How Students Non-Generative Thinking Identifying Parallelogram?

Rahma Wahyu$^{1,2}$, Purwanto$^1$, I Nengah Parta$^1$ and Rustanto Rahardi$^1$

$^1$Universitas Negeri Malang, Jl. Semarang No. 5, Malang, Indonesia
$^2$Universitas Islam Raden Rahmat Malang, Jl. Raya Mojosari No. 2 Kepanjen, Malang, Indonesia

E-mail: rahma.wahyu.1703119@students.um.ac.id

Abstract. This study was carried out to the identification of non-generative thinking of students to take a look at a parallelogram. The respondents involved in this study were 33 mathematics education students in the first semester. Descriptive used in this qualitative study. The implementation of the research used triangulation methods, namely the observation of the process of solving problems related to student levels, interviews, and reviewing documents (student work). Interviews in this study conducted on two students who indicated non-generative thinking. The analysis was done by concluding the data obtained based on the results of observations that have been made. The findings show that from the 33 respondents who took the test, ten students answered the questions correctly. The ten students responded by doing the generative thinking. While six of them answered and indicated doing the non-generative thinking and the rest were wrong. Two respondents were chosen to represent the others. It can be concluded that there were two students did non-generative thinking in answering problems related to a parallelogram. Therefore, it is necessary to study more in the characteristics of non-generative thinking.

1. Introduction

Mathematical thinking means that when someone finds a problem, s/he decides what should be used in solving the problem. Mason [1] show the purpose of mathematical thinking is the way of thinking applied to broaden the scope and depth of mathematical understanding. It is the best way of thinking to solve problems in everyday life. One type of mathematical thinking that is widely studied is generative thinking. The study of generative thinking began to be widely carried out by researchers. Generative thinking is a way of thinking that looks at problems more deeply. Thinking activities carried out are started from understanding what is known and what is being asked in the questions, until looking for ways to find the best solution in solving the problem. Generative thinking indicates that the brain is used actively constructing an interpretation of the information obtained and then making any conclusions [2,3]. Osborne [2] stated that researchers concluded that when someone gets a problem, then the person will try to understand it more deeply. S/he faces and tries to build the most appropriate solution to the problem.

Students or college students who think generatively can understand problems from various perspectives of resolution strategies, understand the depth of the problem, and be able to represent it [4-6]. Generative thinking will develop with age and be influenced by the surrounding environment [6-7]. The higher the age of a person, the more generative thinking will develop. It is necessary to develop further the generative way of thinking, especially in the education environment, both school and college. It can be concluded that the characteristics of generative thinking as follows(1) Knowing the basic facts...
of the problem as they are recognized, (2) Integrating information to understand the problems, (3) Translating sentences into questions and applying rules related to information on questions to get something, (4) Resolving problems by using more than one knowledge, (5) Deciding the steps that are the most suitable for the condition of the problem, and (6) Analyzing the information needed to solve questions on the problem so that a solution is obtained[2, 4-6, 8]. If it does not fulfill one characteristic of generative thinking, it can be said that a person experiences non-generative thinking.

Observations made on college students of mathematics education at Universitas Negeri Malang found that there are still many students didn’t think generatively, specifically in understanding the problems of a parallelogram. It was found that there were still many college students who were still incorrect to answer because they did not deeply solve the problem. Questions about parallelogram gave to the students. The sample of the question that given to the student can be seen in Figure 1.

Which of the buildings below is the parallelogram? Give the reasons!

![Figure 1. The sample of question about parallelogram](image)

Question in Figure 1 gave to the college students to see the ability of college students in understand the definition and kind of parallelogram. Therefore, its suitable gave students related to parallelogram. Students work result of parallelogram problem can be seen in Figure 2.

