# Analysis of High School Students' Difficulties in the Material of Two Variable Linear Equation Systems

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## ABSTRAK

Sebagian siswa mengalami kesulitan untuk mempelajari matematika karena banyaknya kendala yang dihadapi. Pandangan bahwa matematika adalah ilmu yang abstrak, teoretis, memiliki simbol dan rumus yang sulit sehingga membuat siswa mengalami kesulitan dalam memahaminya. Penelitian ini bertujuan untuk menganalisis kesulitan siswa dalam mengerjakan soal materi sistem persamaan linear dua variabel. Penelitian ini menggunakan metode penelitian kualitatif. Subjek penelitian diambil dengan menggunakan teknik *purposive sampling*. Peneliti kemudian mengelompokkan siswa berdasarkan tingkat kemampuannya yaitu kemampuan tinggi, kemampuan sedang dan kemampuan rendah. Subjek penelitian dalam penelitian ini adalah 3 siswa. Teknik pengumpulan data dalam penelitian ini menggunakan teknik tes yang memuat soal sistem persamaan linier dua variabel dan wawancara. Teknik analisis data adalah reduksi data, penyajian data dan penarikan kesimpulan. Berdasarkan hasil penelitian yang diperoleh dalam menyelesaikan soal sistem persamaan linier dua variabel adalah terdapat beberapa kesulitan yang dialami siswa, yaitu kesulitan konsep yang terletak pada kenyataan bahwa siswa tidak mampu menyimpulkan informasi dari suatu konsep, kemudian kesulitan prinsip, yaitu kesulitan menerapkan metode penyelesaian dalam menyelesaikan masalah, dan kesulitan keterampilan yang terletak pada kesulitan operasi hitung.

**Kata Kunci:** Analisis; Kesulitan; Sistem Persamaan Linear Dua Variabel

### *ABSTRACT*

*Some students have difficulty learning mathematics because of the many obstacles they face. The view that mathematics is an abstract, theoretical science, has symbols and formulas that are difficult and confusing so that students have difficulty understanding it. This study used qualitative research methods. Research subjects were taken using a purposive sampling technique. Researchers then grouped students based on their level of ability, namely high ability, medium ability and low ability. The research subjects in this study were 3 students. The data collection technique in this study used a test technique which contained a system of two-variable linear equations and interviews. Data analysis techniques are data reduction, data display and drawing conclusions. Based on the research results obtained in solving problems on the material system of linear equations of two variables, it was concluded that there were several difficulties experienced by students, namely conceptual difficulties which lay in the fact that students were unable to deduce information from a given concept, then principle difficulties, namely difficulties applying solving methods in solving problems, and skill difficulties that lie in the difficulty of arithmetic operations.*

***Keywords:*** *Analysis; Difficulty, Two Variable Linear Equation System*

**INTRODUCTION**

Mathematics as one of the basic sciences has developed very rapidly, both in terms of material and use. Mathematics taught in school education is one of the subjects that is very useful and very helpful for students towards expertise, because mathematics can form critical, systematic, logical, creative thinking, and has the ability to collaborate effectively (Sundary et al., 2022). However, in the practice of learning mathematics, some students still have the notion that mathematics is difficult and frightening. This assumption is inseparable from the perception that develops in society about mathematics.

Students feel that it is difficult for students to learn mathematics due to the many obstacles faced by students in achieving learning outcomes in mathematics. The view that mathematics is an abstract science, theoretical, has symbols and formulas that are difficult and confusing. This assumption forms students' negative perceptions of mathematics (Sundary et al., 2022). This assumption arose because of an unpleasant experience in learning mathematics (Gazali, 2016). This is because many students experience difficulties in learning mathematics whose object of study is abstract (Farida, 2015). Students' difficulty in learning mathematics is because students do not build their own knowledge of mathematical concepts but tend to memorize mathematical concepts without knowing the meaning contained in these concepts so that when students solve mathematical problems students often make mistakes and do not find solutions to solving the problem (Hardiyanti, 2016).

