EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 390-404
DOI: https://doi.org/10.24127/emteka.v6i1.6070

e-ISSN 2746-5594
p-ISSN 2746-5608

LEARNING OBSTACLES IN SYSTEMS OF LINEAR EQUATIONS IN TWO VARIABLES REVIEWED FROM ALGEBRAIC THINKING ABILITY

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Received 25 February 2025; Received in revised form 25 March 2025; Accepted 26 March 2025

ABSTRACT
This study aims to analyze learning obstacles on the topic of Systems of Linear Equations in Two Variables (SLETV) by considering students' algebraic thinking abilities. A qualitative approach with a Didactical Design Research (DDR) methodology was employed to identify and understand the various challenges students face in learning SLETV. Data for this study were collected through written tests related to the SLETV topic and interviews. The findings revealed several learning obstacles identified through difficulties in solving problems. Among the three types of obstacles ontogenic obstacles, epistemological obstacles, and potential didactical obstacles-the most frequently encountered by students in this study were epistemological obstacles. These included difficulties in creating mathematical models, understanding lesson material, and identifying what they comprehend from the subject matter. These findings highlight the importance of developing more effective teaching strategies that focus on enhancing students' algebraic thinking abilities to overcome such obstacles. The implications of this research provide valuable insights for educators in designing curricula and teaching methods that can help students overcome difficulties in learning SLETV, thereby improving the overall quality of mathematics education.
Keywords: Algebraic thinking ability; learning obstacles; mathematics learning.

ABSTRAK
Penelitian ini bertujuan untuk menganalisis hambatan belajar (learning obstacle) pada topik Sistem Persamaan Linear Dua Variabel (SPLDV) dengan mempertimbangkan kemampuan berpikir aljabar siswa. Pendekatan kualitatif dengan desain penelitian Didactical Design Research (DDR) digunakan dalam penelitian ini untuk mengidentifikasi dan memahami berbagai hambatan yang dihadapi siswa dalam mempelajari SPLDV. Data pada penelitian ini diperoleh dari tes tertulis yang berkaitan dengan topik SPLDV serta melalui wawancara. Hasil penelitian menunjukkan bahwa terdapat beberapa hambatan belajar yang terdeteksi melalui kesulitan dalam menyelesaikan soal. Dari tiga jenis hambatan yaitu hambatan ontogenik, hambatan epistemologi dan potensi hambatan didaktis, hambatan belajar yang paling banyak dialami siswa pada penelitian ini hambatan epistemologi yaitu kesulitan dalam membuat model matematika, kesulitan dalam memahami materi pelajaran, dan kesulitan dalam mengidentifikasi apa yang dipahami dari materi pelajaran. Temuan ini menekankan pentingnya pengembangan strategi pengajaran yang lebih efektif dan berfokus pada peningkatan kemampuan berpikir aljabar siswa untuk mengatasi hambatan tersebut. Implikasi dari penelitian ini memberikan wawasan bagi pendidik dalam merancang kurikulum dan metode pembelajaran yang dapat membantu siswa mengatasi kesulitan dalam mempelajari SPLDV, sehingga meningkatkan kualitas pembelajaran matematika secara keseluruhan.
***Kata kunci**: hambatan belajar; kemampuan berpikir aljabar; pembelajaran matematika.*

e-ISSN 2746-5594
p-ISSN 2746-5608

Introduction

The learning process involves many elements, namely teachers, students, learning materials, learning media, and evaluation tools. In essence, learning is the process of changing individual behavior towards better results in terms of understanding, skills, knowledge, attitudes, and one's ability to think (Djamaluddin & Wardana, 2019). In contrast, learning is a series of activities designed to help students achieve their learning goals (Djamaluddin & Wardana, 2019). To achieve the goals and plan the teaching process that allows students to improve their understanding, educators must design learning in line with the expected outcomes. However, students can also experience difficulties in their learning process to achieve the expected goals.

According to Brousseau, every student may experience difficulties in learning, including in the process of learning mathematics (Hidayah, Sudihartinih, & Sumiaty, 2021). Students who face difficulties in learning tend to make mistakes when solving a problem. According to Subroto and Sholihah (2018) Learning obstacles or in Indonesian called learning obstacles are challenges faced by students during the learning process and can result in the achievement of unsatisfactory learning outcomes (Sumarni, Ramadianti, Syofiana, & Jumri, 2023). Meanwhile, according to Khairani, Sofiyan, Ramadhani, and Sukirno (2019) learning obstacle is when students have difficulty in learning or solving problems presented in the questions.

