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Reflective Thinking Ability of Junior High School Students in Solving Problems Involving Systems of Linear Equations in Two Variables

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Abstract

This study wants to show how students think when solving math problems about two-variable linear equations. The research used both numbers and interviews, and it was done at a junior high school in Bandar Lampung.. The subjects consisted of 60 eighth-grade students. The students' test responses were analyzed, and three representative students—each corresponding to one of the phases of mathematical reflective thinking related to SLETV—were selected for interviews. The instruments used in this study included three items designed to assess mathematical reflective thinking ability and an interview guideline. This study used three questions to see how students think in math and also used interviews. The answers were checked in three steps: reacting, comparing, and thinking deeply. The results showed that students did a good job in reacting and comparing, and did fine in thinking deeply.

Keywords: Reflective Thinking, Profile, System of Linear Equations in Two Variables (SLETV)

1. Introduction

Mathematics is known as a subject that is used to help build knowledge in many different parts of everyday life (Levinta et al., 2024). Therefore, mathematics as one of the subjects taught in schools becomes is an essential part of the learning process for students (Nabila et al., 2024). Mathematics education is considered fundamental, as it serves as the basis for other disciplines, particularly in the field of science and technology. Zalukhu et al. (2023) argue that mathematics is a branch of science that enables individuals to become critical and creative thinkers, thereby equipping them with the ability to solve problems through logical reasoning. In learning mathematics, students are expected to build on previously acquired material to facilitate the understanding of new concepts. Moreover, students hope that they can better retain their learning and apply it to solve everyday problems related to mathematics (Susanti et al., 2020).

The main goal of learning mathematics is so that students can be given the skills to think clearly and carefully. that support their understanding of mathematical concepts, apply these concepts flexibly, and solve problems effectively. Additionally, mathematics education aims to enable students to use arguments in identifying patterns and characteristics, make generalizations through mathematical manipulation, and communicate mathematical ideas in a structured manner to reinforce logical proof (Pangestu & Santi, 2016). Anwar and Soraya (2022) stated that thinking ability refers to the capacity for efficient mathematical reasoning. The process of developing reflective thinking skills involves recognizing prior knowledge, modifying that understanding to overcome new challenges, and applying the solution in different contexts.

Thinking is a distinctive human trait that sets us apart from other living beings, and reflective thinking is defined as reasoning guided by purpose (Widiyasari et al., 2020). One crucial cognitive ability to be developed is mathematical reflective thinking. This ability involves problem-solving through the identification of known information, adapting understanding to resolve a given issue, and applying the outcomes in new situations (Anwar & Soraya, 2022). Furthermore, the function of reflective thinking is to provide meaning, formulate relationships between experiences, and foster continuity (Ching Yim & Tan, 2017). Learners who possess reflective thinking skills are more aware of what is needed in their learning process, allowing them to solve problems with logical reasoning and reanalyze their solution strategies. Reflective thinking also aids students in achieving learning objectives and behavioral transformation (Diana Hernawat et al., 2021).

To assess students' mathematical reflective thinking ability, indicators adapted from Ariestyan & Kurniati (2016) and Rahmawati et al. (2022) are used. These steps are: (1) Reacting, where students are asked to say what they know, what the question is, and how both are connected; (2) Comparing, where students are asked to tell how to solve the problem in a smart way and link it to other problems they have seen before; and (3) Contemplating, where the problem is solved using a chosen method, mistakes are found and fixed, and a final answer is explained.

tudies by Isna et al. (2024) and Permatasari et al. (2020) found that students' reflective thinking skills in mathematics remain at a low level. This is evidenced by the failure to meet the indicators of reflective thinking ability. Students often struggle with interpreting instructions and face time constraints during problem-solving, leading to frequent mistakes in both the process and final answers.

The system of linear equations in two variables (SLETV) is one of the topics in mathematics education that offers potential for developing students' competencies. This topic is relevant to students' daily experiences and activities. Moreover, SLETV is introduced in junior high school and offers multiple solution methods such as elimination, substitution, and a combination of both (Maydawati, 2024). A student is considered capable of solving a problem when they can understand the question, develop a solution plan, write down the answer, and review the result (Zulfikar & Masni, 2021). Based on this background, this study's goal is to analyze junior high school students' reflective thinking abilities in solving problems involving systems of linear equations in two variables.

