\bar{Y} = 23,112 + 0,586 X$ . It means each one self-confidence increased score; the students’ mathematics creative thinking skill would increase with a percentage of 0.586%. The influence of the students’ self-confidence toward the students’ mathematics creative thinking skills is explained in Table 1.

**Table 1.** The Regression Test Result

R	R Square	Adjusted R Square	Std. The error of the Estimate
.535 <sup>a</sup>	.286	.261	10.154

The results of the simple regression test showed the positive correlation of self-confidence and the students’ mathematics creative thinking skills although it was not dominant. The self-confidence influenced students’ mathematics creative thinking skills with a percentage of 28.6%. There were 71.4%

of other variables influencing the students’ mathematics creative thinking skills.

Based on the hypothesis test, it showed that the Treffinger learning model assisted by Geogebra was effective toward the students’ mathematics creative thinking skills. This finding is in line with Dwijanto (2019). He found that the Treffinger learning model could

reach classical completeness. It was also found that the Treffinger learning model was better than the PBL model. Then, the findings of Lestari (2015) showed that the Treffinger learning model could improve the spatial skills of the students in geometry material. The next study was done by Nugraeheni (2019). She found that the students' creativities taught by the Treffinger were better than those taught conventionally. It was also found that Treffinger could influence students' problem-solving skills.

According to Usman (2018), learning assisted by Geogebra better influenced the students' mathematics creative thinking skills. Geogebra could facilitate students to complete the problem-solving skill questions effectively and based on Polya's stages (Nursasongko, 2020). The students' mathematics creative thinking skills were not only influenced by the learning process but also the internal factor of the students or their self-efficacies. It is in line

with Trisnawati et al (2018). They found that self-confidence influenced the students' mathematics creative thinking skills. Higher self-confidence would lead to intense curiosity. Then, it would improve the students' mathematics creative thinking skills.

The results of the written test and interview were then analyzed to obtain the qualitative data concerning with the students' mathematics creative thinking skills reviewed from self-confidence. The self-confidence questionnaire respondents consisted of 30 students of the experimental group. The questionnaire results were grouped into three: high, moderate, and low. From 30 students, 5 of them were categorized as high self-confident students, 23 students as moderate self-confident students, and 2 students as low self-confidence category. The categorization was reviewed from the students' self-confidence as seen in Table 2.

**Table 2.** The students' categorizations reviewed from self-confidence

Criteria	The numbers of the students	Percentage (%)
<b>High</b>	5	16.70
<b>Moderate</b>	23	76.67
<b>Low</b>	2	06.63
<b>Total</b>	30	100.00

Table 2 shows that the group have different characteristics of students. It could be seen the numbers of the moderate category students were higher than those of high or low self-confidence category students. These students could complete the given problems concerning with the mathematics creative thinking skills. They had the confidence and the mathematics creative thinking skill with a significant

correlation. Higher self-confidence of the students would lead to higher mathematics creative thinking skills (Winarsih et al, 2018). Dewi (2018) also states that the self-confidence of students upon mathematics will influence their mathematical problem-solving skills. The post-test results of a subject with high-self confidence could be seen in Figure 2.

Diketahui : Sudut dalam adalah =  $180^\circ$   
 $40^\circ \times 5n = 180^\circ$   
 ditanyakan : Besar nilai  $n$  dan besar sudut masing-masing segitiga  
 1. Sudut C =  $40^\circ n + 5n = 180^\circ$   
 2. Sudut B =  $142^\circ + n + 10 + 3n + 18^\circ = 180^\circ$   
 $= 145^\circ + n + 28^\circ = 180^\circ$   
 $145n = 180 - 28$   
 $145n =$   
 $n + 3n = 180 - 10 - 18 - 10$   
 $4n = 142$   
 $n = \frac{142}{4} = 35.5$   
 $n + 18 = 3(35.5) + 18 = 125.5^\circ$   
 $n + 10 = 1(35.5) + 10 = 45.5^\circ$

Cara III  
 $142 + 10 + n = 180$   
 $n + 152 = 180$   
 $n = 180 - 152 = 28$   
 Cara IV  
 $5n = 3n + 18 + n + 10$   
 $5n = 4n + 28$   
 $n = 28$

Figure 2. The Post-test Result of High Self-Confidence

Based on the Figure 2, it shows the subjects could provide various ways to solve problems with similar and accurate answers. To solve the problems, the subjects wrote the concept to calculate the n-value. They did it by using the triangle angle concepts. The subjects could also share additional information about the angled corners. To find out whether the subjects did understand what they had written, the interviews were done with the subjects. From the interview results, the subjects could explain again what they had written. It showed that the subjects could successfully work on the questions with the flexibility indicator.

Based on the findings, high self-confidence subjects could meet three or all indicators of mathematics creative thinking skills maximally. They were fluency, flexibility, originality, and elaboration. However, dealing with originality, both subjects were not maximum because they had not been habituated to deliver their ideas. They tended to follow their

teacher's style to deliver it. This finding is also supported by Eviliasani et al (2018). They found that high self-confidence students had high creative thinking skills found in fluency, flexibility, originality, and elaboration. It is supported also by Trisnawati (2018). She found that higher self-confidence would lead to higher curiosity and would encourage and improve their mathematics creative thinking skills.

The moderate self-confidence students could solve several problems concerning with the students' mathematics creative thinking skills. It was proven from the students' works that met the aspects of fluency, flexibility, originality, and elaboration. However, they were not perfect completely. Meanwhile, for another subject in the same category, he only met the indicators of fluency and flexibility. When the students' works were triangulated with the interview, they answered it faithfully based on what they had written. The post-test results of a subject with moderate self-confidence could be seen in Figure 3.

