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Ika Eryanti[1*], Emmanuel Kwadzo Sallah[2], Emmanuel Gakuba[3]
[1]Sekolah Menengah Kejuruan Bunda Auni, Bekasi, 17148, Indonesia.
[2]Evangelical Presbyterian College of Education, Amedzofe, 23227,Ghana
[3]University of Rwanda, College of Education,Kigali,4285,Burundi,
*eryantiika@gmail.com

Abstract

This research is research using the descriptive analysis method, where this type of research provides descriptions, descriptions, and presentations related to the object under study by the circumstances when the research was carried out. SPLD (System of Linear Equations of Two Variables). the subjects in this study were students of SMK Bunda Auni class 10 for the 2021/2022 Academic Year. The total number of students who became the subject was 13 students, including 1 male student and 12 female students. The method used in collecting research data was by giving questions to three grade 10 students of Bunda Auni Vocational School who had taken part in the daily assessment of SPLDV material that had low mathematical ability, moderate mathematical ability, and high mathematical ability. The results showed that students with high algebraic thinking ability categories were able to fulfill all indicators of algebraic thinking in problem-solving questions, for students with medium algebraic thinking ability categories students were not yet able to think analytically and dynamically and organize, and for students with low thinking ability categories, students had not yet able to think analytically and dynamically and organize.

Keywords: *thinking skills and SPLDV.*

Abstrak

Penelitian ini merupakan penelitian dengan menggunakan metode analisis deskriptif, dimana jenis penelitian ini memberikan gambaran, deksripsi, dan pemaparan terkait objek yang diteliti sesuai dengan keadaan ketika penelitian itu dilaksanakan.. Dalam penelitian ini yang menjadi instrumen pendukung adalah TPM (Tes Pemecahan Masalah) terkit materi SPLD (Sistem Persamaan Linier Dua Variabel). subjek didalam penelitian ini adalah siswa SMK Bunda Auni kelas 10 Tahun Pelajaran 2021/2022. Total jumlah siswa yang menjadi subjek adalah 13 siswa yang diantaranya 1 siswa laki-laki dan 12 siswa perempuan. Cara yang dilakukan dalam pengambilan data penelitian adalah dengan cara memberikan soal kepada tiga orang siswa SMK Bunda Auni kelas 10 yang telah mengikuti penilaian harian materi SPLDV yang memiliki kemampuan matematis rendah, kemampuan matematis sedang dan kemampuan matematis tinggi. Hasil penelitian diperoleh bahwa siswa dengan kategori kemampuan berpikir aljabar tinggi mampu memenuhi seluruh indikator berpikir aljabar pada soal pemecahan masalah, untuk siswa dengan kategori kemampuan berpikir aljabar sedang siswa belum mampu berpikir secara analitis dan dinamis dan pengorganisasian dan untuk siswa dengan kategori kemampuan berpikir rendah siswa belum mampu untuk berpikir secara analitis dan dinamis dan pengorganisasian.

Kata Kunci: kemampuan berpikir dan SPLDV.

1. Introduction

The ability of students to think algebra is one of the abilities that is a prerequisite and is felt to be very important for students to have in developing students' mathematical skills and knowledge, the background to this is because students' skills in algebraic thinking is one of the mathematical abilities that places more emphasis on students' thinking activities. Based on this, it can be said that the ability to think algebra is a very important ability to be mastered by students, because with the provision of algebraic thinking skills students are able to understand well a mathematical problem and are able to solve problems involving algebraic forms in solving them that students encounter in life. daily. Students' ability to solve problems in everyday life by involving mathematics makes students appreciate the role of mathematics in life(Irsal et al., 2017; Kahl et al., 2021). From the flow of a student's thinking process, it can be seen how the student's ability to solve a problem. In addition, the flow of students' thinking processes can be used to determine the level of understanding of concepts and the stages of the problem-solving process. Thus in solving mathematical problems it is necessary to have good thinking skills, where good thinking skills can be achieved by students if their thinking processes in solving mathematical problems are also good(Kenan, 2017; Rahmi, 2021).

Algebraic thinking refers to a thinking process in which students collect information from a problem involving algebraic forms, then students sort each piece of information obtained to make predictions by exploring the known information(Brijlall & Ndlovu, 2013; Kenan, 2017). Then the next step is to represent the given problem in different terms. The form of problem representation referred to in this case is the use of notations and symbols, mathematical equations, tables, pictures, graphs and others. So it can be said that students' algebraic thinking abilities and mathematical abilities are closely related to each other, students' differences in algebraic thinking are influenced by differences in students' mathematical abilities(Borchardt & Bozer, 2017).

