

## Profile Reflective Thinking Ability of Vocational High School

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### Abstract

The aims of this research were to describe the reflective thinking abilities of the students in Grade XII of Vocational High School in Surakarta. This research used qualitative case study approach. The data of research were tests and task based in interviews. Analysis of the results of written tests and interviews shows that the profile of reflective thinking ability in solving math problems on the content of derivative applications for step by step of the process of mathematization are (1) In solving problems of application of function derivatives at the stage of problem definition, almost all subjects can provide the main problem. (2) In the problem analysis stage, almost all subjects can provide the main problem, but only one subject adjusts the subject matter to the basic formula of flat build. (3) In the criterion stage of the solution, almost all subjects met this stage, even though the results of the evaluation experienced errors. (4) In the information analysis stage, only one subject does not need other information in solving the problem. (5) In the propose solutions stage, all subjects are able to take what I am solving to solve the problem. (6) In the select solution stage, there are some students who can reach this stage. (7) In the implement solution stage, only two subjects reach this stage until completion. (8) In the feedback analysis stage, only two subjects did the re-checking of the steps in solving the problem.

*Keywords:* Reflective Thinking, Mathematic Ability

### 1. Introduction

Critical thinking ability became demand in Curriculum 2013 which is now being applied in all vocational high schools. The ability to think mathematics, especially the ability to think at a high level or high order thinking skill (HOTS) is one of the benchmarks for achieving the goals of mathematics learning. Higher order thinking skills include critical, logical, reflective, metacognitive, and creative thinking, this is show that one of HOTS is reflective thinking [1], [2]. Vocational high schools have begun to apply HOTS questions in the 2018/2019 National Examination.

Reflective thinking ability is one of the abilities needed in learning mathematics [3], [4]. That is because the targets of mathematics learning such as understanding, problem solving, connections, and mathematical communication, as well as other abilities will be possessed by students well if students are able to realize what is done right, and can conclude what should be done if they fail, and can evaluate what has been done.

In achieving reflective thinking abilities, there are stages that need to be passed. Based on Mezirow's theoretical framework that reflective thinking can be divided into 4 steps, they are habitual action, understanding, reflection,

and critical thinking [5]–[7]. Habitual Action is a mechanical and automatic activity that is performed with little conscious thought. Understanding is student understands the situation without relating another situation. Reflection is active, persistently and considering the general truth of student consius. (d) Critical thinking is the highest thinking of reflective thinking that involves the students understanding why they feel various things. Decide and solve the problem. From reflective thinking, Nasriadi [4] students are not only able to answer questions, but also able to express the step by step that occur in his mind when solving the problem.

The stages of reflective thinking consisting of eight stages [8]–[10], namely: 1) problem definition, the stage for understanding the objectives to be achieved from problem solving; 2) problem analysis, the stage of analyzing the problem carried out in order to obtain information that is known (cause) and what is asked (as a result) and clarify the interpretation (facts) of the problem so that it is easier to arrange solutions; 3) selection criteria, the stage briefly describes the characteristics of the possibility of a solution where the characteristics are arranged along with rational reasons to classify information that needs attention in order to lead to the solution; 4) information analysis, the stage of identifying information that is still needed to make solutions to problems and linking information obtained with the knowledge possessed; 5) propose solutions, the stage of proposing possible solutions to problems. The possibility of the solution is checked for compatibility with information that has been analyzed to support the answer; 6) select solution (s), the stage to determine the actual solution of the problem by paying attention to the suitability of the information in the problem; 7) implement solution (s), the stage of selecting a method to determine the type of mathematical operation that will be used to obtain a solution accompanied by analysis so that the application is correct; and 8) feedback analysis, at this stage an evaluation of the settlement that has been obtained from the initial steps of the settlement.

Subjects with high mathematical ability have higher reflective thinking ability than medium and low ability subjects in senior high school. From this, the researcher is curious about the mathematical ability of vocational high school students in solving reflective thinking questions [11]. Based on these results, the authors conducted research on the reflective thinking ability of

students with mathematical ability on solving derivative application problems.