The two-variable linear equation system is a continuation of the one-variable linear equation material and is a prerequisite for studying the three-variable linear equation system material. However, in reality there are still many students who experience difficulties in solving problems of systems of linear equations of two variables (Sari & Lestari, 2020). The difficulties faced by students when solving story matter in two-variable linear equation system material are difficulties in determining and exemplifying variables, changing story questions into mathematical model forms, difficulties using the elimination method as well as substitution, students also having difficulty operating addition and subtraction, difficulty determining variable value. Factors that cause these difficulties are the low level of mastery of two-variable linear equation system material, students are not diligent, students are not careful when solving problems and students do not master two-variable linear equation system concepts and principles (Puspitasari et al., 2015). Based on this, there are still many students who experience difficulties when working on a two-variable system of linear equations problems.

In the case of working on problems students often make conceptual, arithmetic, and strategic errors making it difficult to solve math problems (Kastolan, 1992). Moreover, seeing the fact that many students view mathematics as the most difficult field of study so that it becomes an obstacle for students to understand mathematics itself which results in low scores in mathematics when tests are held. Students who experience difficulties in learning mathematics generally lie in a lack of understanding of concepts and principles in mathematics (Kumalasari et al., 2013). Cooney states that students' difficulties in learning mathematics to focus on two important types of knowledge of mathematics are knowledge of concepts and knowledge of principles (Cooney et al., 1975). Conceptual difficulties consist of an inability to remember technical names, an inability to include the meaning of a term that represents a particular concept, an inability to remember one or more conditions necessary for an object to be expressed by the term that represents it, unable to classify objects as examples of a concept from objects that are not examples and inability to infer information from a given concept. Principle difficulties include not being able to carry out discovery activities about something and not being careful in calculating algebraic operations, the inability of students to determine relevant factors and consequently not being able to abstract patterns and students can state a principle but cannot express its meaning, and cannot apply the principle. Then there is also a skill error which refers to the process of using arithmetic operations in addition, subtraction, multiplication, and division (Pratiwi, 2021; Rosdianah et al., 2019).

This happened when researchers made observations at SMA 3 Takengon. Based on observations, information was obtained that students had difficulty solving questions when the questions given by the teacher were different from the examples of questions discussed during the delivery of the material. Some of the students had not finished and did not even work on the questions given by the teacher. Students still have difficulty understanding concepts and difficulties understanding principles in mathematics. When in class, there are still few students who want to ask the teacher if there is still unclear material. In addition, difficulties are also caused by the lack of student discussion with friends in learning mathematics.

The researcher found students who had difficulty solving the questions given by the researcher regarding the material for the system of two variable linear equations such as, students did not understand the concept so they were wrong in solving the problem. This of course affects the student's response in responding, dealing with, preparing himself in

learning mathematics material as a whole. In the process of learning mathematics, especially the two-variable linear equation system material, it is often found that there is a tendency for students not wanting to ask questions to the teacher, but when the teacher asks students to test whether they have understood the material intended, students are silent, and after the teacher gives practice questions about system material linear equation of two variables, only then the teacher understands that students are still experiencing difficulties in the material being taught. Based on this, researchers conducted research on the analysis of high school students' difficulties in the matter of a system of two-variable linear equations. This study aims to analyze the difficulties of high school students in the matter of a system of two-variable linear equations.

## METHOD

This study used qualitative research methods. The research subjects in this study were students of class X SMA 3 Takengon. Research subjects were taken using a purposive sampling technique. Researchers then grouped students based on their level of ability, high ability, medium ability and low ability. The research subjects in this study were 3 students. The data collection technique in this study used a test technique which contained a system of two-variable linear equations and interviews. Previously, the tests and interview guides were validated by experts. Furthermore, data analysis techniques are data reduction, data display and drawing conclusions (Miles & Huberman, 1994).

## RESULTS AND DISCUSSIONS

The researcher gave a material test on a system of two-variable linear equations to 22 students of class X SMA 3 Takengon, and selected 3 research subjects with high, medium and low abilities. Furthermore, the researchers conducted interviews with the 3 research subjects. Difficulty in working on questions is divided into three indicators, namely difficulty in concepts, principles, and skills. The following is a description of test and interview data based on the three indicators of difficulty.
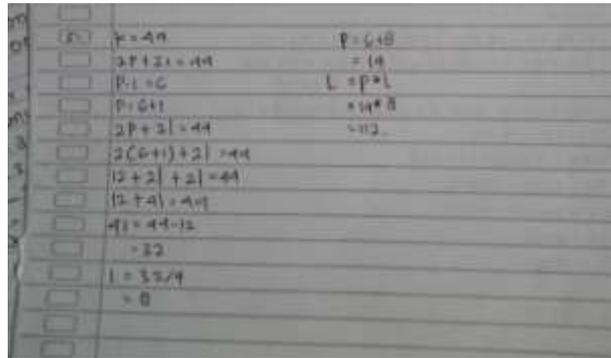
A. ST Subjects with High Ability