Brousseau categorizes learning barriers into three types: ontogenic barriers, which stem from students' cognitive abilities; epistemological barriers, which arise from the limited context known to students; and didactic barriers, which are caused by the teaching methods used by teachers (Sumirat, Sudihartinih, & Sumiaty, 2023). With different knowledge, each student certainly experiences different learning barriers. Teachers must understand these barriers as they create learning designs to achieve learning objectives that match the learning outcomes.

Didi Suryadi in Farisal, Sudihartinih, and Sumiaty (2022) categorize learning barriers that occur during the learning process into three types. Ontogenic barriers are caused by a child's inadequate mental readiness to learn, often because the child's age is not yet suitable for a particular level of learning. These barriers usually disappear on their own as the child develops mentally and physically. Didactic barriers arise from a teacher's lack of teaching skills or mistakes in planning the learning process. They can be caused by inadequate teaching ability or insufficient preparation to organize the lesson. Epistemological barriers are related to students' limited knowledge in a particular context, which leads to difficulties in solving non-routine problems.

One important component that needs to be developed by educators is mathematical thinking skills. According to Radford, one of the mathematical thinking skills that must be mastered by students is algebraic thinking (Andini, 2020). Kieran in Farida and Hakim (2021) states the importance of mastering algebraic thinking skills by students is important, because it will help them focus on relationships and representations in solving problems. In line with the findings of Lingga & Sari in Utami, Ekawati, and Handayanto (2020), which explains that solving problems will be easier for students who have good algebraic thinking skills.

According to Kusumaningsih, et al. which was adapted from Kriegler in Abdillah, Mastuti, Kasliyanto, and Buamona (2023) algebraic thinking indicators are

e-ISSN 2746-5594
p-ISSN 2746-5608

algebra as a mathematical language; representation ability; problem-solving ability; quantitative reasoning ability; algebra as a tool for mathematical functions and modeling. Indicators of algebraic thinking ability can be used as a guideline for making instruments.

Systems of linear equations in two variables (SPLDV) is one of the topics in algebra studied at the junior high school level. The approach in solving problems related to the systems of linear equations in two variables is mostly given in the form of story problems relevant to everyday life which are then converted into mathematical expressions and solved using various solution methods. However, the results of Indonesia's Program for International Student Assessment (PISA) study in 2022 showed that Indonesia's mathematics score was 366 (OECD average 472) (OECD, 2023). The results of the study reveal that Indonesian students' mathematics skills, especially in reading and numeracy literacy, are still far below average. This may be due to various factors. Some of the causes include students' difficulties in understanding reading, and difficulties in creating and interpreting models (Mauliddiana & Gozali, 2023). As for other factors, students do not master the material as a whole, rush to work on problems, and are not careful in working on or understanding the information in the problem (Pramasdyahsari, Amillia, & Sugiyanti, 2023).

The learning difficulties experienced by students in solving problems related to the topic of SPLDV will be analyzed more deeply through a review of their algebraic thinking ability indicators. Although many studies have been conducted, it seems that no one has specifically examined learning barriers on the topic of the systems of linear equations in two variables from the perspective of algebraic thinking ability using Kiegler's indicators. This article discusses the barriers experienced by students when solving problems on the systems of linear equations in two variables based on indicators of algebraic thinking ability so that it can be used as material for further research to create didactic designs to overcome learning barriers on the material of the systems of linear equations in two variables in terms of algebraic thinking ability.

Research Methods

This study used a qualitative approach to describe social or human problems by gaining an understanding of the meaning of individuals or groups (Purwanza, 2022). research design applied was Didactical Design Research (DDR), which has its roots in didactical situation theory, which suggests that educators should focus on learner independence in thinking about, designing, and applying teaching materials in the learning process (Suryadi, 2023). According to Gravemeijer & Cobb in Fauzi and Suryadi (2020) emphasize that understanding of various educational innovations and researchers' efforts in creating innovations in the field of education is the philosophical basis for DDR.

