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Reflective Thinking in Solving of Open Ended Problems in Plane Figure for Seventh Graders

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Abstract. This research aims to describe of students' reflective thinking in solving open-ended problems in plane figure. This research is a case study. The subject was seven graders of SMP N 8 Malang 2018/2019. The research instrument was mathematical open ended test about plane figure. Subjects were chosen based on reflective thinking characteristics of the seven graders. The data collection technique was done by giving the test to the subjects, and the subjects solved the test in writing while doing think out loud. Data analysis was done by: (a) reducing data, (b) displaying data (c) making a conclusion. The results showed that the description of characteristic students' reflective thinking in solving open-ended problems in plane figure included three characteristics. These three characteristics explain the different character of the stages of the students' reflective thinking process in solving open-ended problems. The first characteristic includes stages: (1) students identify the problem; (2) formulate information the problems; (3) compile plans for more than three of these considerations; and (4) implementing a problem solving plan, linking information that is owned by the problem, explaining it well, and checking again. The second characteristic includes: (1) students identify the problem; (2) formulate the problems; (3) draw up a plan on these three considerations; and (4) implementing a problem solving plan, explaining three problem solving solutions, and linking information that is owned by the problem. The third characteristic includes (1) students identify the problem; (2) formulate information the problems; (3) develop a plan for each of these considerations; and (4) implementing a problem solving plan, explaining less than 3 problem solving solutions, linking information that is owned by the problem. The implication of this research is to develop the understanding of students and teachers in learning that can improve reflective thinking in solving each mathematical problem solving.

INTRODUCTION

Thinking is one of the basic components that someone uses in solving problems. [1] argues that thinking is a means to construct one's knowledge. Constructing knowledge means linking previously owned concepts to building new concepts. By thinking, a person can build new concepts and give reasons logically, critically, creatively, and other high-level thinking in solving problems.

High order thinking which is very necessary and fundamental for someone to solve a problem is thinking reflective. [2] explained that reflective thinking is a mental process that is based on an active consideration, persistent (continuous), and careful on a belief/knowledge received by looking at various reasons that support it and further conclusions. Reflective thinking is a mental process that begins with a problem that is upsetting and then encourages someone to conduct an investigation to obtain a problem solving solution [3].

Someone is said to be a problem solver, if he is able to rethink previous knowledge, criticize questions, and persistently associate previous knowledge with problem questions. This condition shows that students must high order thinking to solve problems. [4] states that a good problem solver faces many problems by trying to understand complex problems and routinely dealing with and solving those problems. [5] states that high order thinking as problem solving can equip students to solve problems set for them (routine problem solving) as well as solving new problems that are

self-defined. This gives a presumption to researchers that problem solving skills in high-order thinking can encourage students' creative thinking.

One of the material in solving problems faced by students is plane figure problem. Plane figure is given to middle school students [6]. Plane figure can encourage someone to think reflective [7]. Solving the problem of plane figure in this research is an open ended problem-solving. [8] explains that open ended problem-solving is one form of problem solving that has many solutions in solving problems. This shows that students can explore knowledge from various perspectives, make plans and choose diverse methods or methods in the problem solving process. [9] argue that open-ended problem solving can provide a development of a person's reflective thinking structure by considering its logical and deductive nature to produce various possible answer solutions.

Everyone always has reflective thinking skills but they have different reflective thinking characteristics. The characteristics of reflective thinking in this research are the different characters from the stages of students' reflective thinking process in solving open-ended mathematical problems based on the number of original solution findings. Djasuli and Rodgers research [3], [10] explains the stages of students 'reflective thinking process but they have not explained and described the characteristics of students' reflective thinking in solving of the problem. Therefore, this research aims to describe students' reflective thinking in open-ended about plane figure.

METHODOLOGY

The subjects of this research were ten seventh grade students of SMP N 8 Malang 2018/2019. Subjects were chosen based on reflective thinking characteristics of the seven graders. The research instrument was mathematical open ended test about plane figure The data collection technique was done by giving the test to the subjects, and the subjects solved the test in writing while doing think out loud. Data in this research are the results of written tests and think out loud students. Based on the data obtained in this stage, a description of students' reflective thinking is obtained.