![Figure 2. Student Work Result in Answering Parallelogram Problems](image)

Translate Version

Based from Figure 1, Parallelogram is only pictured C and F, because:
1. Has four sides
2. The opposite corner is equal
3. Picture A: rectangle
   Picture B: kite
   Picture C: square
   Picture E: rhomb
4. The sides facing has the same length

The subject in Figure 2 thought that picture C is a parallelogram, and the others aren’t. The subject ignores the possibility that the other picture is a parallelogram. This answer, indicate that the subject had decrease thinking. This problem can’t be ignored because the subjects tend to make mistakes in understanding and solving problems repeatedly.
Decrease thinking is one of the processes that cause a lack of accuracy in finding solutions to any problems. Therefore, students are expected to be able to consider and evaluate the solutions that have been found. The completion strategy must be developed by the students themselves by connecting the concepts that have been previously owned and the concepts they are learning. Generative thinking is a type of mathematical thinking. Generative thinking is one way to find out the subject’s thinking process. Problems arise when one of the research subjects does not show an indication of generative thinking. Therefore, it will examine non-generative thinking based on indicators on generative thinking. The indicators of non-generative thinking and the perspective of the students viewed the parallelogram problems explained in this article.

2. Method
This research used a qualitative approach that was designed as a case study because the aim of the study was uncovered and described the case of college students non-generative thinking in solving parallelogram problems. The research subjects were the first-semester college students in Malang State University. Then two selected subjects would be reviewed in the discussion. The subject choose because it was found that there were still incorrect to answer because they did not deeply solve the problem. The researcher acted as the first instrument that would plan, implement, collect the data, draw conclusions and make research reports. While the math problem about parallelogram as the second instrument. The technique of data collection was by analyzing the worksheets of the first-semester students. Furthermore, the collected data would be analyzed based on data acquisition. Data analysis conducted in this study was data collection, data presentation, data reduction, and conclusion.

3. Result
The work results of the college students showed that there were six people from 33 respondents who indicated doing non-generative thinking in answering parallelogram problems. Then there were ten students who answered the questions correctly. The ten students responded by doing the generative thinking. Meanwhile, the rest are still wrong in answering. Based on the six respondents who indicated doing the non-generative thinking, two respondents were chosen to represent the others.

Generative thinking process in 10 respondents who answered with generative thinking. That is, by answering all possible answers about the parallelogram. This includes integrating information to understand the problem, which is indicated by providing information on any picture that might be included in the parallelogram. Furthermore, giving the characteristics of parallelogram problem and applying the relating to information on the problem. Then solve the problem by using more than one knowledge, which is indicated by analyzing the characteristics of the parallelogram. The next step is to set the steps that are most appropriate for the condition of the problem and work on the problem with the solutions that have been thought of. Finally, analyze the information needed to solve the questions in the problem so that the right solutions is obtained that the other buildings are multi-level. The researcher focused on two people whose responses indicated doing the non-generative thinking. The results of the work of the two respondents can be seen in Figure 3 and 4. This respondent was chosen because basically the respondent knew what a parallelogram is, but the respondent did not think of another possibility that there was another picture which was also parallelogram. They only focus on one form of parallelogram. The answer of respondents can be seen in Figure 3 and 4. Figure 3 and 4 was the result of the work of respondent 1 and respondent 2.
Parallelogram is only in picture C because it has no folding symmetry and the opposite corner is equal. The others picture aren’t parallelogram because haven’t folding symmetry.

Figure 3. The Work Result of Respondent 1 in Answering Parallelogram Problem

Based on the results in the of the work on respondent 1 Figure 3, it shows that respondent one can understand what is known and asked about the problem, integrating information to understand the problem marked by writing that C in the problem is the parallelogram. It wasn’t wrong, but the respondent one did not understand what was meant in the problem. Respondent 1 ignored that there was another picture of the questions was the parallelogram. Respondent 1 tried to mention the characteristics of the parallelogram that has four sides and has an opposite angle. But respondent 1 ignores that the characteristics of the mentioned levels are in other pictures, namely A, D, F. Besides that respondent one also shows the names of each picture.

