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Analysis of Mathematical Creative Thinking Process Based on Self-Confidence in Complex Number

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Abstract. This study aims to describe students' creative thinking process based on self-confidence. The research subjects were Mathematics Education students who took the Introduction to Complex Number. The topic of the material used is the complex number. This type of research is qualitative. Data collection techniques included creative thinking skills tests, self-confidence questionnaires, interviews, and documentation. A creative thinking skills test is made based on indicators of fluency, flexibility, originality, and elaboration. Based on the self-confidence questionnaire data, students were grouped into low, moderate, and high. From each category, two people were taken as informants. Data analysis uses the Miles and Huberman type: data reduction, data presentation, and conclusions. The mathematical creative thinking process consists of preparation, incubation, illumination, and verification stages. The results showed that students could fulfill cognitive activities during the preparation and verification stages. Each category has a different way and answers at the incubation and illumination stages. The thing that affects is the previous knowledge.

Key words: Creative Thinking Process; Self Confidence; Complex Number

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INTRODUCTION

Mathematics is one of the efforts applied or learned in schools to improve quality human resources. The state provides views on learning mathematics in schools in Undang-Undang RI No. 20 of 2003 Article 37 that mathematics is a compulsory subject at the SD to SMA/SMK level. It was reaffirmed about the purpose of mathematics education through Permendikbud No. 22 on the first point, namely that students understand mathematical concepts and are suitable for solving problems. Apply concepts or algorithms flexibility, accurately, and efficiently and explain the relationship between concepts (Kemendikbud, 2016). In the 21st century, mathematics learning has a goal, one of which is creative mathematical thinking (Arifin, 2017). Therefore, it can be said that creative thinking is an ability in mathematics that needs to be possessed by students to meet the mathematical goals set by the state and the needs of the times. Mathematics requires mathematical skills, one of which is thinking creatively mathematically (Ernawati, 2016).

In dealing with and solving problems in learning mathematics, students need to have the ability to think creatively Machromah et al. (2015). Not only in mathematics but in everyday life, creative thinking becomes helpful in solving problems in life. However, creative thinking is one of the elements in mathematics teaching that has received less attention (Siswono, 2004).

Creative thinking is an activity to compile and generate new ideas or ideas and find many possible answers to a problem based on the available information (Siswono, 2010). Meanwhile, according to Saefudin & Mursidik (Nitano, 2019), creative thinking is a unit of divergent and logical thinking. There are indicators to measure the ability to think creatively in mathematics. According to Silver (Siswono, 2010), there are three indicators of creative thinking, namely fluency (fluency), flexibility (flexibility), and novelty (novelty). Fluency (fluency) measures how many answers students make in response to a problem. Flexibility measures the number of different solution methods used to solve a problem. Novelty (novelty) to measure the authenticity of ideas or answers made by students to solve a problem and different from what is done to other students. One of the factors that influence creative thinking is personality (Puryear et al., 2017). According to Gunawan et al. (2022), the aspect of personality closely related to creativity is self-confidence. According to Hendriana et al. (2017) explain the indicators of self-confidence, namely believing in their abilities, daring to make decisions, having a good personality, and daring to convey ideas. Based on the explanation above, the definition of creativity and self-confidence has a strong relationship. Therefore,

this is the motivation of the author to explain the creative thinking process based on self-confidence.

METHODS

This type of research is descriptive and qualitative. The subjects involved were 25 students of the Mathematics Education study program. The topic of the material used is the convergence of the Real number sequence. The student has studied for three years and is taking courses related to the material. The number of male students was five, while 20 were female.

The instrument used to collect data consisted of a self-confidence questionnaire, a creative thinking ability test, and interview guidelines. The questionnaire is prepared based on the indicators of self-confidence. All students filled out a questionnaire. Based on the results, students were grouped into low, moderate, and high self-confidence categories. Respondents were taken using a purposive sampling technique (Sukestiyarno, 2020). All students took the creative thinking ability test. The focus of the interview is the mathematical creative thinking process based on Wallas's theory, namely preparation, incubation, illumination, and verification. Data analysis techniques include data reduction, presentation, and concluding.

RESULTS AND DISCUSSION

The following explains the students' mathematical creative thinking process in completing the creativity test. Analysis of student answers based on the stages of the mathematical creative thinking process, namely preparation, incubation, illumination, and verification.

Preparation Stage

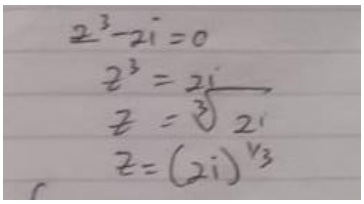

Figure 1. Worksheet P1

At this stage, all respondents wrote the equation $z^3 - 2i = 0$ then the two parts were added up by $2i$. It can be seen in Figure 1. Respondents with high self-confidence perform algebraic operations on the equation to obtain the z value. This is in line with Sitorus (2016) that one of the activities in the preparation stage is developing the information obtained. Based on the interview results, the first thing that came to his mind was to perform simple algebraic operations. Here is the interview.

R : What is the first thing to do after reading the problem carefully?

P1 : Perform algebraic operations, namely adding the two parts with $2i$ and the square root of 3.

Incubation Stage

At this stage, respondents with moderate confidence category add up $\frac{\pi}{2} + \frac{2\pi}{1}$. This addition helps to find a way to solve the root form in contrast to what was done by the low self-confidence category, namely rewriting the table of tangent values at particular angles. These activities help students in finding solutions. Research by Baird et al. (2012) also states the same thing; namely, the incubation process can increase creativity products. Figure 2 and Figure 3 below are evidence of respondents carrying out activities.