Data analysis was carried out by: (1) data reduction that is verifying students' test by setting aside data that does not support research, (2) data display that is clarifying and identifying organized and categorized data that allows conclusions to be drawn, (3) conclusion drawing / verification namely draw conclusions or verification.

RESEARCH RESULTS AND DISCUSSION

The description of students' reflective thinking in solving open-ended problems about plane figure can be grouped into 3 characteristics. The characteristics of reflective thinking in this research are the different characters from the stages of students' reflective thinking process in finding original solutions in solving open ended problems.

(1) Reflective thinking of students on the first characteristic.

Reflective thinking on the first characteristic includes several stages that are shown in the results of student work with codes R1 through R15 and the results of think out loud. Student work results are shown in Fig. 1 below.

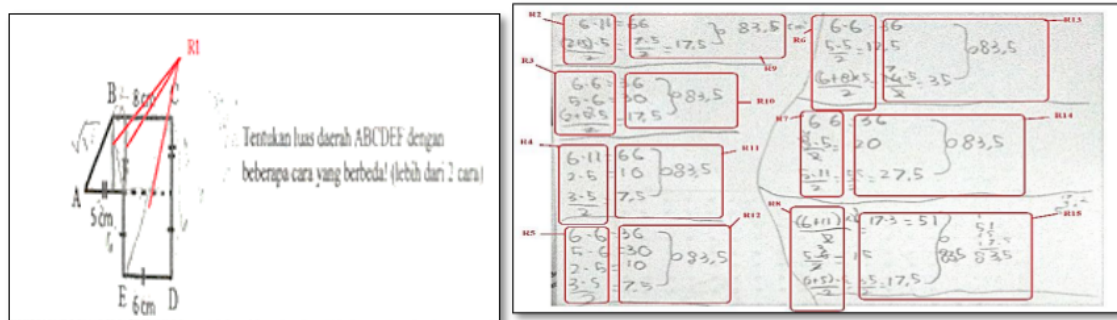


FIGURE 1 (a). Results of Answers from Students with the First Characteristics

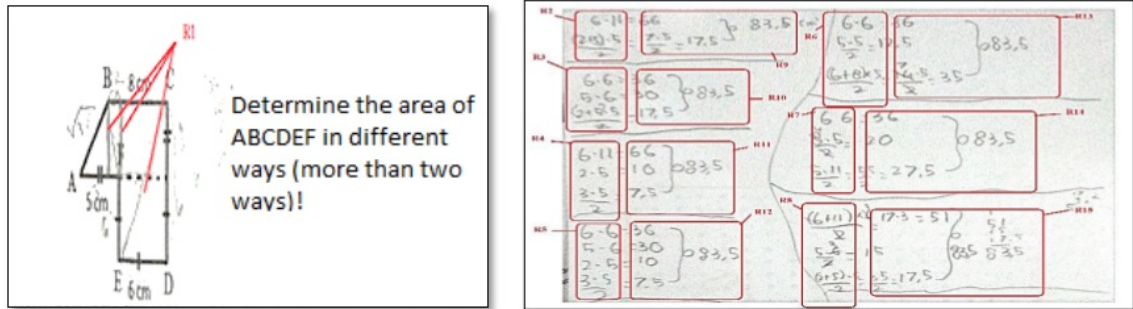


FIGURE 1 (b). Translate Figure 1 (a)

In the first stage, students identify the problem. The process of identifying this problem begins with the confusion of students in understanding the problem. This is shown in the results of think out loud. Students seemed to read repeatedly the problem. This student's confusion encourages students to deeply identify the problem. At the stage of identify the problem, students appear to describe the problem first so that the problem is easily understood. The results of this study are students verbally mentioning the things that are known and asked of the questions. The second stage were students formulate information the problems. The results at this stage are to make more than three considerations for finding problem solving solutions. Each of these considerations is indicated by giving a boundary (dashed line) to the main building to form several pieces of wake (R1). The third stage is to draw up a plan for each thing that has been described. Based on the results in the second stage, students write down the extent of each constructed piece obtained and form it in the form of addition. This is shown in the results of student work (R2 to R8). The fourth step is to apply the problem solving plan (R9 to R15) and explain it again well through think out loud. At this stage, students associate the information they have with the problem and check the results of their work.