In exploring algebraic thinking skills which include problem solving, representation and analysis skills, it is necessary to have the role of algebra as a branch of mathematics. Algebra is considered to have an important role to be mastered by students both directly and indirectly because algebra is used to solve problems in everyday life(Indrawatiningsih, 2017; Lee, 2018). Thus it becomes a natural thing if algebra is considered as a part of mathematics that is important for students to learn.

Algebra is a presentation in the field of mathematics which presents its own challenges for students and teachers because it involves the existence of symbols in mathematics in the form of variables. Algebra provides many benefits in solving everyday life problems faced by students, based on this, algebra plays a role as one of the critical aspects of mathematics. Students assume that learning the values of x and y in mathematics is not real. Even though it has been assisted by learning contexts that are close to the daily lives of students, it is often encountered by those who experience difficulties.

One of the factors that causes errors in solving algebraic problems is the difficulties and failures in algebraic thinking processes faced by students. As stated by (Permatasari et al., 2021) factors that cause students to repeatedly make mistakes in learning algebraic materials and other related materials and there are obstacles to the process of acquiring new knowledge, namely the existence of misconceptions about previous knowledge. Thus we can say that if students do not understand the concept, then this can be the cause of students' mistakes in solving algebraic material problems in real life(Anne & Mangulabnan, 2013). Incidents like this can also occur because in the process of understanding algebra material students do not empower their knowledge or it is caused by a discrepancy between the initial concepts possessed by students and the concepts given by the teacher,

teaching materials, teaching methods and so on. The student's final answer cannot be used as a reference in viewing and assessing the mistakes made by students, but it can also be seen from the process of determining the method used by students in solving the problems given, namely in the form of questions. Thus students will be able to find the location of mistakes made in solving problems more specifically, from this students will be more motivated to improve and try not to repeat the same mistakes.

Algebraic thinking is an ability to think mathematically in mathematics which in its thinking activity includes several activities, including generalization, abstraction, analytical thinking, dynamic thinking, modeling, and organizing. organization) (Lew in Utami et al., 2020). This opinion is in line with the objectives of learning mathematics, namely students are trained in thinking and reasoning patterns in terms of making conclusions (Arfianto & Hakim, 2019). Furthermore, students must also be able to analyze logically and rationally (Kurniasih & Hakim, 2019). From the description above, it can be said that algebraic thinking is a thinking activity where students are more emphasized on the use of algebraic symbols in solving mathematical problems, so that this ability is important for students to have and master.

The system of two-variable linear equations, known as the abbreviation SPLDV, is mathematical material that contains variables (variables) so that many problem-solving skills are involved in solving it. SPLDV is closely related to mathematical problems in everyday life, so students' understanding of SPLDV material and using it in solving problem-solving questions is very important. There are several methods that can be used to solve SPLDV questions, namely the graphical method, the elimination method, the substitution method, and the mixed method which involves more than one method in this mixed method(Ferdiani et al., 2021). The efforts to understand and solve SPLDV questions involve algebraic thinking skills. Therefore, in order for students to achieve the maximum possible mathematical problem solving abilities, it is necessary to have students' algebraic thinking abilities.

A research conducted by (Aksu & Koruklu, 2015) shows that many students still do not meet graduate competency standards and their algebraic thinking skills are still low. This is due to students' lack of understanding of algebraic concepts. In addition, the algebraic thinking ability of students with low mathematical ability to solve problems in the form of story questions, in this case the indicator stage of algebraic thinking ability has not been achieved by students which is reinforced by the results of research conducted by (Drummer et al., 2018; Schoenberger-Orgad & Spiller, 2014). Based on research (Yusrina & Masriyah, 2019), the results of this study indicate that algebraic thinking of students with low mathematical abilities in solving contextual math problems consists of generalization, dynamic thinking, and organizing. Based on the problems above, the researcher is interested in examining more deeply the algebraic thinking skills of class X students of SMK Bunda Auni in solving two-variable linear equation system problems (SPLDV). The purpose of this research is to describe the algebraic thinking ability profile of SMK students in solving problems related to their mathematical abilities.