**Figure 1. ST subjects in working on questions**

Based on the picture, it can be seen that ST did not write down what was known and what was asked in the problem, the next step in solving the problem, he did not make an example and a mathematical model which would later be used to answer the existing questions. In solving problems, ST tends to solve with rectangular solving steps rather than solving a system of two-variable linear equations. However, the final conclusion he wrote is correct, namely the area of the plant is 112 cm².

Based on the written answers above, interviews were also conducted to support the analysis of student answers. The following are excerpts of the interviews conducted:

R : Pay attention to question number 5, can you tell what is known and asked from the question?

ST : It is known that the length of the garden is 44 cm, and the width is 66 cm shorter than the length, then ask the area of the garden.

R : You still haven't written down what you know and what you're asking, right?

ST : Not yet ma'am.

R : Now try to explain what you know and what you wrote

ST : The circumference of the garden is equal to 44 cm, then the circumference is equal to twice the length plus twice the width, right?

R : Then there is p minus one equal six, what does this mean?

ST : That's not one, but L ma'am, that's P minus L equals six because the width is six centimeters shorter than the length, right?

R : then why don't you solve it using material on a system of two-variable linear equations? Even though in the question I was asked to use the substitution method

ST : I'm confused about how to make an analogy and a mathematical model

R : Ok, fine. Thank you.

Based on the interview results above, the ST concept indicator is able to say exactly what is known in the problem, namely the circumference of the garden is 44 cm, and the

width of the garden is 66 cm shorter than the length. Then on the principle indicator, ST was unable to explain the steps in determining the mathematical examples and methods correctly because ST felt confused, so it was also very clear on the skills indicator ST was not sure that the answers he got and the conclusions he wrote were in accordance with what who was asked in the problem because he was unable to change verbal sentences into mathematical sentences by making a mathematical model of a two-variable system of linear equations problem or unable to use concepts and procedures in solving problems related to a two-variable system of linear equations.
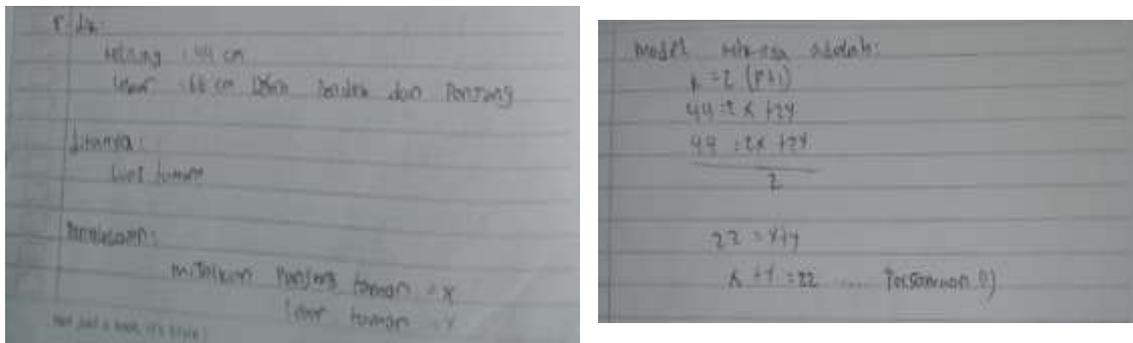
B.    SS Subjects with Medium Ability



**Figure 2. SS subjects in working on questions**

Based on the picture, it can be seen that the SS writes down what is known and what is being asked or what the main issues are in the problem. Furthermore, SS took advantage of the ideas that were known and asked in the problem to create a mathematical model that would later be used to answer the questions, but it was a pity that he only completed the answers up to the determination of the first equation, namely $x + y = 22$ and did not continue with the next step.