Picture A: rectangle
Picture B: kite
Picture D: square
Picture E: trapezium

Based on the writing of the answers, it can be seen the fact that respondent 1 considers that rectangles and squares are not included in parallelogram because they have their names. It can be interpreted that respondent 1 ignores the characteristics of the levels that appear on rectangles and squares. The answer to respondent 1 shows that respondent one has not understood the question and has not used all of the information that they had to solve the problem. Therefore, it can be concluded that respondent1 does not fulfill the indicators of generative thinking and is indicated to do a non-generative thinking process. The statement was strengthened by the results of the interview. The results of interviews with respondent 1 show the fact that respondent 1 considers parallelogram only in the picture C and the other has a separate name such as rectangle, square, rhombus. Respondent 1 also assumes that even though the characteristics of parallelogram appeared on the rectangles, squares or rhombus, but they have different names. The learning experience is also stated that respondent 1 focuses on the shape of the parallelogram and ignores that when the characteristics arise in another object, then the other build is also a parallelogram. Based on the results of the work and interviews conducted on respondent 1, it can be said that respondent 1 experienced non-generative thinking. Respondent 1 ignores the possibilities of other answers that can arise in solving problems, especially the parallelogram.
Based from Figure 1, Parallelogram is only pictured C and F, because:
1. Has four sides.
2. The opposite corner is equal.
3. Picture A: rectangle
   Picture B: kite
   Picture C: square
   Picture E: rhomb.
4. The sides facing has the same length

Figure 4. The Work Result of Respondent 2 in Answering Parallelogram Problem

While in the Figure 4, respondent 2 shows that they can understand what is known and asked about the problem, integrating information to understand the problem is marked by writing that “C” in the problem is a parallelogram. This was not wrong, but respondent two also did not understand what was meant in the problem. Respondent 2 also ignored that there was another object to the questions included in the parallelogram. Respondent 2 tried to mention the characteristics of the parallelogram, that is not having the symmetry of folding and having the opposite angle. But respondent 2 ignored that the characteristics of the mentioned are inappropriate. Because respondent 2 found that picture A, D, and F have a folding symmetry and has an angle that is facing the same magnitude. So the respondent 2 concludes that another picture is not a parallelogram. It can also be interpreted that respondent 2 ignores the characteristics of the parallelogram that appear on rectangles and squares and rhombus.

From the answer of respondent 2, it can be concluded that respondent 2 indicated to do a non-generative thinking process. To strengthen the state, the researcher also interviewed respondent 2. The results of interviews with respondent 2 show the fact that respondent 2 considers that the parallelogram has no folding symmetry. Respondents 2 learning experiences were also stated that respondents two were taught like that when they were in high school. Respondent 2 also said that when answering it already felt very confident with the answer. Based on the results of the work and interviews conducted on respondent two it can be said that respondent 2 experienced non-generative thinking. Respondent 2 also ignored other possible answers that could arise in resolving the problem, especially the parallelogram. Also, respondent two also did not use the previous scheme to answer the question about these levels.

Interviews were conducted to find out more reasons for respondents regarding their answers. The results of interviews with respondents 1 and 2 can be seen in Dialogues 1.

Dialogues 1

Researcher : Based on the questions you answered, what is your reason for saying C is parallelogram?
Respondent 1 : Yes, I chose C as a level because C fulfills the parallelogram characteristics.
Respondent 2 : Yes, I chose C as a parallelogram because C have no folding symmetry and the opposite angles are equal, and the opposite side is equal.
Researcher : What do you think/imagine about parallelogram when answering that question?
Respondent 1 : The parallelogram is the one that has the same opposite angle, while the other one is rectangular, kite, square, trapezoid
Respondent 2: Yes I see the shape of the picture. While the others are rectangular, kite, square, trapezoid.

Researcher: What do you think the parallelogram is? (For example its characteristics)

Respondent 1: Yes, just like before, sir, it has an equal angle.

Respondent 2: Yes, it has an equal angle.

Researcher: Have you (at school) received material about parallelogram?

Respondent 1: Yes sir, it was indeed learned in class.

Respondent 2: Yes sir, it was indeed learned in class.

Researcher: When learning parallelogram at school, what do you learn?

Respondent 1: Yes sir, starting from the characteristics, shape around, and the area.

Respondent 2: Yes, starting from the characteristics and shape around.