**2. Method**

This research is a qualitative descriptive research that describes reflective thinking ability of vocational students. Research subject are 6 students who have mathematical ability. The research subjects were determined using purposive sampling techniques, on the basis of the teacher's consideration with the following conditions: (1) having heterogeneous mathematical thinking skills seen based on test results and observations of mathematics teachers during the mathematics learning process, (2) can collaborate with researchers to engage in research, (3) has the ability to communicate the results of thought both verbally and in writing properly.

Data analysis techniques in this study use three ways, namely: 1) data reduction, 2) data presentation, 3) drawing conclusions or verification, drawing conclusions after the data analysis results are known while for the validity test data in this study using triangulation techniques performed with how to check data with the same source but different techniques [12], [13].

**3. Result and Discussion**

Analysis of reflective thinking skills on eight subjects was carried out on the basis of test and interview results. The following are presented based on the types of questions given.

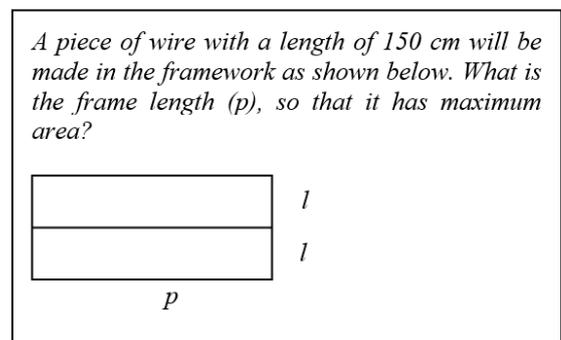


Fig 1: One Problem

Figure 1's: In phase 1 problem definition, all subjects are able to know the problems that exist in the problem and formulate it in a definite statement.

However, there are several differences in the subject's formulation. Subject 1 formulates by combining the perimeter of a rectangle with a picture, while five other subjects formulate directly according to the basic

circumference of a rectangle. This can be seen from the interview quotation as in Table 1.

Table 1. Phase 1 Problem Definition

Subject 1	Subject 2
Transcript of interview subjects who formulate with information with what is written on the questions	Transcript of interview subjects who formulate with information but do not match what is written in the problem
Q: What do you understand from this problem? S1: It is known that there is a 150 cm long wire and then made rectangular as drawn Q: Then what is the problem with this problem? S1: Asked to determine the length of the framework	Q: Try what you understand from that problem? (refer to question number 1) S2: How do you explain it Q: Just explain with your own language it's okay. S2: It is known here that the wire (while referring to the problem in the answer sheet), A piece of wire with a length of 150 cm will be made in the framework as shown below. What is the frame length (p), so that it has the maximum area?

In phase 2 Problem Analysis, each subject has been able to identify which information is a factor causing the emergence of problems that exist in the problem. Nevertheless, there is diversity in the subject's ability to express it. Subject 2 states what is known in the

problem according to the picture, the other five subjects also state the perimeter of the rectangle but do not adjust the formula around the rectangle according to the picture. This can be seen from the interview quotation as in Table 2.

Table 2. Phase 2 Problem Analysis

Subject 2	Subject 5
Transcript of interview subjects who formulate according to the picture  Q:What is the corresponding circumference formula in this figure? S1: If according to the picture, it becomes $3p + 4l$ , but if it fits the basic formula $K = 2p + 2l$ Q: Why do you write $3p + 4l$ ? S1: Because there are 3 pieces in length and 4 in width	The interview transcript of the subjects which formulated did not match the picture  Q: Still remember the formula related to the picture below? S2: Still, why exactly mom? Q: Is the formula you write is correct? S2: Yes, ma'am, the formula for traveling around length 2 (p + l)

In phase 3, Criteria Solution, all five subjects have the idea that the problem can be solved by a circular rectangle formula to find the length or width split. Each subject is also able to determine important information and lead to possible solutions so that all subjects meet the criteria selection stage indicator. This can be seen from the interview quotation as in Table 3.

In phase 4 Information Analysis, at the stage of identifying information that is still needed to make a solution to the existing problem, only subject 1 no longer needs other information. Therefore, the other five subjects did not meet the information analysis stage indicator.

