

# 14. Mathematical Concepts

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Students who can understand mathematical concepts can explain the concepts they have learned, distinguish which are examples and which are not examples based on the definitions and materials provided, and apply the concepts they have learned in solving related problems [8]. It can also be said that understanding mathematical concepts requires students to understand the previous material or prerequisite material to understand the material they will study previously.

Although the skill to understand mathematical concepts is said to be important in education, especially in learning mathematics, there are still many incidents that students' skill to understand mathematical concepts is low, especially on the material System of Linear Equations in Three Variables (SLETV). Based on the 2013 curriculum, the SLETV material is one of the primary materials in class X SMA learning. Where there are still many students who have difficulty understanding and solving SLETV problems related to everyday life, such as story questions with additional misleading information [9]. The students said that they understood and understood the material and examples of questions given by the teacher. However, when given a slightly different question from the example given, students start to get confused about working on the problem. The factor of this happening is that many students still memorize and remember something given by the teacher. Another factor that influences this is using a teacher-centered learning model during classroom learning [10].

Therefore, a learning model is needed that can improve the skill to understand concepts in learning mathematics. One of the learning models that can be used as an alternative to this problem is the discovery learning model. Discovery Learning is a learning model that directs students to find new concepts and designs for students to be able to find concepts and principles by themselves [11]. In using the Discovery Learning model, the teacher will act as a mentor by providing opportunities for students to learn actively. Learning activities using the Discovery Learning model will change the initially passive learning conditions into active and creative learning conditions [12]. It can be said that the Discovery Learning model is a model that develops how students learn actively can find concepts independently where the concepts obtained will be easy to remember and not easily forgotten.

Based on the problems described above, the authors would like to conduct a study entitled "Skill to Understand Mathematical Concepts of Class X Students in System of Linear Equations in Three Variables Materials Using the Discovery Learning Model."

## 2. METHOD

The type of research in this research is descriptive research. Where it aims to describe the skill to understand

students' mathematical concepts in SLETV material using the Discovery Learning model. The research subjects are a class of science X.4 in Senior High School Number 1 Talang Kelapa students, totaling 35 people and have not studied SLETV material. The focus of this research is the skill to understand students' mathematical concepts in SLETV material, which consists of 5 indicators, namely (1) restating a concept, (2) providing examples or non-examples of the concepts being studied, (3) presenting concepts in various ways. Form of mathematical representation, (4) Using, utilizing, and selecting specific procedures or operations, (5) Classifying concepts/algorithms into problem-solving.

This research was conducted through 3 stages, namely: (1) the preparation stage (2) the implementation stage, (3) the final stage [13]. This preparation stage is the initial stage of research. The preparatory phase of this research is compiling a proposal, contacting the school that will be used as a place of study, preparing instruments in the form of appropriate test questions and interview guidelines as supporting tests and teaching materials in the form of lesson plan and student's worksheet following the discovery learning model and SLETV material, and validating research instruments and teaching materials with education experts.

Furthermore, after the research carried out the preparation stage, the researcher proceeded to the implementation stage, where the researcher conducted SLETV material learning in the research class using the discovery learning model for three meetings. At the fourth meeting, the researcher gave a written test containing indicators of understanding mathematical concepts to students in the research class. The researcher conducted interviews with the participants—students with questions related to their answers to the test questions.

After the research activities have been carried out, the researcher proceeds to the final stage, where the researcher collects data in the form of test results that students have carried out at the last meeting and the effects of interviews that have been conducted. Furthermore, the data that has been obtained is analyzed which indicators appear on the students. After being analyzed, the researcher draws conclusions, where the conclusions generated, can answer the questions from the problem formulation.

## 3. RESULT AND DISCUSSION

Data on students' understanding of mathematical concepts obtained from tests conducted by participants at the fourth meeting. The test is given to see the skill to understand the mathematical concepts of students given after learning using the discovery learning model. The questions have given consist of 2 questions with details number 1 consisting of 2 indicators and question 2

composed of 3 indicators. The test was given boldly through a zoom meeting and was only attended by 25 students. From the number of students who have taken the test, three subjects will be selected for interviews. The three subjects were taken based on the test results; namely, all indicators were met, only three indicators were met, and one indicator was met.

### 3.1. Analysis Test and Interview

Table 1 shows indicators and descriptors with its code.

**Table 1.** Table code indicators

Number Of Question	Code Of Indicators	Indicators	Descriptor
1	A1	restating a concept	Skill to define the meaning of system of linear equations in three variables in their language.
	A2	Provide examples or non-examples of the concepts being studied	Skill to give correct and incorrect examples.
2	A3	Presenting concepts in various forms of mathematical representation	Able to change a problem related to everyday life into mathematical model.
	A4	Using, utilizing, and selecting specific procedures or operations	Able to translate system of linear equations in three variables problems related to daily life using substitution, elimination, and combination methods.
	A5	Classifying concepts/algorithms into problem-solving	Able to interpret system of linear equations in three variables problems related to daily life using substitution, elimination, and combination methods. Able to solve system of linear equations in three variables problems related to daily life using substitution, elimination, and combination methods.