According to Suryadi (2023), to conduct didactical design research, it needs to involve three formal stages. The first stage is to analyze the didactical situation before learning is carried out, this is realized in the form of a Hypothetical Didactical Design including ADP (Didactical and Pedagogical Anticipation). The second stage is a metapedidactic analysis, which involves analyzing the sequence of didactical situations that occur in the classroom, analyzing the learning situation, and

e-ISSN 2746-5594
p-ISSN 2746-5608

analyzing the interactions that influence changes in the didactical situation and learning process. The third stage involves an analysis that links the results of the hypothetical first stage with the results of the second stage. However, in this study, the focus is currently only on the initial stage, which is exploring learning barriers before analyzing the didactical situation.

The place of this research is in one of the State Junior High Schools (SMP) in Bandung City, with a focus on grade VIII students who have learned the material of the systems of linear equations in two variables. The subjects in this study were students in grade VIII of junior high school in the 2023/2024 academic year. The number of students taken is in accordance with the number of students in the class selected to be the research subject. The participants selected in this study were based on the grade level that had studied the systems of linear equations in two variables.

The test instrument that will be given to students is in the form of a description test, the description test consists of 5 description questions, 1 problem is related to the prerequisite material for the systems of linear equations in two variables, namely making a mathematical model and 4 problems are problems related to the systems of linear equations in two variables. Before being used in research, the test instrument was validated first by the Supervisor who was the lecturer in charge of the Mathematics Education Seminar course.

After the written test, the participants' answers were examined and grouped based on the types of errors made, then six students were selected who represented several different obstacles for further interviews. These interviews were conducted flexibly, according to the errors and ways of thinking of the six participants on the problem. The interview aims to explore deeper information about students' solutions to written test answers as well as students' understanding and views on the material of the systems of linear equations in two variables which will then be used to determine the learning barriers experienced by students. In addition, interviews were also conducted to find out the learning experiences that students had gone through in previous learning.

To reach the right conclusion, data that can be analyzed is needed. How to collect data in this study, triangulation techniques were used. According to Creswell in Kusumastuti and Khoiron (2019) data triangulation technique is a method of collecting data from various sources of information by examining evidence from these sources and using them to build a coherent justification in accordance with the research theme. The data collection techniques used in this study include written tests and interviews. After the written test was conducted, the participants' answers were examined and categorized based on the types of errors made. Furthermore, six students representing different barriers were interviewed.

Results and Discussion

Based on the responses from the participants and the results of the interviews that have been conducted, the following results were obtained.

Learning Obstacle Analysis Problem Number 1

This problem is an example of the application of algebraic material for students in grade VII of Junior High School (SMP). In the problem, participants were asked to produce mathematical representations of the situation described in the

e-ISSN 2746-5594
p-ISSN 2746-5608

problem. In this test, the indicator of algebraic thinking ability involves participants in explaining the meaning and role of variables and using variables to illustrate identified or unidentified information.

Of the six participants selected, there was one participant who had difficulty answering question number 1. The written recording of the researcher's interview (P) with participant five (P5) can be seen in Figure 1

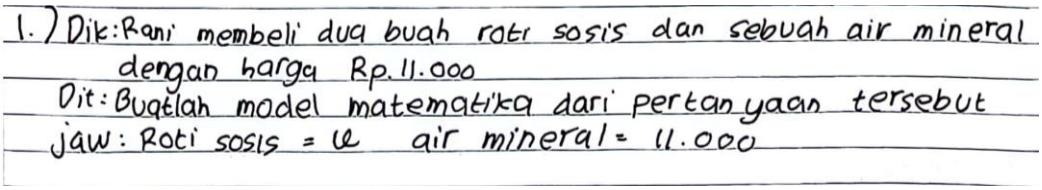

Figure 1: Participant 5's answer

Written Record of Conversation 1

P : For question number 1, did you have any difficulty in answering it?
P05 : Yes ma'am, I had difficulty in answering the question, because I didn't really understand the method.
P : Where did you have difficulty in answering the question?
P05 : The inside counts.
P : What causes you to experience these difficulties?
P05 : What I had difficulty with was understanding the question.
P : Which part of the question did you not understand?
P05 : From the part of question number 1 that I don't understand, ma'am, from "Model the question".
P : Okay fine.
P : If we model two variables, do you have an idea of what to model?
P05 : The visualization is of a sausage bun and a mineral water.

Based on Figure 1 and the results of the interview, the researcher concluded that the participant experienced epistemological obstacles when making mathematical modeling of the situation presented in the problem. The participant did not understand the meaning of "making a mathematical model" itself, but after being traced during the interview and given instructions that the first step to be done is to make a memorization of two variables, the participant just understood the meaning of the problem. This includes epistemological barriers because participants have difficulty in developing their concepts due to a lack of understanding of the prerequisite materials. This is in accordance with the findings of Hidayah et al. (2021).