Researcher: If I choose one of these images, for example A is a parallelogram, what do you think? Why?

Respondent 1: Ehmmm, how come sir, if you think about it, it fulfills the characteristics of the parallelogram, but I chose C because the shape is indeed multi-level. I assume that images other than C have their own names. So that I did not think that the image other than C is parallelogram.

Ehmmm, how come sir, if you think of other images that have fulfilled the characteristics of the parallelogram, I don't think of other images, because what I see is the shape. After you asked me like this, I was hesitant, sir. I already ignored the other images, sir.

Dialogue 1 findings that respondents 1 and 2 ignored the possibilities that there are other images which are also parallelogram. The respondents only focuses on the image shape and ignore the characteristics of parallelogram.

4. Discussion

The results of the work of both respondents have different points of view in understanding parallelogram problems. Based on the findings, it was found that respondents one and two already understood what was asked and answered in the matter. Then they also tried to integrate information to understand the problems. This is shown by giving a description of the characteristics of parallelograms and mentioning that the parallelogram is picture C. The answer to C is indeed parallelogram, but the two respondents ignored that parallelogram not just picture C. The results of the analysis of the work of respondents one and two have not been able to show the characteristics of generative thinking. This is contrary to [5] that generative thinking can be known from the results of the work of research respondents. Based on the results of the work it can be seen that generative thinking characteristics do not appear and it can be said that respondents one and two do the non-generative thinking.

Respondents one and two also showed that the two respondents had a similarity to the one faced, namely the two respondents had not been able to understand that the characteristics of the parallelogram appeared in other pictures, but were ignored. This is contrary to what is conveyed by [2,9] that generative thinking is a process of thinking in overcoming the problems faced in more depth to find the right solution to the problem. So it can be said that respondents one and two do not do the generative thinking. The results of the analysis of the results of the work of these two respondents in accordance with [10] that the implementation of good learning will result in students obtaining satisfaction in completed work, increasing self-confidence, independence, developing decision-making abilities, and fostering a sense of responsibility and discipline in learning. However, the learning experience in these two respondents was ignored, and it was seen that the two respondents had not tried to develop information about the levels and characteristics that exist in other constructs. If both respondents can develop their knowledge based on their learning experience, perhaps the results of their work will be much better.

The way of looking at a problem and being able to know the characteristics of the problem would be able to help solve these problems more precisely [4]. It emphasises observing before evaluating, paying attention to an event based on various perspectives, and always paying attention to the meaning of the
observed things [12]. Whereas the two respondents did not have a deeper perspective in determining anything had the same characteristics as the parallelogram. Generative thinking needs to be developed because by doing the generative thinking; students will be able to understand more deeply about the problem and be able to find a solution to the problem appropriately [6, 11]. Also, generative thinking will help the subject gain satisfaction from work and be able to develop the ability to make and implement decisions. The statement also contradicts the results shown by the two respondents. Errors that occur in answering the problem will be reduced if the two respondents work on the problem using a generative way of thinking. The findings of this study are also in line with what was done by [6] that it needs to develop generative thinking because by doing the generative thinking, students or college students will be able to understand more deeply about the problem and quickly to find solutions to these problems appropriately.

5. Conclusion and Suggestion
The result was found that the two respondents selected in this study did not do the generative thinking so that a solution to the parallelogram problem was still lacking. Whereas many studies state that generative thinking processes will be able to help in understanding the depth and scope of the problem appropriately. The researcher obtained the fact that the two respondents had not been able to solve the given problem. The researcher defines that both respondents experience non-generative thinking. The way of thinking that considers the problems faced are equivalent to the problems commonly encountered, without thinking about the depth of the content or the scope of the problem is non-generative thinking. Because the results of the work and interviews of the two respondents did not show the characteristics of generative thinking. Therefore, also the solution obtained becomes more precise because other solutions are ignored.

By the findings, it is expected that further researchers will develop learning that can develop generative ways of thinking. Further researchers are also expected to develop the characteristics of generative thinking that have been prepared by researchers. Also, further researchers are expected to be able to examine more deeply the causes of non-generative thinking.

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