2. Methods

This study was done using two kinds of ways: using numbers (quantitative) and using words or stories (qualitative). The students who were part of this study were from grade 8 at a junior high school in Bandar Lampung. The sample was selected using purposive sampling, which involves selecting the sample class based on specific considerations (Tanjung, 2019). The total sample included 60 students. The students' test responses were analyzed, and three students were then selected for interviews based on the same criteria, categorized under mathematical reflective thinking ability in unravelling difficulties correlated to the issue of Systems of Linear Equations in Two Variables (SLETV). The purposive sampling technique used in the interview phase aimed to select a few students who were considered representative of the overall group, sharing the same characteristics in terms of mathematical reflective thinking ability (Lestari et al., 2024).

The tools used in this study were a math thinking test and interview questions. The data were collected by giving students written tests and doing interviews. The data were looked at using both numbers and explanations. The scores from the math test were counted as number data from the written answers. These scores came from how students answered three questions, and the way the scores were given can be seen in Table 1.

Table 1.
Scoring Rubric for Mathematical ReflectiveThinking

Skor	*Reacting*	*Comparing*	*Contemplating*
0		No answer	
1	Presents information, but with inaccuracies	Constructs a mathematical model, but it is incorrect	Provides only limited explanation (inaccurate)
2	Presents information, but incompletely	Develops a mathematical equation from the given problem, but with some inaccuracies	Constructs a solution based on previously learned mathematical concepts, but the approach is still imprecise
3	Presents information completely, but with some errors	Constructs a correct solution to the given problem	Accurately formulates the general form of the relevant concept, accompanied by justification

The written test in this study consisted of three open-ended questions administered to the research subjects. The test items were contextual problems related to the topic of Systems of Linear

Equations in Two Variables (SLETV). Prior to data collection, a test instrument trial was conducted with students who had already studied the topic. The results of the instrument trial were then analyzed to ensure the validity and appropriateness of the test items. The results of the instrument validation are presented below:

Table 2.

Results of Instrument Validation

No	V	r_{11}	DP	TK
1	Valid	0,892 (reliabel)	0,346	0,407
2			0,282	0,074
3			0,375	0,444
4			0,370	0,000

Based on the analysis of Table 2, it was found that the instrument was valid and appropriate for use. Consequently, the next step was data collection. The data were collected by giving a written test with questions about two-variable linear equations. The students' answers were checked using three thinking steps: reacting, comparing, and contemplating. The results of the math thinking test were explained using certain rules or standards.

Table 3.

Criteria for Mathematical Reflective Thinking Ability

Percentage Indicator	Criteria
$P \geq 75\%$	Very Good
$50\% \leq P < 75\%$	Good
$25\% \leq P < 50\%$	Pair
$P < 25\%$	Poor

2. Result and Discussion

The test instrument consists of three questions, which were completed by students within a duration of 2×40 minutes (2 class periods). The first question is about knowing the difference between a system of two-variable linear equations and just a two-variable linear equation. The second question asks students to find the values of x and y by using the substitution or elimination method. The third question asks students to find x and y by drawing a graph. These questions were made based on the steps of reflective math thinking, the differences in students' thought processes were identified as follows:

Table 4.

Percentage of Students' Responses to Question 1

Tahap	Experiment		Control	
	Percentage	Criteria	Percentage	Criteria
Reacting	89%	VG	78%	VG
Comparing	91%	VG	92%	VG
Contemplating	72%	G	86%	G

The data in Table 4 shows that the "comparing" phase achieved the highest percentage, as students used their reflective thinking ability to relate the problem in the question to experiences they had previously encountered, enabling them to determine the correct solution steps (Rahman et al., 2024). The average achievement of the experimental class students in this phase was 91%. There were 15 students out of 60 who did not meet the indicator, and they tended to make the same mistake, namely, an error in defining the variables x and y.