(2) Reflective thinking of students on the second characteristic.

Reflective thinking in the second characteristic includes several stages that are shown in the results of student work with codes P1 through P9 and the results of think out loud. The results of student work are shown in the following Figure 2.

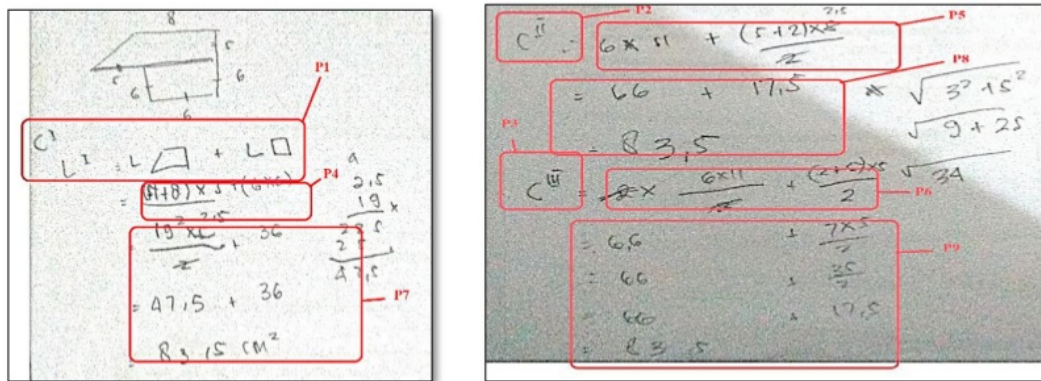


FIGURE 2. Results of Answers from Students with the Second Characteristics

In the first stage, students also identify the problem. The process of identifying this problem begins with the difficulty of students in understanding the problem. This is shown in the results of think out loud. Students seemed to read repeatedly the problem and the students verbally mentioning the things that are known and asked of the questions. The second stage were students formulate information the problems. At the stage of formulate information the problems, students appear to describe the problem first on P1, P2, & P3 so that the problem is easily understood. P1, P2, & P3 show various plane figure pieces from a main building with different considerations. Based on the results of the answers and think out loud, students have not been able to understand the problem, because students make 3 considerations (P1, P2, & P3). The third stage is planning a problem solving solution. At this stage, students write the formula for the plane figure area of each plane figure piece on a consideration (P4, P5, & P6). At this stage students associate previous knowledge (various formulas for the area of plane figure) with current knowledge (area of each piece). The fourth stage is to implement a problem solving plan, which is to determine the area of each piece of plane figure on a consideration and calculate the total area of the piece of plane figure (P7, P8, P9). At this stage, students provide three different ways of solving problems. This shows that students meet the problem questions faced, but students have not been able to reflect back and provide other different ways in more than 3 ways.

(3) Reflective thinking of students on the third characteristic.

Reflective thinking on the third characteristic includes several stages shown in the results of student work with codes S1 to S6 and results of think out loud. The results of student work are shown in the following Figure 3.