2. Research methods

2.1 Conteks

This research is a research using descriptive analysis method, where this type of research provides an overview, description, and presentation related to the object under study in accordance with the circumstances when the research was carried out. In this study, the approach used was a qualitative approach, in which the research process did not use statistical or mathematical calculations, but

emphasized more on analysis in the form of words, the meaning of the data obtained, and the categorization of value or quality. Thus, this research can be said to be a research method that provides descriptive data about the characteristics of students' algebraic thinking skills from the results of tests and interviews.

2.2 Participant

The subjects in this study were students of SMK Bunda Auni grade 10 for the 2021/2022 academic year. The total number of students who became the subject was 13 students, including 1 male student and 12 female students. Of the 13 students who were the subject, it was a class with heterogeneous student circumstances, thus there was a possibility that each student's algebraic thinking ability was different. Based on this, 3 students were taken as subjects in the study. Each of the three students represents a category of low mathematical ability, moderate mathematical ability and high mathematical ability.

Grouping students into three categories, namely low, medium, and high mathematical ability based on daily assessment of the previous material, namely randomly selecting a student who represents the high mathematical ability category (female) with code S1, a student representing the moderate mathematical ability category (male) -male) with code S2, a student representing the low mathematical ability category (female) with code S3. Meanwhile, based on the tools used by students to study during this pandemic, data was obtained that 8 students used mobile phones, 8 students used laptops, and 2 students used tablets.

Table 1 Sample Demographics

Category		Amount
Gender	Male	1
	Female	12
Mathematical ability	High	5
	Medium	4
	Low	4
Tools to use for learning during a pandemic.	Handphone	8
	Laptop	3
	Tablet	2
	PC	0

2.3 Instrument

In this study, the supporting instrument was the TPM (Problem Solving Test) regarding SPLD material (System of Two Variable Linear Equations), and the results represent students' algebraic thinking abilities according to their abilities in SPLDV material(Dwi Susandi et al., 2019; Hastuti et al., 2021). The reason for using the description test in this study was because it was adapted to the purpose of this study, namely to study the profile of students' algebraic thinking skills in solving problems of systems of two-variable linear equations(Kenan, 2017).

The second instrument used is the interview. The purpose of this interview is to obtain in-depth data regarding the description of students' algebraic thinking skills in solving mathematical problems, especially in SPLDV material(Dwi Susandi et al., 2019; El Hakim & Pinta Deniyanti Sampoerno, 2020). Interviews were conducted after observations and tests in the form of giving problem solving questions. This interview was conducted with three selected students who were representatives of each student category, namely students with high, medium and low mathematical ability categories who had completed the problems in the form of problem solving given by the researcher regarding the SPLDV material.

Table 2 SPLDV Troubleshooting Problem

SPLDV Problem Solving Problem (System of Linear Equations of Two Variables)

One of the efforts we can make to prevent the spread of the corona virus is the use of hand sanitizers and masks. In the midst of the threat of the Covid-19 pandemic, the availability of these two products has become a rarity. This resulted in the price of hand sanitizers and masks rising sharply. Cici, Boby and Ani wanted to buy masks and hand sanitizers at the pharmacy to meet the needs of daily health protocols. To purchase 2 masks and 3 bottles of hand sanitizer, Ani pays Rp. 84,000. At the same pharmacy, Boby paid IDR 63,000 to purchase 3 masks and 1 bottle of hand sanitizer. Meanwhile, Cici plans to buy 2 masks and 4 bottles of hand sanitizer. If Cici pays with Rp. 150,000, how much change did Cici receive?

The indicators of algebraic thinking skills used in this study are as follows:

Table 3 Algebraic Thinking Ability Indicator

Algebraic Thinking Ability Indicator	
Algebraic Thinking Components	**Activity**
Generalization	Students are able to compose a linear equation form of two variables.

Abtraction	Students are able to formulate problems into algebraic forms.
Analytical Thinking	Students are able to determine the value that is not yet known.
Dynamic Thinking)	Students are able to carry out manipulation activities from a known value to obtain the next unknown value.
Modeling	Students are able to carry out systematic and sequential solutions according to algebraic rules.
Organization	Students are able to arrange algebraic forms of any information obtained.

2.4 Data collection technique

The research data obtained was in the form of test results in the form of essay questions to measure algebraic thinking abilities and interviews were evaluated and analyzed descriptively, through this data it was also used as material for analysis to determine students' algebraic thinking abilities when answering tests in the form of essay questions to measure students' algebraic thinking abilities. given. This phase is very important in research to get data in accordance with what is expected. The data collection technique used in this study was an algebraic thinking ability test technique in the form of test instruments in the form of essay questions and interviews.