Learning Obstacle Analysis of Problem Number 2

This question relates to the participant's representation ability, where participants are asked to understand the contents of the problem through the images that have been given. The indicators of algebraic thinking skills tested in this problem are that participants are asked to create representations of information relationships from statements, produce variations in the form of subject representations, and explain the information generated from the representations that have been made.

EMTEKA: Jurnal Pendidikan Matematika
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DOI: https://doi.org/10.24127/emteka.v6i1.6070
e-ISSN 2746-5594
p-ISSN 2746-5608

Based on Figure 2 and Figure 3, the difference in the approach to answering the question is clearly visible. Participant 1 only wrote down the known and questionable information, while Participant 5 had reached the stage of making the intended mathematical model but could not complete the work. The written recording) can be seen in Figures 2 and 3.

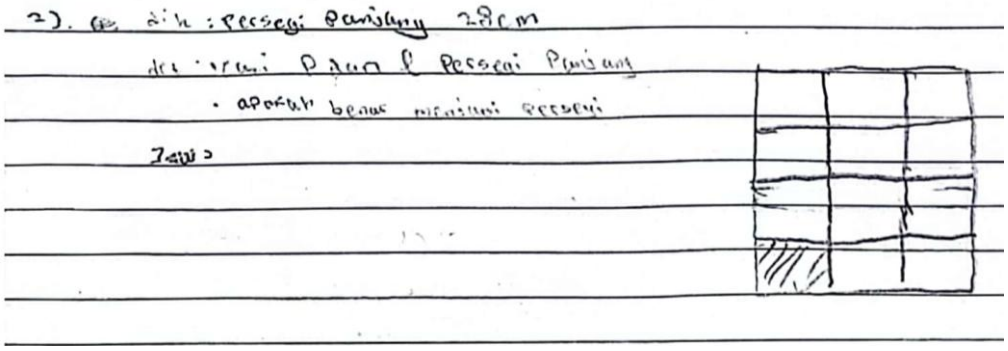

Figure 2: Participant 1's answer

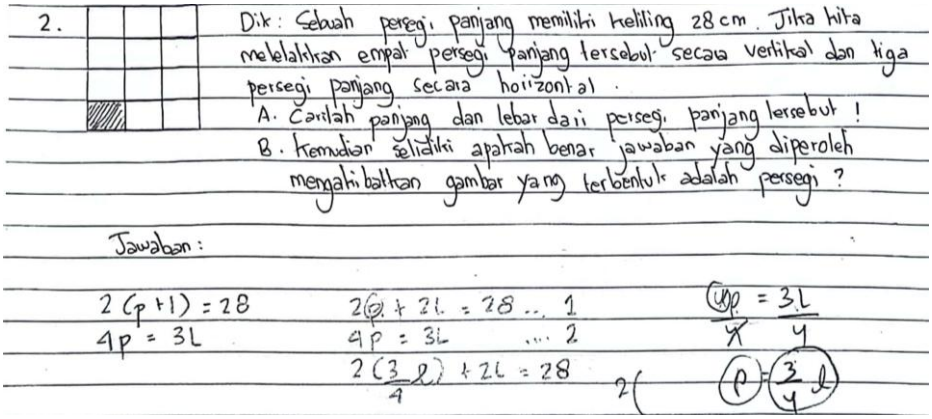

Figure 3: Participant 6's answer

The following is a written recording of the researcher's (P) interview with Participant Five (P06).

Written Record of Conversation 2

P : Now from question number 2, do you have difficulty in answering it?
P06 : Yes, I had difficulties.
P : So where did you have difficulty in answering question number 2?
P06 : All of them don't understand.
P : Can you explain what you have written?
P06 : The 2(p+l) uses the formula for the side of a square. The 4P one is because the length and rectangle above have 4 squares in the length and 3 squares in the width.
P : Okay, that means you have made a separation from what is known in the problem. Now let's see slide to the center of your answer sheet. There you try to multiply the 2 into the brackets. Already got the equation that is the second equation. Then finally the next thing you substitute the value of P so that it becomes $\frac{3}{4}l$.
P06 : Yes.