3 - diketahui = Sudut dalam =  $180^\circ$   
 $70^\circ + 5n = 180^\circ$   
 $n + 10 + 40 + 3n + 18 = 180$   
 ditanya : Besar nilai  $n$  dan besar sudut masing-masing segitiga  
 1. sudut C =  $90^\circ n + 5n = 180^\circ$  karena saling berpelurus  
 2. Sudut B =  $142^\circ + n + 10 + 3n + 18^\circ = 180^\circ$   
 $145 + n + 28 = 180$   
 $145n = 180 - 28$   
 $145n =$   
 $n + 3n = 180 - 10 - 18 - 40$   
 $4n = 112$   
 $n = \frac{112}{4} = 28$   
 $3n + 18 = 3(28) + 18 = 102^\circ$   
 $n + 10 = 1(28) + 10 = 38^\circ$

③. Cara 1.

$$40^\circ + 5n = 180^\circ$$

$$5n = 180^\circ - 40^\circ$$

$$5n = 140^\circ$$

$$n = \frac{140}{5}$$

$$n = 28$$


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$$142^\circ + 10^\circ + n = 180^\circ$$

$$n + 152^\circ = 180^\circ$$

$$n = 180^\circ - 152^\circ$$

$$n = 28^\circ$$

Figure 3. The Post-test Results of the Moderate Self-Confidence Subjects

Figure 3 shows the works of moderate self-confidence subjects. Figure 3 shows that the subjects could solve the problems with accurate problem-solving steps. The subjects wrote the given and the questioned information on the questions clearly and accurately. To solve the problems, the subjects wrote the concept to calculate the n-value. They did it by using the triangle angle concepts. The subjects could also share additional information about the angled corners. In finding out the value of n, the subjects used the concept of angled corners.

Based on the findings, moderate self-confidence students could meet all indicators of mathematics creative thinking skills although they were not maximal. In another hand, only one subject could meet the indicators of fluency and flexibility. After interviewing the moderate self-confidence subjects who met all indicators of creative thinking skills, it was found that they noted what the teacher explained, and they learned it before taking the exam. They also asked the teacher or their friend when they had

not understood the materials. It proved they struggled and had the interest to understand mathematics. Thus, they could obtain the proper results of their examinations. These interests and habits became an important factor to influence mathematics learning and to determine the students' successes in mathematics learning (Siagian, 2015).

Based on the findings, typically, most of the low self-confidence students had not been able to complete the given problems concerning mathematics creative thinking skills. It was due to low self-confidence that would lead to low curiosity and mathematics creative thinking skill improvement (Trisnawati, 2018). It was proven from the students' works, from 2 low self-confidence students, only one could meet two indicators of mathematics creative thinking skill. The indicators were flexibility and elaboration. Meanwhile, another learner did not meet the indicators at all. The post-test results of a subject with low self-confidence could be seen in Figure 4.

3.  $n + 10^\circ + 3n + 18^\circ + 40^\circ = 180^\circ$

$$68^\circ + 4n = 180^\circ$$

$$4n = 180 - 68$$

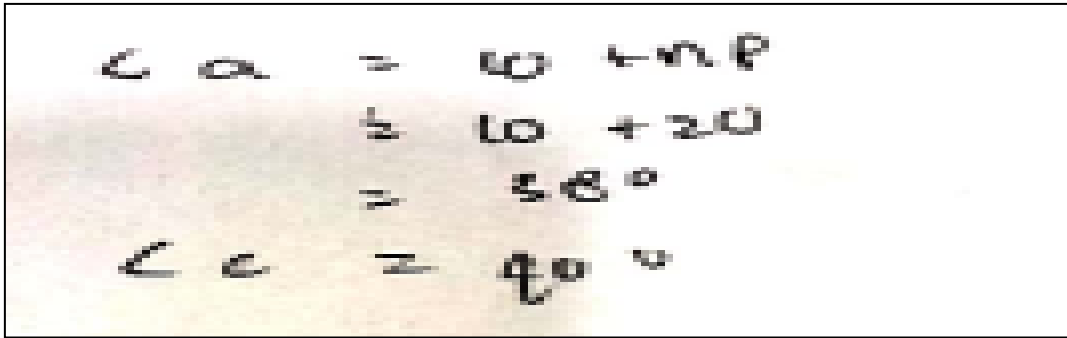
$$4n = 112$$

$$n = 28$$

$$\angle B = 3n + 18$$

$$= 2 \times 28 + 18$$

$$= 102$$



**Figure 4.** The Post-test Results of the Low Self-Confidence Subjects

Figure 4 shows that the subjects could not write what was recognized and questioned in the question items. However, the subjects could correctly write or formulate the concept to find the angles in a triangle. The subjects had not been able to write various methods to get the n-value. The subjects only could write a method while each corner in the triangle, as instructed by the questions, had not been written. It could be considered that the subjects could only find the n-value. It showed that the subjects were still lacking skills to work on the questions with the flexibility indicator.

The findings showed from two low self-confidence students, one of them met the flexibility and the elaboration although they were not perfect. Meanwhile, dealing with reliability and originality indicators, the subjects were not able to work on them.

## CONCLUSION

It could be concluded that the implementation of the Treffinger learning model could improve the students' mathematics creative thinking skills. It was shown by the seventh graders' mathematics creative thinking skills that could meet the average completeness after being intervened by the Treffinger. The students' mathematics creative thinking skills taught by the Treffinger were better than those taught conventionally. The high self-confidence students met all mathematics creative thinking skills maximally than those with moderate or low self-confidence.

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