The method used in collecting research data was by giving questions to three grade 10 students of Bunda Auni Vocational School who had taken part in the daily assessment of SPLDV material that had low mathematical ability, moderate mathematical ability and high mathematical ability.

The test instrument in the form of descriptive questions in this study was used to describe students' algebraic thinking skills and the mistakes made by students in the process. While interviews were conducted to see the causes of errors made by students.

2.5 Analysis Data

The data analysis technique used in this study was descriptive qualitative in the form of written words about the algebraic thinking abilities of the students who were observed as research objects. The analysis in this study is a method for systematically searching for and compiling data obtained from the results of tests of students' algebraic thinking abilities and the results of interviews. In analyzing the data, it is carried out through the following stages: 1) data collection stage, 2) data classification stage, 3) profile description stage.

At the data collection stage, the researcher collects the results of students' work in solving the problems given, then examines the results of the student's work so as to obtain initial conjectures about the student's flow/way of thinking and what information is empowered by students to solve the problems. At the classification stage, the data from the work on problem-solving questions is analyzed based on

indicators of algebraic thinking, while the results of the interview analysis are used as a support in drawing conclusions. Next is the stage of determining student profiles based on the results of the answers to the given problem solving questions, namely Generalization, Abstraction, Analytical Thinking, Dynamic Thinking, Modeling, Organizational.

3. Results and Discussion

Based on the results of research data analysis, an overview of the algebraic thinking skills of SMK students in solving problems solving a system of two-variable linear equations (SPLDV) is as follows:

3.1 Algebraic Thinking Ability in Solving SPLDV Problems in High Mathematical Ability Students.
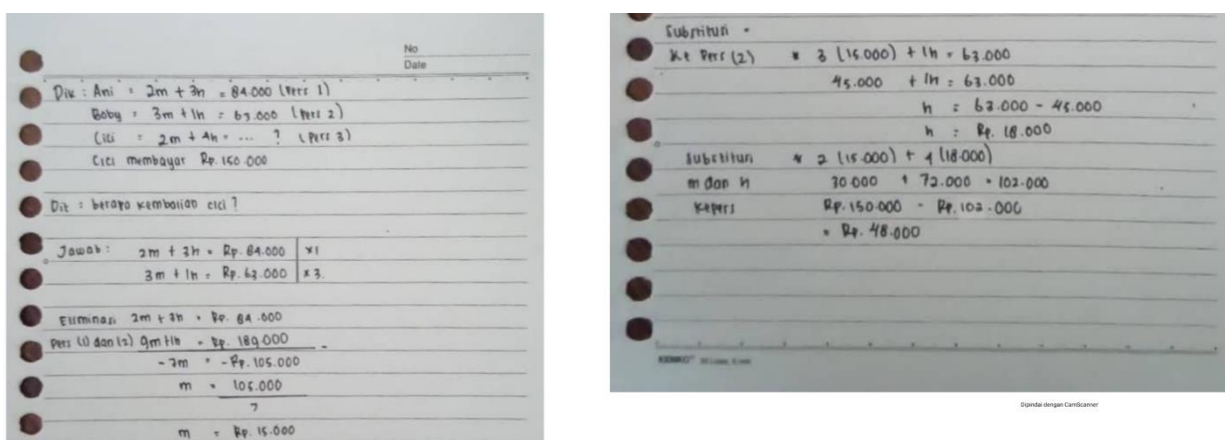
Figure 1 Subject Answers S1

For problem 1, from figure 1, information is obtained that the subject wrote down every information contained in the question correctly. Written by the subject, bring the price of one mask with the example of m and the price of one hand sanitizer with the example of h. students are able to write down things that are known, namely 2 masks and 3 hand sanitizers = Rp. From the answers above, students were able to generalize, it was seen that students were able to write down a system of linear equations for two variables from the problem, namely $2m + 3h = Rp. 84,000$ and $3m + h = 63,000$, this is supported by the following interview results:

P : Pay attention to question number 1, explain what information is contained in this question?

S1 : Here there is information that Ani bought 2 masks and 3 bottles of hand sanitizer at a price of Rp. 84,000.
At the same pharmacy, Boby bought 3 masks and 1 bottle of hand sanitizer at a price of Rp. 63,000.