Figure 1
Incorrect Answer from One of the Experimental Class Students

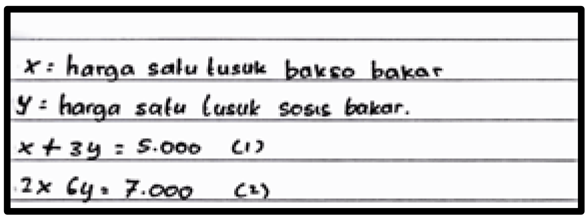
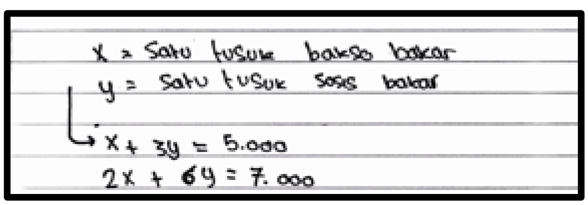


Figure 2
Incorrect Answer from One of the Control Class Students



Based on Figures 1 and 2, it is evident that there is a difference in how some students define the values of x and y, leading to incorrect results. Students should have defined x as the price, not as the object itself. The students admitted to being confused about how to define the variables x and y because of the contextual nature of the question. Here is a part of an interview with a student:
Interviewer (P): "Have you encountered a problem like this before?"
Student(S):"Yes,I have, ma'am."
P: "Can you explain how you understand the concept of finding variables in this problem?"
S: "Well, first I look for what is given and what is being asked, ma'am. Then, after that, I define the values of x and y based on what I obtained from the given information."

Figure 3

Percentage of Students' Responses to Question 2

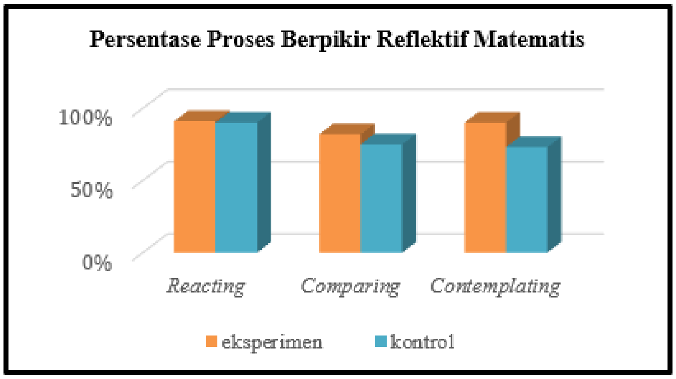


Figure 3 shows that the "reacting" phase had the highest score, with 91%. This means most students did really well in the "reacting" phase. Almost all students were able to write what was given and what was being asked in the problem using math symbols. Out of 60 students, 15 students did not meet the "reacting" phase because they did not fully write down what was given and what was asked. The students who did not meet this phase failed to include all the information provided in the question.

Figure 4

Incorrect Answer from One of the Control Class Students

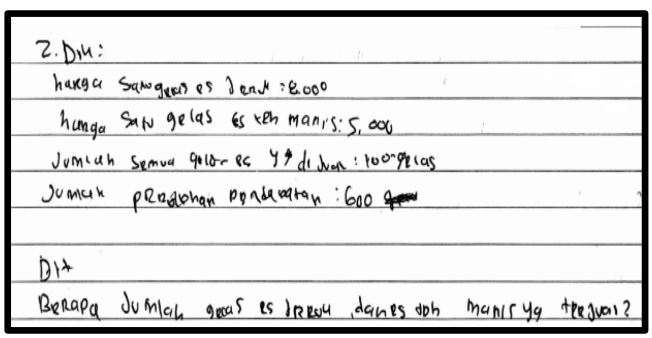
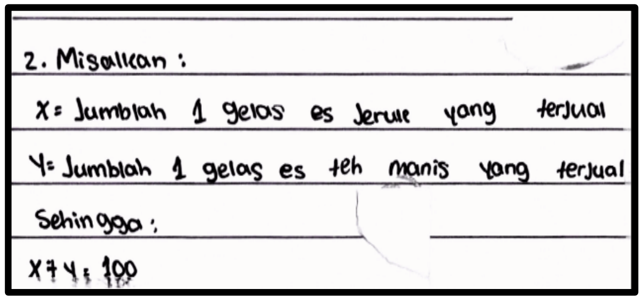