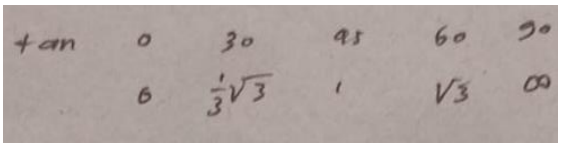

Figure 2. Worksheet P3

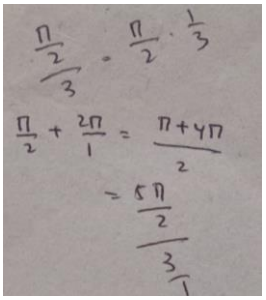

Figure 3. Worksheet P2

The results of the interviews also showed the same results. Here is the quote.

R : How do you come up with ideas?

P3 : I wrote a table about the tangent values at particular angles.

R : Can it help find ideas?

P3 : Yes, it can help

Illumination Stage

After doing some previous calculation activities, to find solutions to ideas, students in the high self-confidence category were able to answer the problem by writing two solutions to find the root of $z^3 - 2i = 0$. Figure 4 explains

that respondents wrote in several different ways of solving.

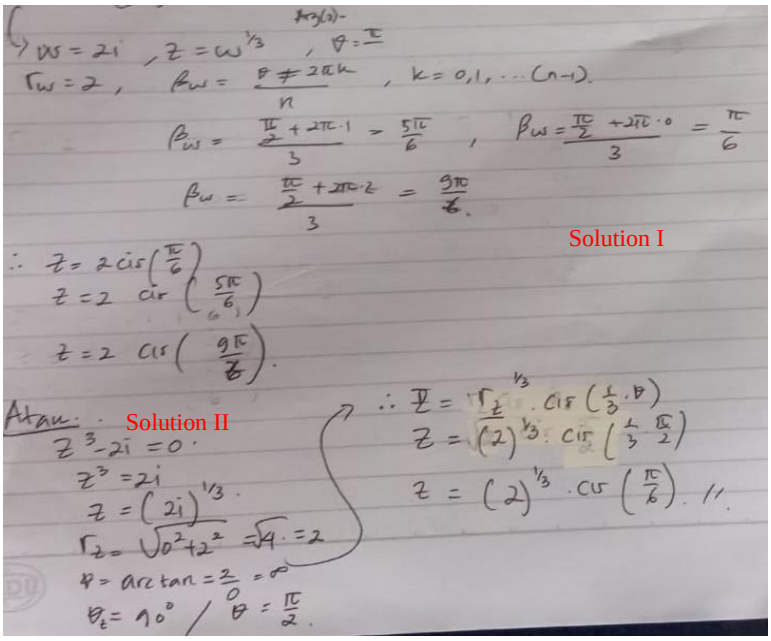

Figure 4. Worksheet P1

Respondents also showed the same thing in the medium category. Be able to write with two solutions to determine the roots of z. In contrast to respondents in the low self-confidence category, they only wrote one way of solving it. Figure 5 presents evidence of the work of low-category respondents in answering problems.

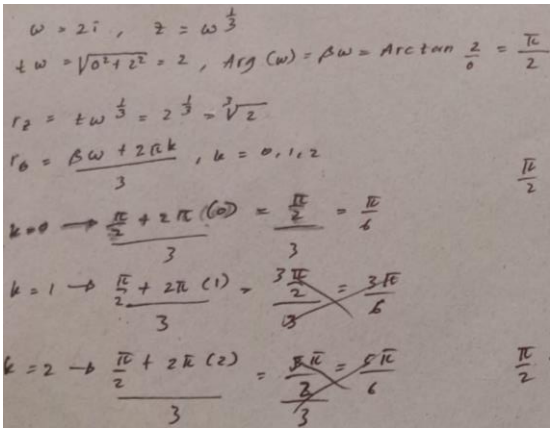

Figure 5. Worksheet P3

Based on the interview's conclusion, respondents did not know other ways of solving that could be used. Here is an interview excerpt.

R : How many solutions are used to answer the problem?

P3 : I only use one solution

R : Do you have another solution?

P3 : No, I do not know which method to use anymore.

Verification Stage

At this stage, all respondents re-check the answers that have been written. The checks carried out include mathematical notation, the completion process, the use of rules or concepts, and the truth value of the answers. In line with Nuha et al. (2018), one of the cognitive activities at the verification stage is looking back at the completion process, whether it is correct or not. The following are the results of interviews with moderate category respondents.

R : After finishing work, what do you do?

P2 : I checked all the answers again

R : What did you check?

P2 : Usually I check the process, the mathematical notation, and the truth value

R : Do you usually do these activities?

P2 : Yes, I usually do it

CONCLUSION

Based on the results of the research and discussion above, the conclusion that can be written is that the cognitive activities carried out by students in the low, moderate, and high categories in different mathematical creative thinking processes. The mathematical creative thinking process consists of preparation, incubation, illumination, and verification stages. At the preparatory stage, all students in each category of self-confidence develop information that is known to be more straightforward. Students in the moderate and low self-confidence categories have different ways of

getting inspiration at the incubation stage. At the illumination stage, students in the high and moderate confidence categories could write two different solutions (flexibility), while students in the low self-confidence category only wrote one solution. This is because their knowledge is limited. At the verification stage, all students re-examine their answers. The completion process, mathematical notation, and use of concepts are re-examining sections. This study provides information about students' cognitive activities based on self-confidence in the creative thinking process. The two variables are closely related. Further research that can be done is to look for other personality factors that influence creativity, such as self-efficacy.

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