P : State what is asked in the question?

S1 : Find the price to buy two masks and four bottles of hand sanitizer.

P : Is there any other information?

S1 : There is. Asked is the money back from buying 2 masks and 4 HS if paying it with 150 thousand.

P : Do you understand what is being asked in the question along with the steps for solving it?

R1 : Yes, I understand, ma'am.

Students are able to abstract, visible students can inform things that are known and asked in question 1. Furthermore, in solving problems students are able to think analytically and dynamically in determining the price of masks and hand sanitizers, namely m = 15,000 and h = 18,000. In addition, students are also able to do modeling and organizing, it can be seen that students are able to solve problem number 1 properly and correctly and students are able to write conclusions from the return for the price of 2 masks and 4 hand sanitizers, which is IDR 15,500 where the money paid is IDR 150,000. This explanation confirms that subject 1 is able to fulfill all indicators of algebraic thinking in question number 1, which indicates high students' algebraic thinking skills. This is supported by research results which reveal that in solving mathematical problems students in the high category can carry out good problem-solving procedures, and the indicators are always there at each step of completion (Ferdiani et al., 2021; Galbraith & Stillman, 2006; Kaiser & Schwarz, 2006).

3.2 Algebraic Thinking Ability in Solving SPLDV Problems in Moderate Mathematical Ability Students.

Figure 2 Subject's Answers S2

For problem number 1, based on figure 2, the subject wrote down all the information contained in the question correctly, namely 2 masks and 3 hand sanitizers = IDR 84,000, 3 masks and 1 hand sanitizer = IDR 63,000, and what was asked was the change from the purchase 2 masks and 4 hand sanitizers if you pay IDR 150,000. From the answers above, students are able to generalize and model the problem

into algebraic form, where students are able to write down the form of a system of linear equations of two variables 2x + 3y = 84,000 and 3x + y = 63,000. Then, students are also able to abstract the problem, it can be seen that students are able to for example masks = x and hand sanitizer = y. However, in this case students have not been able to think analytically and dynamically and organize. Evidently, students experienced difficulties in the elimination method step, by not eliminating one of the x or y variables, but students made a new equation. So, the x and y values obtained by students are wrong. This confusion caused the students to write down the conclusion that the prices for 2 masks and 4 hand sanitizers were also inaccurate, so the final result, namely finding the change that Cici received, where she paid IDR 150,000, was not quite right. This explanation confirms that Subject 2 has not been fully able to fulfill the six indicators of algebraic thinking ability in question number 1, which indicates moderate students' algebraic thinking ability. In line with research suggests that students experience difficulties because of misconceptions in algebra material carried out by students (El Hakim & Pinta Deniyanti Sampoerno, 2020; Novita, 2018). This is supported by the following interview.

P	:	To solve this problem, what is the first step you take?
R1	:	I use the example, ma'am.
		For example:
		x = masks
		y = hand sanitizer
P	:	Why should you use an analogy?
R1	:	So that the problem can be made in the form of an algebraic or mathematical model, you have to give an example first, ma'am, so that it's easy to solve later.
P	:	From the mathematical model obtained, namely 2x+4y, can it be used to answer the problem posed?"
R1	:	Yes ma'am.
P	:	If possible, please explain how to solve it?
R1	:	You do this with the elimination method

$$2x + 3y = 84,000 \quad \times 2 \qquad 4x + 6y = 168,000$$
$$3x + y = 63,000. \quad \times 2 \qquad 6x + 2y = \text{IDR } 126,000$$

Then obtained 2x + 4y = 42,000

We just have to look

$$2x = 42,000 \qquad\qquad 4y = 42,000$$
$$x = 21,000 \qquad\qquad y = 10,500$$

to pay the price 2x + 4y = 2(21,000) + 4 (10,500)