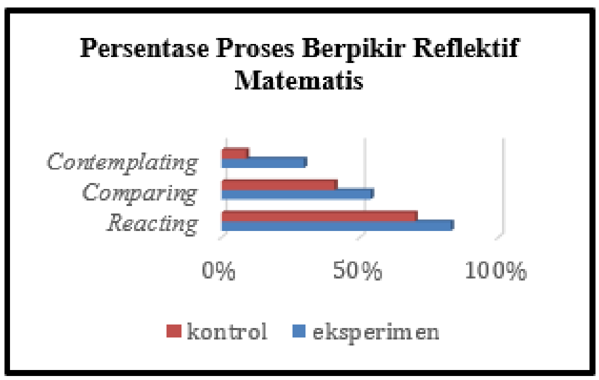
Figure 5

Incorrect Answer from One of the Experimental Class Students



Based on Figures 4 and 5, it is evident that the students' responses indicate that some students have not yet achieved the "reacting" phase. It can be seen that the student incorrectly wrote down the information from Figure 4. The student should have written Rp. 600,000, but instead, they only wrote Rp. 600.

Figure 6. *Percentage of Students' Responses to Question*



The final phase is "contemplating," which is the stage where students complete the problem and draw a conclusion (Riswadi & Adirakasiwi, 2023). This phase had the lowest percentage, with only 30% of students able to answer correctly. On average, all students were able to attempt the problem, but a significant amount of time was spent trying to understand the meaning of the question. As a result, the "contemplating" phase was not reached because the students could not find the answer to what was being asked.

One of the reasons for the difficulties experienced by students was that they struggled to find the intersection point to graph the solution. The limited time caused them to draw the graph incorrectly, leading to wrong conclusions and, in some cases, even failing to write a conclusion.

Figure 7

Incorrect Answer from One of the Control Class Students

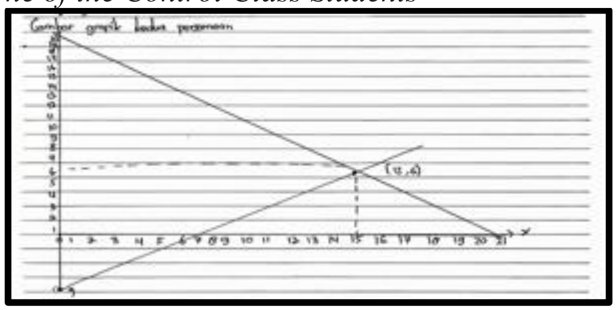
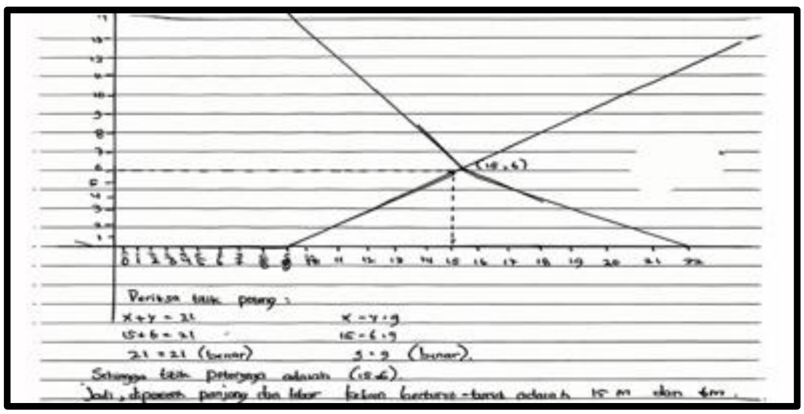


Figure 8

Incorrect Answer from One of the Experimental Class Students



The most frequently unmet indicator is the students' ability to correct and explain errors in their answers, as well as draw conclusions. For example, in the experimental class, students S-1 and S-3 obtained the same equation results, but S-3 did not write a detailed explanation for drawing the conclusion. Therefore, it can be said that S-3 did not meet one of the indicators.

4. Conclusion

Overall, The reflective thinking process of eighth-grade students on the topic of two-variable linear equations shows different average scores in each phase. In the reacting phase, the average reflective mathematical thinking process of students reached 87% (very good). Next, in the comparing phase, students obtained an average of 79% (very good). However, in the final phase, contemplating, students' average score declined to 63% (good). The decline in the average percentage of reflective thinking processes is due to many students not completing the problem fully and spending more time trying to understand the problem presented, which prevented them from solving the problem.

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