Based on the written answers above, interviews were also conducted to reveal student understanding, along with excerpts from the interview:

R    :    What is known from the question?
SS   :    The circumference of the garden is 44 cm and the width of the garden is 66 cm shorter than the length, right?
R    :    What is asked from the question?
SS   :    What is being asked is the area of the park
R    :    How do you solve the problem?
SS   :    First, I used the formula for the perimeter of the rectangle to answer the problem, namely $k=2p+2l$, then I substituted each value into the formula

Ma'am.
R : Good, but why didn't you finish your answer?
SS : Because I'm confused about how to determine the mathematical model for the two equations
R : Ok, fine. Thank you.

Based on the interview excerpts above, the SS concept indicators are able to state what is known and asked in the questions correctly and precisely. SS explains how to change the story sentences in the problem into a mathematical model by using the formula for the perimeter of a rectangle and getting the first equation. However, in completing the answers he wrote, it only stopped here because SS still did not understand the steps in working on the questions.

C. SR Subjects with Low Ability
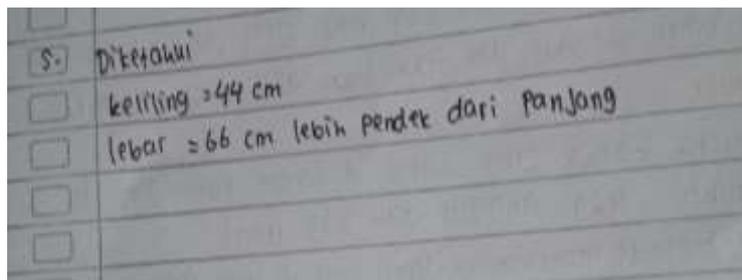


**Figure 3. SR subjects in working on the questions**

Based on the picture, it can be seen that SR only wrote down what was known in the questions and did not continue with the answers until conclusions were drawn. Researchers conducted interviews to reveal students' understanding. The following is an excerpt of the interview:

R : From question number five, what do you know about that question?
SR : A garden in the form of a rectangle with a circumference of 44 cm and a width of 6 cm.
R : What is asked from the question?
SR : The area of the park
R : What can you say from this question?
SR : I don't know, Ma'am
R : Did you find it difficult to solve this problem?
SR : Yes ma'am, I don't understand and don't understand how to solve it, even though I've read it over and over again ma'am
R : Have you ever had questions like this before?
SR : Yes ma'am, but it's been a long time so I don't remember anymore
R : Ok, fine. Thank you.

Based on the interview excerpt above, the SR concept indicator is able to state what is known and what is asked in the problem, but the SR principle indicator does not write down exactly what is asked. On the skill indicator, SR was unable to work on the questions according to the steps in solving the questions because he was unable to understand the questions properly.

**Table 1. Data Conclusion on Each Subject**

| Indicators | ST | SS | SR |
|---|---|---|---|
| **Concept Difficulty** | Subject can determine variables, but subjects cannot understand the problem and make a mathematical model using the perimeter formula of a rectangle because the subject does not understand the material of a two-variable system of linear equations to solve problems. | Subject did not write down what was known and asked in the problem, the subject determined a plan to solve the problem but did not finish it. The subject has concept difficulties. | The subject can determine what is known and asked, but the subject cannot determine variables, cannot understand the problem and cannot make a mathematical model using the formula for the perimeter of a rectangle |
| **Principle difficulty** | The subject does not master the principles of solving algebraic operations using the elimination/substitution method. The subject experiences principle difficulties and difficulties planning completion and carrying out plans. | The subject cannot solve the problem using the information in the problem or the method of solving a system of two-variable linear equations, so it means that the subject has difficulty in principle | The subject cannot determine the method of completion, the subject has difficulty applying the principle. |
| **Skill Difficulty** | The subject uses the operation to calculate the perimeter of the rectangle correctly. However, the subject did not use concepts and procedures in solving problems related to a system of two-variable linear equations | Students are not able to make conclusions or reflect on the methods that have been used to solve the problem of a system of two-variable linear equations. Subjects experiencing skill difficulties. | Subject cannot write down the completion steps. Subjects experiencing skill difficulties. |

In the results of research on the difficulty in working on a system of two-variable linear equations, each subject found different difficulties, from the test results and interviews the researcher paid attention to three types of indicators that students had difficulty solving a system of two-variable linear equations, namely:

1. Concept Difficulty

   Basically, the concept refers to basic understanding, concept difficulties mean students' difficulties in understanding and concluding information from a given concept. Based on the analysis of students' answers and interviews, the conceptual difficulty lies in the students' difficulty in understanding the intent of the problem such as determining what is known and students not understanding what is desired from the problem and students not understanding the meaning of the substitution and elimination methods in solving a system of two-variable linear equations. Indicators of conceptual difficulty are the inability to remember concepts, the inability of students to restate a concept, the inability to understand concepts and the inability to deduce useful information. This is also in line with Baskorowati and Wijayanti's research which stated that students had conceptual difficulties because they did not understand the information in the questions (Baskorowati & Wijayanti, 2021).