Table 3. Phase 3 Criteria Solution

Reflective Thinking Ability	Subject 3
Criteria Solution	Transcript of subject interviews that connects with material around the flat shape Q: Regarding the length of the wire, remember what formula was used in doing this problem? S3: The circumference of a flat shape Q: In addition, what other materials are used to maximize the maximum area? S3: derived application material in terms of maximum or minimum values

In phase 5: Propose Solutions, based on a description of possible solutions and after reviewing the information in the problem, all subjects were finally able to propose a solution to solve the problem but the

results obtained from the other four students experienced errors at the evaluation stage. This can be seen from the interview quotation as in Table 4.

Table 4. Phase 5 Propose Solutions

Subject 1	Subject 2
Transcript of subject interviews that formulates with an initial problem	Transcript of interview subjects who formulate with two solutions
Q: Try to explain how you completed?	Q: How do you solve this problem, what should you look for first?
S1: Here there are known wires with a length of 150 cm, the first step is to interpret the length of the wire in the form of a circumference	S2: The first one is to find the length or width first, but you have to look at the picture mom.
P: Then what else?	Q: From the pictures, what information did you get?
S1: Look at the picture and find there are lengths of 3 pieces and widths of 4 pieces, then separated into rectangular formulas	S2: length and width, that there are 3 pieces in length and 4 in width.
Q: Do you need other steps to determine questions according to your prayers?	P: Then what are you doing again?
S1: Yes necessary, maximum area, with the application of the concept of derivatives	S2: Suppose $p = \dots$ or $l = \dots$ one of them can be taken
Q: Are there other ways to think about it, before going to the broad formula?	P: If for example $p$ only is it possible?
S1: I don't know, but for me there isn't	S2: Yes, but I can use two examples at once to be valid

In phase 6 Select Solution, at the stage of choosing a solution, not all subjects follow up the proposed solution to solve the problem. From one subject that proposes 2 kinds of solutions is subject 2. The other subjects choose to solve the problem with the steps according to the basic formula around the square display.

In phase 7 of Implement Solution, all subjects have applied the solution in accordance with the solution chosen in the previous stage. In addition, there are no subjects who make mistakes in applying the count operations used to solve problems, but have not yet solved the problems listed in the problems.

In phase 8 Feedback Analysis, when re-evaluating the resolution obtained, subject 4, subject 5 and subject 6 did not re-evaluate the solution obtained because they were sure of the answer. The other three subjects examine the initial steps of completion. Where subject 2 does the analysis by examining using a different way of looking for length and width values. This can be seen from the interview quotation as in Table 8.

Thus, only subjects 4, 5, and 6 did not meet the feedback analysis indicator stage, while the other three subjects did not meet the feedback analysis indicator stage.

Table 8. Phase 8. Feedback Analysis

Reflective Thinking Ability	Subject 2
Feedback Analysis	Transcript of interview subjects who formulate in two ways and check again Q: Are you trying to double check what is obtained? S2: Yes, I checked, right first I used the method of $p = 50 - 4 / 3l$ and then checked it with an example $l = 150/4 - \frac{3}{4}p$

**4. Conclusion**

Based on the results of the analysis of the reflective thinking ability of students in completing derivative applications, then the following conclusions from the problem. (1) In solving problems derived from function applications at the problem definition stage, almost all subjects can provide the main problem. (2) In the problem analysis stage, almost all subjects can provide the main problem, but only one subject adjusts the subject matter to the basic formula of flat build. (3) In the criterion stage of the solution, almost all subjects met this stage, even though the results of the evaluation experienced errors. (4) In the information analysis stage, only one subject does not need

other information in solving the problem. (5) In the propose solutions stage, all subjects are able to take what I am solving to solve the problem. (6) In the select solution stage, there are some students who can reach this stage. (7) In the implement solution stage, only two subjects reach this stage until completion. (8) In the feedback analysis stage, only two subjects did the re-checking of the steps in solving the problem.

Not all students with high ability can reach eight stages of reflective thinking so it is likely that students with abilities below those students also cannot reach 8 stages of reflective thinking. Based on these results it is recommended for teachers to emphasize the reflective thinking process of students in learning mathematics. Therefore, it is recommended for teachers to practice their reflective thinking skills by solving these problems.

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