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e-ISSN 2746-5594
p-ISSN 2746-5608

P : So why don't you continue the work there, where are you confused about continuing it?
P06 : I don't understand the substitution.
P : Okay, then you are still confused about where to substitute it.
P06 : Yes

Based on Figure 3 and the results of the interview, the researcher concluded that participants still had difficulty making graphs to strengthen their reasons when answering the question. To use algebraic procedures, there are still shortcomings in the participants' answers. Because the algebraic reasoning that makes more sense is if the comparison value of the coefficients of the two equations is sought, then the ratio is the same or if the gradient of the line of the two equations is sought, then the gradient is obtained. This barrier is epistemological because of the limited knowledge of students in the prerequisite material so that they do not get comprehensive information and the lack of student practice to graph the systems of linear equations in two variables. This is in accordance with the findings (Maarif, Setiarini, & Nurafni, 2020; Insani & Kadarisma, 2020).

Learning Obstacle Analysis of Problem Number 3

This problem is related to problem-solving skills, where participants are asked to understand what information is contained in the problem until they can find a solution. The indicators of algebraic thinking ability tested in this problem are that participants are asked to recognize the known and questionable elements, choose a plan to solve the problem, and solve the problem with the plan chosen by the students themselves.

Participant 3 (P03) did not solve the third problem. For this reason, the researcher was interested in digging deeper into what difficulties P03 experienced so that he did not solve the problem. The following is a written recording of the researcher's (P) interview with P03 can be seen in Figure 4.

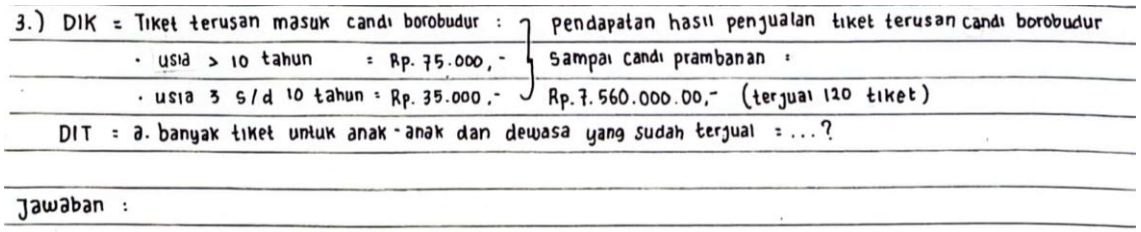

Figure 4. Partisan 3's answer

Written Record of Conversation 3

P : Actually question number three you have written what you know, what you have asked also know what exactly. Why didn't you try to write the math model? Are you having trouble or what?
P03 : Actually, when I first read it, it was still a bit difficult to digest the question. More precisely, it was difficult to digest the question.
P : The question or the information in the question?
P03 : The question. The question but the information in the question is still a bit confusing. So I'm still hesitant to answer it. So it's like I'll do it later.

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P : Do you know whether these kinds of problems rarely appear or when the teacher explains how? Can you explain what the cause is?
P03 : Sometimes the teacher rarely gives questions like this. So suddenly the questions are different. So if I get a problem like this, it feels like I'm not really clear, I don't really understand the material.
P : Oh, okay. So this is like a non-routine problem, right? Does it mean that your teacher mostly gives you these types of problems? Is the known number in this problem too big?
P03 : This problem is more elaborated. So if the teacher usually just gives the equation like for example 3y + ...

Based on Figure 4 and the results of the interview, the researcher concluded that the participants were still not familiar with the problem of the systems of linear equations in two variables given in the form of a narrative in the form of a story. Because the participants mentioned that teachers at school more often give practice problems where the system of equations has been written clearly, as a result, students do not need to make mathematical modeling first to determine the solution. This barrier is an instrumental ontogenic barrier because participants have difficulty developing their concepts due to a lack of training in working on non-routine problems or problems that do not match the examples usually given. This is in accordance with the findings of Ramdhani, Suryadi, and Prabawanto (2021).

Learning Obstacle Analysis of Problem Number 4

This question is related to quantitative reasoning skills, where participants are asked to understand whether the statements contained in the problem are not true. The indicator of algebraic thinking ability tested in this question is participants are asked to answer the correct question with reasonable reasons and use correct algebraic procedures. The following is a written recording of the researcher's (P) interview with Participant 2 (P02) can be seen in Figure 5.