   Based on the presentation of the test results of several subjects and the results of their interviews about the two-variable linear equation system problem, it shows that the subject does not understand the problem, starting from the test results the subject immediately writes down the solution without writing down the steps for solving the problem such as not writing down what is known and asked. So that this case can be said as students having difficulty understanding the concept. This is relevant to research conducted by Maspupah and Purnama which states that conceptual difficulty occurs when students do not understand the problem so that the answers do not match the questions asked (Maspupah & Purnama, 2020).

2. Principle Difficulty

   In this section, data analysis is carried out which aims to determine the difficulties experienced by the subject in solving problems with a system of two-variable linear equations. Indicators of principle difficulties are students not understanding variables, lack of mastery of the basics of algebra, lack of students' ability to convert into equations and errors in number operations.

Based on the presentation of test result data by several subjects as well as interview data regarding difficulties in understanding principles, the subject wrote a solution using the elimination and substitution method of a two-variable linear equation system problem that was seen but the subject made a wrong decision in writing the mathematical model. So, it can be concluded that the difficulties in understanding the principle, namely the difficulties experienced by students, can be seen from the mistakes made in writing the equations and the difficulties in applying the methods used. This is relevant to research conducted by Alfi, et al., principal difficulties when changing the form of an equation incorrectly and unable to complete the calculation (Riyanda & Maidiyah, 2022). The principle difficulty is when students have difficulty determining the solution to a system of linear equations of two variables using either the substitution or elimination methods (Maspupah & Purnama, 2020).

3. Skill Difficulty

Skill difficulty is difficulty in solving math problem steps, indicators of skill difficulty are the lack of ability to understand the form of the problem, the inability of students to write down the completion steps correctly and students unable to write answers correctly. Based on the presentation of the test results of the subject with the initials SS and the results of interviews with the subject regarding the difficulty in solving the two-variable linear equation system problem in number 3, it can be seen that the subject did not use the correct steps and immediately wrote down the final answer, so it can be concluded that the subject experienced skill difficulties. This research is relevant to research conducted by Idris, et al, regarding skill difficulties when students experience errors in operating on numbers (Idris et al., 2016).

Factors that include matters related to students' intellectual abilities and the way students process or digest mathematical material include:

1. Students have less practice working on the questions

This can be seen when the researcher gives assignments to do, but only students who have high abilities and some other students do not do the assignments given. This is relevant to Sundary et al's research which states that there is a lack of practice on various questions (Sundary et al., 2022).

2.  Lack of interest in learning mathematics so that students are less active in the learning process

    When carrying out the teaching and learning process the researcher saw that some students were active but not a few students just sat and were silent, some students did not ask questions even though they did not understand, this was also conveyed by the mathematics subject teacher who said that student learning outcomes were not optimal because most of them did not pay attention when the teacher explained the lesson and was less active in the teaching and learning process.

3.  Students don't study despite knowing there will be a test

    When the teaching and learning process was almost finished, the researcher informed all students of class X IA that there would be a test afterwards and gave them a few minutes to review the material, however, when the researcher gave test questions to students, some students had difficulty solving these questions and admitted they did not repeat the material when given time.

**CONCLUSION**

Based on the research results obtained in solving problems on the material system of linear equations of two variables, it was concluded that there were several difficulties experienced by students, namely conceptual difficulties which lay in the fact that students were unable to deduce information from a given concept, then principle difficulties, namely difficulties applying solving methods in solving problems, and skill difficulties that lie in the difficulty of arithmetic operations. The results of this study are expected to be recommendation for teachers to improve students' mathematical abilities in the matter of a system of two-variable linear equations. The teacher should give several real-world examples to help students understand the concept, remind them to read the questions carefully, and teach them how to write down what is understood and what is being asked for in the questions to make the task easier to accomplish.

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