$$= 84,000$$

Return of IDR 150,000 – 84,000 = IDR 66,000

3.3 Algebraic Thinking Ability in Solving SPLDV Problems in Low Mathematical Ability Students.
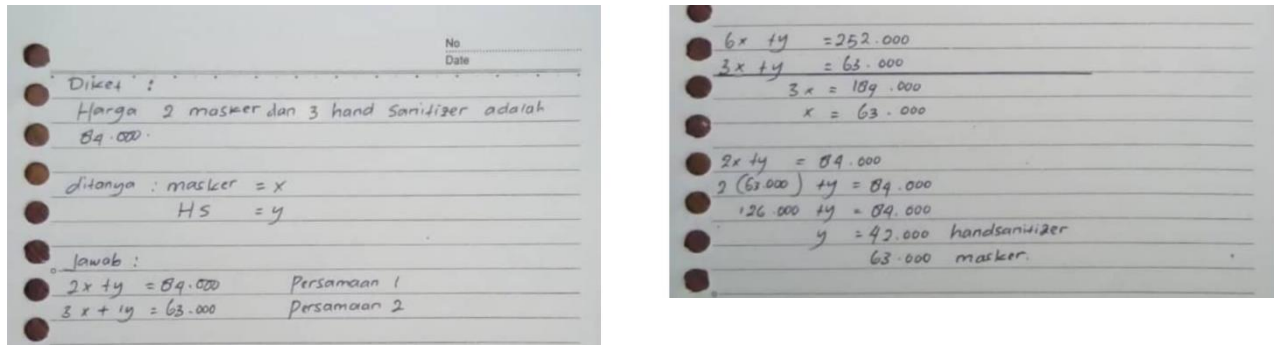
Figure 3 Answers from Subject S3

For problem number 1, based on figure 3, the subject writes down all the information contained in the question correctly, namely 2 masks and 1 hand sanitizer = IDR 84,000 which should be 2 masks and 3 hand sanitizers = IDR 84,000, 3 masks and 1 hand sanitizer = IDR 63,000 , and did not write down what was asked in the question, namely money back from purchasing the price of 2 masks and 4 hand sanitizers if paying with 150 thousand in cash. From the answers above, students are able to generalize and model the problem into algebraic form, where students are able to write down the form of a system of two-variable linear equations (SPLDV) 2x + 3y = 84,000 and 3x + y = 63,000. Then, students are also able to abstract the problem, it can be seen that students are able to for example masks = x and hand sanitizer = y. However, in this case students have not been able to think analytically and dynamically and organize. Evidently, students experienced difficulties in the elimination method step, namely students were unable to complete the elimination method stages of one of the x or y variables correctly. So, the x and y values obtained by students are wrong. In addition to these mistakes, students also did not write down the conclusion of what value is meant/looking for in the problem. This explanation confirms that Subject 2 has not been fully able to fulfill the six indicators of algebraic thinking ability in question number 1, which indicates low students' algebraic thinking ability. In line with research conducted by suggests that students experience difficulties because of misconceptions made by students in algebra material (Font Moll et al., 2016; Nakhanu & Musasia, 2015; Novita, 2018; Sa'dijah, 2007; Zhang & Wu, 2016),. This is supported by the following interview.

P : Can you complete the algebraic arithmetic operations on this problem?

R1 : Yes, ma'am.

P : How can you solve it?

R1 : First 2x + 3y = 84,000 times 3

Second 3x + y = 63,000 times 2.

		After multiplying everything, then the first equation is subtracted from the second equation to find the value of x. Then look for the y value
P	:	Explain how you can get an answer like this!
R1	:	In the process, I use a mixed method, ma'am, namely the first method of elimination. After finding the x value, then plug the x value into the second equation to find the y value.
P	:	Explain why you chose this solution method!
R1	:	Because it is easy to understand and fast to do it.
P	:	Are you sure the method you are using is correct?
R1	:	Yes ma'am.

5. Conclusion

Based on the results of data analysis and discussion of research results, it was concluded that students with high algebraic thinking ability categories were able to fulfill all indicators of algebraic thinking in problem solving questions. For students in the category of moderate algebraic thinking skills students have not been able to think analytically and dynamically and organize, in other words they have not been able to fulfill all indicators of algebraic thinking in problem solving questions. Whereas for students with low thinking ability categories students are not yet able to think analytically and dynamically and organize, it is evident from students who experience difficulties in the elimination method step, namely students are unable to complete the elimination method stages of one of the x or y variables correctly. Thus, the x and y values obtained by students are wrong. In addition to these mistakes, students also did not write down the conclusion of what value is meant/looking for in the problem. In other words, they have not been able to fulfill all indicators of algebraic thinking in problem solving questions.

Identitas Penulis
Ika Eryanti
Email: eryantiika@gmail.com

Emmanuel Kwadzo Sallah
Email: emmanuel@epc.edu.gh

Emmanuel Gakuba
Email: em.gakuba.buruni@gmail.com

Konflik Kepentingan
Penulis menyatakan tidak ada konflik kepentingan

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