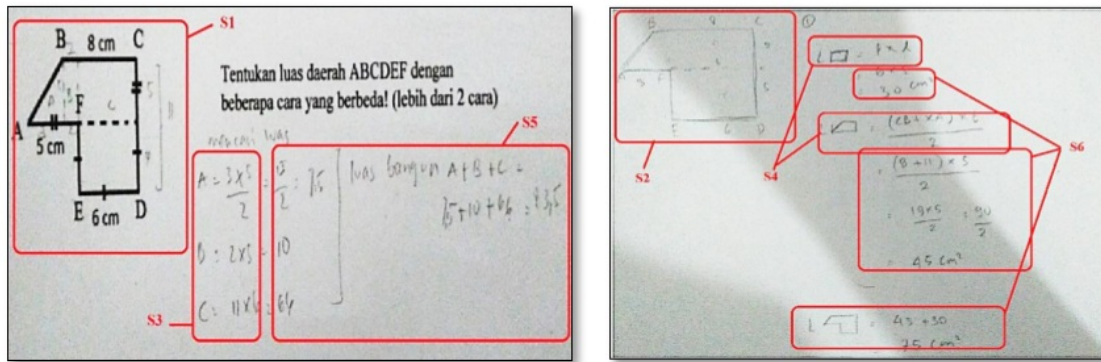


FIGURE 3. Results of Answers from Students with the Third Characteristics

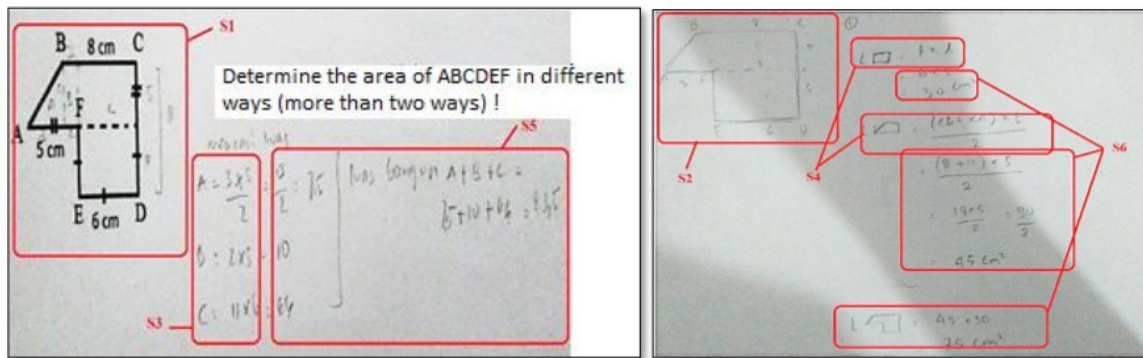


FIGURE 3 (b). Translate Figure 3 (a)

In the first stage, students identify problems to overcome their confusion in understanding the problem. This is shown in the results of think out louds. Students seemed to read repeatedly the problem and then students verbally mentioning information of the problem questions, namely "Determine area of ABCDEF in different ways". The second stage were students formulate information the problems. At the stage of formulate information the problem, students appear to describe the problem first on S1 & S2 so that the problem is easily understood. S1 & S2 show a variety of plane figure pieces from a main building with different considerations. Based on the results of the answers and think out loud, students have not been able to understand the problem, because students only make 2 considerations (S1 & S2). The third stage is planning a problem solving solution. At this stage, students write the formula for the area of plane figure from each piece of plane figure on a consideration (S3 & S4). At this stage students associate previous knowledge (various formulas for the area of plane figure) with current knowledge (area of each piece). The fourth stage is to implement a problem solving plan, which is to determine the area of each piece of plane figure on a consideration and calculate the total area of the piece (S5 to S6). At this stage, students have not been able to check the results of their work carefully. This is because Figure 3 asks students to give more than two different ways to solve problems, but students only make two different ways of solving problems.

DISCUSSION

Based on the results of the research above, there are three characteristics of students' reflective thinking. These three characteristics explain the different character of the stages of the students' reflective thinking process in solving the problem of plane figure. This stages is compared to the reflective thinking stage proposed by [3], [10].