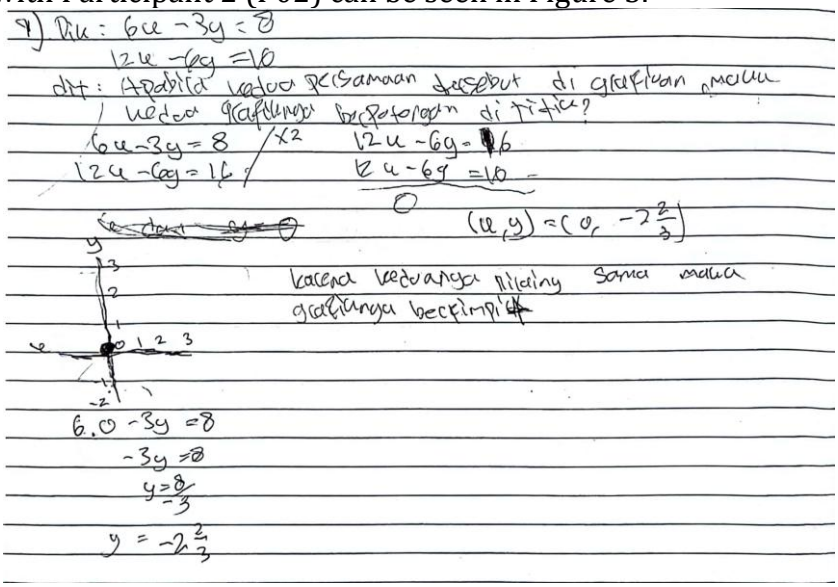

Figure 5. Partisan 2's answer

Written Record of Conversation 4

e-ISSN 2746-5594
p-ISSN 2746-5608

P : For question number 4, did you have any difficulty in answering it?
P02 : Number 4 had difficulty when determining the point
P : Other than this, were there any other difficulties while working on it?
P02 : When the x or y value is 0, it's a bit confused
P : That means you still have trouble making the graph, right?
P02 : Yes ma'am, it's hard to make a graph
P : For the next question, related to question number 4, what makes you sure that the graphs of the two equations coincide?
P02 : Maybe because the value was 0 P On the answer sheet, you have actually drawn the cartesian coordinates, are there any obstacles to continue drawing the graph?
P02 : The worksheet is $y = -2\frac{2}{3}$ so I'm not sure where the y is.

Based on Figure 5 and the results of the interview, the researcher concluded that participants still had difficulty making graphs to strengthen their reasons when answering the question. To use algebraic procedures, there are still shortcomings in the participants' answers. Because the algebraic reasoning that makes more sense is if the comparison value of the coefficients of the two equations is sought, then the ratio is the same or if the gradient of the line of the two equations is sought, then the gradient is obtained. This barrier is epistemological because of the limited knowledge of students in the prerequisite material so that they do not get comprehensive information and the lack of student practice to graph the systems of linear equations in two variables. This is in accordance with the findings (Maarif, Setiarini, & Nurafni, 2020; Insani & Kadarisma, 2020).

Learning Obstacle Analysis of Problem Number 5

This problem challenges participants by providing questions in the form of puzzles that must be solved. The indicator of algebraic thinking ability tested in this problem is that participants are asked to apply patterns or rules in the form of words or equations, and present mathematical ideas from each pattern using equations, inequalities, tables, graphs, or words accurately. Many participants did not answer this question, there were only 2 out of 32 participants who answered the fifth question. One of these participants was Participant 4 who was selected to be interviewed. The following is a written recording of the researcher's (P) interview with Participant 4 (P04) can be seen in Figure 6.

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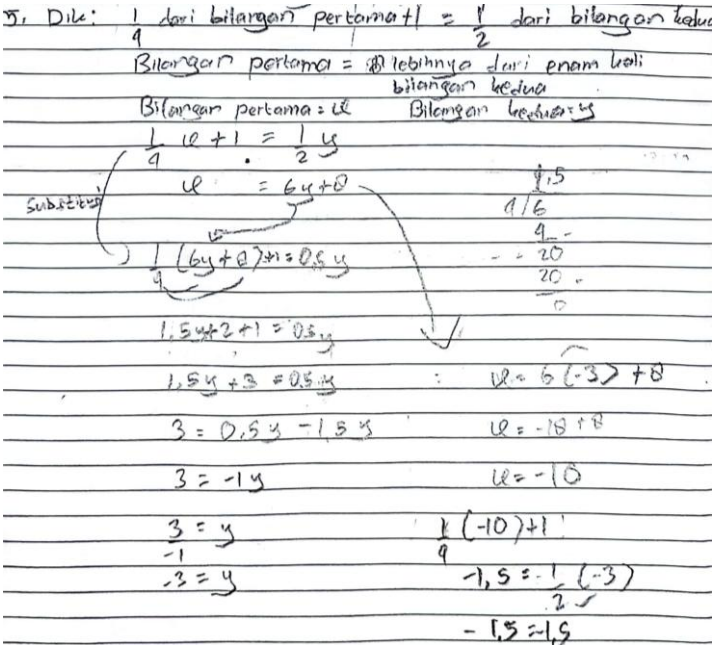