TABLE 1. Comparison of the stages of the Reflective Thinking Process

Rodgers [3]	Djasuli et al. [10]	This Research
The presence of confusing new experiences		Students identify problems
Describe the new experience	Observe deeply at the problem	Students formulate information the problems
Analyze previous experience to gain new experiences	Plan actions with prior knowledge Compile, rearrange, formulate activities, model, and anticipate new concepts that emerge	Students plan various alternative of a new solutions
Action / experimentation	investigating and testing its general truth	students apply the problem solution plan

Based on TABLE 1, the reflective thinking process of students in the first stage in this study was students identify the problems. The process of identifying this problem begins with a confusion from students in understanding the problem. This is supported by [3] who states that the first stage in reflecting thinking process is the presence of new confusing experiences. Problems experienced by students are caused because students are not accustomed to imagining and creating in finding new solutions [11]. Therefore, students identify problems.

The second stage is students formulate information the problems. This is in accordance with the second stage by [3] and the first stage by [10]. In the next stage, students plan various alternative of a new solutions. This is in accordance with the third stage by [3]. that is students analyze previous experience to gain new experiences. This is also in accordance with the second & third stage by [10], namely student make the plan actions based on prior

knowledge; and students compile, rearrange, formulate activities, model, and anticipate new concepts that emerge. This condition shows that the identification of problems from the second stage has a positive impact, namely forming a problem solving plan to produce various new solutions. However, this condition is different from the argument of [13], namely the identification of problems has a negative impact on the creativity of new products. This gives a new question for future research, namely, what is the role of the "identification of the problem" stage in each problem-solving? How about the impact of this stage? What is the cause of these impacts (about of identification of the problem)?

The final stage in this reflective thinking process is to apply the problem solution plan. This is in accordance with the final stages by [3], namely there is action/experimentation. This is also in accordance with the fourth stage by [10], namely students investigated and test general truth of new concept.

All stages of reflective thinking in class VII students in SMP Negeri 8 Malang in solving open-ended problems about plane figure are described in three different characteristics. Students at SMP Negeri 8 Malang with the first characteristics have demonstrated all the stages of reflective thinking expressed by [3]. Students seem to identify problems, plan solutions, and implement plans with open thinking and are able to provide more than three solutions to the right answers. This was also stated by [14] who revealed that one characteristic of reflective thinking is being able to develop and find various alternative solutions to the right answers.

Whereas, students with the second characteristic have fulfilled all stages of reflective thinking but lack open thinking and only provide three answer solutions which are the minimum number of solutions requested in the problem. This is different from students in the third characteristic who do not fulfill the reflective thinking stage in solving problems. Students do not understand the problem so that it does not provide a solution to the answer that matches the problem question and only makes 2 answer solutions.

The implication of this research is to develop the understanding of students and teachers in learning that can improve reflective thinking in solving each mathematical problem solving. For the next study, researchers want to identify more in-depth reflective thinking levels for each of the reflective thinking characteristics mentioned above.

1 **CONCLUSION**

Based on the analysis and discussion of the results of the data, the description of students' reflective thinking in solving open-ended problems about plane figure can be grouped into 3 different characteristics. Each characteristic has a different character from the stages of students' reflective thinking. The first characteristic, students identify the problem; students formulate information the problems with make more than three possible descriptions of problem solving solutions and each description of the formulate of this problem is indicated by giving a boundary (dashed line) to the main building so as to form several pieces of wake, then write additional letters, and name them; make a plan by making more than three considerations of problem solving solutions, namely writing down the width of each piece of wake obtained and formulating it in the form of addition, and then calculating all the area of plane figure and reflecting back the results of his work.

The second characteristic, students identify the problem; students formulate information the problems with make three possible descriptions of problem solving solutions that are the minimum number of solutions that are asked for in the problem; draw up a plan by making three considerations of problem solving solutions, and then calculate all the area of plane figure. The third characteristic, students only give two possibilities to picture problem solving solutions; draw up a plan by making two considerations of problem solving solutions, and then calculate all areas of plane figure. Students with these third characteristics have not been able to reflect back on the results of their work because they do not provide solutions to answers that match the problem questions and only provide two different ways.

This research is expected to be able to help other researchers to conduct re-research related to reflective thinking of students on other material by looking at different characteristics and also being able to contribute knowledge to teachers or researchers related to the description of reflective thinking of different students.

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