Figure 6. Partisan Answer 4

Written Record of Conversation 4

P : For number 5, why didn't you do part B, which is checking the answer again?
P04 : The answer is almost the same ma'am as number 3. Rechecking the answer is by reworking it ma'am, looking at/counting the results that I have done, until I am sure it is right.
P : Okay
P : That means because you are sure, so you don't elaborate anymore?
P04 : Yes ma'am

Based on the results of the interview, the researcher concluded that the participant was not used to rechecking the solution that had been obtained. Based on the participant's explanation, it can be understood that the way he re-checks the answer is by reworking or checking the calculation, even though re-checking can be done by substituting the results obtained in one of the two equations. This barrier includes procedural epistemological barriers because participants do not perform the procedure of re-examining the solution that has been obtained. But this can also be included in potential didactical barriers because it could be that in learning the teacher does not accustom students to re-examine the solutions that have been obtained.

This is in accordance with the findings of Winarti, Firdaus, & Hartono (2023). Through analysis of the participants' work, it can be concluded that the learning obstacles that occur in each participant are shown in Table 1.

Table 1. Learning obstacles that occurred for each participant

Participants	Question

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	Number 1	Number 2	Number 3	Number 4	Number 5
01	None	Difficulty making mathematical models	Does not recheck the solution results that have been obtained	Difficulty making graphs	Difficulty identifying what is known from the problem
02	None	Difficulty making mathematical models	Does not recheck the solution results that have been obtained	Difficulty making graphs	Difficulty identifying what is known from the problem
03	None	Difficulty making mathematical models, distinguishing between substitution and elimination methods	Difficulty understanding the meaning of the problem	Difficulty making graphs	Difficulty identifying what is known from the problem
04	None	Difficulty making mathematical models	Does not recheck the solution results that have been obtained	Difficulty making graphs	Does not recheck the solution results that have been obtained
05	Difficulty making mathematical models	Difficulty making mathematical models, distinguishing between substitution and elimination methods	Does not recheck the solution results that have been obtained	Difficulty making graphs	Difficulty identifying what is known from the problem
06	None	Difficulty linking the material with previously learned concepts	Difficulty identifying what is known from the problem	Difficulty understanding the meaning of the problem	Difficulty identifying what is known from the problem

Based on Table 1 above, it can be concluded that the learning obstacles that occur to participants if grouped based on the types of learning obstacles are presented in Table 2.

Table 2: Classification of learning obstacles

Number of problems	Learning Obstacle	Classification
1.	a. Difficulty making mathematical models	Epistemology
2.	a. Difficulty making mathematical models	Epistemology
	b. Difficulty distinguishing between substitution and elimination methods	Didactic Potential
	c. Difficulty linking the material with previously learned concepts	Ontogenic
3.	a. Difficulty understanding the meaning of the problem	Ontogenic
	b. Difficulty identifying what is known from the problem	Epistemology
	c. Does not recheck the solution results that have been obtained	Epistemology and Didactic Potential
4.	a. Difficulty understanding the meaning of the problem	Ontogenic
	b. Difficulty making graphs	Epistemology

e-ISSN 2746-5594
p-ISSN 2746-5608

Number of problems	Learning Obstacle	Classification
5.	a. Difficulty identifying what is known from the problem b. Does not recheck the solution results that have been obtained	Epistemology Epistemology and Didactic Potential

Table 2 shows the classification of learning obstacles experienced by participants in the form of epistemological barriers, ontogenic barriers, and potential didactic barriers. Epistemological barriers that occur in the form of difficulty making mathematical modeling, difficulty identifying what is known from the problem, difficulty making graphs, and not re-examining the solutions that have been obtained. This is in accordance with the opinion of Dedy and Sumiaty (2017) who explained that epistemological barriers are obstacles related to students' limited knowledge of certain materials. This barrier causes students to have difficulty solving non-routine problems.

As for ontogenic barriers they occur in the form of difficulty understanding the meaning of the problem and difficulty relating the material to previously learned concepts. This is in accordance with the opinion of Prasetyo (2019) who explains that ontogenic barriers can occur because students have not mastered the prerequisite materials. The didactical barriers are only potential because the researcher has not interviewed the teacher to ask whether this has been taught or not. The potential didactical obstacle found in this study is that students do not recheck the results of the solutions that have been obtained.

Based on the findings, it is known that only a few participants managed to overcome the challenges in solving problems related to the systems of linear equations in two variables, which were evaluated from the aspect of algebraic thinking ability. Because the majority of participants still experience learning obstacles, along with the findings of Winarti et al. (2023) where students experience learning obstacles in the material of the systems of linear equations in two variables, both in students with problem-solving skills at high, medium, and low levels. Learning obstacles that occur vary such as incorrectly determining the formula that must be used, wrong concept of problem solving and not checking the answer again.

The most common learning obstacle found in this study is making mathematical modeling of the problems given. In the research of (Sumbandari, Misdalina, and Fuadiah (2021) the main obstacle encountered was that as many as 90.9% of students were unable to make mathematical modeling of the two-variable linear equation system problem. This could be due to students' low understanding of algebraic topics related to story problems (Farida & Hakim, 2021). In accordance with the findings of Pangaribuan (2018) the students identified the solution to SPLDV using their chosen solution method, while they did not consider the use of x and y variables to make mathematical modeling of the given problem.

The next frequently encountered learning obstacle is the difficulty in interpreting the essence of the problem and identifying relevant information from the problem. In the study there were still students who had difficulty when making mathematical modeling of the situation presented in the problem because the students themselves did not understand the meaning of "making mathematical models" requested in the problem. In the research of Winarti et al. (2023) one of the obstacles experienced by students in answering problems is solving problems

e-ISSN 2746-5594
p-ISSN 2746-5608

incorrectly, because they are not in accordance with the instructions of the problem, lack of understanding, and confusion of students when solving problems. It is suspected that one of the causes of these obstacles is the difference in student understanding during learning, where some students only understand the material when learning takes place, while others may only follow the steps taught by the teacher without deep understanding (Fauziah, 2016). In addition, Fauziah (2016) hypothesized that forgetting can occur because students only understand some mathematical concepts separately without combining them as a whole. This is because students do not understand the material as a whole (Pramasdyahsari, Amillia, & Sugiyanti, 2023).

Of the three types of barriers, namely ontogenic barriers, epistemological barriers, and potential didactic barriers, the learning barriers most experienced by students in this study are epistemological barriers, where these barriers are caused by students' limited knowledge of certain topics. Overcoming epistemological learning barriers is very important so that students can solve various problems using what they know before. If students' knowledge does not increase, students experience a decrease in knowledge, which causes the emergence of epistemological barriers (Rismayantini, Kadarisma, & Rohaeti, 2021). Therefore, to overcome these obstacles, a didactical design that is oriented towards a systematic approach that connects old and new knowledge, provides appropriate support to students such as a scaffolding-based approach, and creates an active and meaningful learning experience is needed.

Conclusion and Suggestion

Based on the results and discussion, it can be concluded that there are three types of learning barriers on the topic of the systems of linear equations in two variables. The classification of these barriers includes epistemological, ontogenic, and didactic barriers. Epistemological barriers include difficulties in designing mathematical models, identifying available information from the problem, making graphical representations, and re-verifying the solutions that have been obtained. Ontogenic barriers include difficulties in understanding the essence of the problem and connecting the material with previously learned concepts. Potential didactic barriers also include difficulties in rechecking the solutions that have been obtained.

Thus, further research is needed in designing lessons to provide solutions related to learning barriers in the topic of systems of linear equations in two variables by considering students' algebraic thinking ability. Teachers need to understand these barriers when designing lessons to achieve the desired learning objectives. Then, it is expected that future researchers can investigate more deeply about didactical barriers by conducting interviews with teachers and analyzing the teaching materials they use. This aims to develop a more detailed learning design in overcoming learning difficulties faced by students.

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