From the table above, there are two questions where; the first question consists of 2 indicators, namely indicators A1 and A2 indicators, and the second question consists of 3 indicators, namely A3 indicators, A4 indicators, A5 indicators. The following is a complete analysis of the data obtained:

Try to explain what you know about a three-variable system of linear equations and Express the following equations do they form a three-variable linear equation system? Give reasons for your answer!

a.  $x = -2; y = 5; \text{ dan } 2x - 3y - z = 8$   
 b.  $2x + 5y = 7, 4y + 3z = 3$

**Figure 1** Question number one

A rice seller mixes three types of rice. Rice with the first mixture consisting of 1 kilogram of type A, 2 kilograms of type B, and 3 kilograms of type C is sold for Rp. 145,000. Rice with the second mixture consisting of 2 kilograms of type A and 3 kilograms of type B is sold for Rp. 170,000. Rice with the third mixture composed of 1 kilogram of type B and 1 kilogram of type C is sold for Rp. 55,000. Determine the price of which type of rice among the three types of weight is the cheapest?

**Figure 2** Question number two

#### 3.1.1. Analysis of Understanding Mathematical Concepts of AN Subjects

AN Subjects are categorized as competent subjects, because the subject meets all indicators of the skill to understand mathematical concepts. The following is an analysis of understanding mathematical concepts of AN subjects:

In question number one, AN's subject has fulfilled the A1 indicator where the subject has been able to define the meaning of SLETV in his language. This is evident from the results of the answers from AN's subject and has been confirmed through interviews.

SLETV → Sistem Persamaan Linear Tiga Variabel yg terdiri dari tiga Persamaan yang masing-masing Persamaan memiliki tiga Variabel. Misal nya (x, y, z)

**Figure 3** Answer from subject AN



Q : In question number 1, there are 2 questions. The first question is do you understand this?

AN: Yes, sir, understand

Q : Try to explain what your answer is?

AN: A three-variable linear equation system is a system of linear equations It consists of three equations that each have three variables. Variable (x,y,z).

In this question, the subject of AN has also fulfilled the A2 indicator where the subject has been able to mention correct examples and bad examples of SLETV. This is evident from the results of the answers from AN's subject and has been confirmed through interviews.

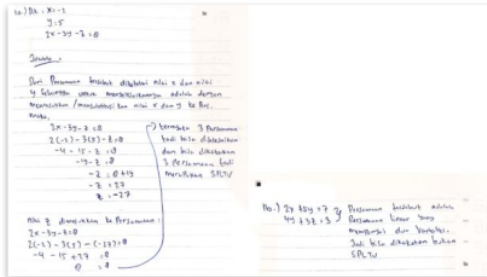


Figure 4 Answer from subject AN

Q : in the second question, in part a there is an equation  $x = -2$ ;  $y = 5$ ; and  $2x - 3y - z = 8$ . Do these three equations make up System of Linear Equations in Three Variables?

AN: Yes, sir. Three equations are System of Linear Equations in Three Variables

Q : Why can it be said that way, why?

AN: Because the 3 equations can be solved by substituted values from x and y to equations  $2x - 3y - z = 8$  and obtained values  $z = -27$ . If Substituted values x, y, and z into the equation then the result of the operation is equal to 8.

Q : Next, I see on your work sheet saying that for Equation b does not include System of Linear Equations in Three Variables, the reason why?

AN:  $2x + 5y = 7$  and  $4y + 3z = 3$  it is a System of Two Variable Linear Equations because the equation has only 2 variables namely x and y for equations  $2x + 5y = 7$  and variables y and z for equations  $4y + 3z = 3$

In question number two, the subject of AN has met the A3 indicator where the subject has been able to change a problem related to everyday life into a mathematical model. This is evident from the results of the answers from AN's subject and has been confirmed through interview.

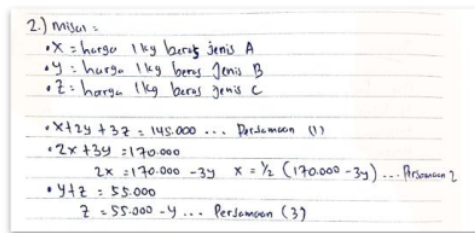


Figure 5 Answer from subject AN

Q : In question number 2, a problem is given. Any information that Is there anything about that?

AN: So that's where I see there are 3 types of rice mixed. Rice with the first mixture consists of 1 kg of type A rice, 2 kg of type B rice and 3 kg of rice type C and sold for Rp145,000. Rice with the second mixture consists of 2 kg of type A rice, 3 kg of type B rice and sold for Rp170,000. Rice with the last mixture consists of 1 Kg of type B rice and 1 Kg of type C rice and is sold For Rp55,000.

Q : From the answer you wrote, why get the equation  $x + 2y + 3z = 145,000$ ,  $2x + 3y = 170,000$ , and  $y + z = 55,000$ ?

AN: So, from the previous problem I suppose the price of 1 kg of type A rice as x, 1 kg of rice type B as y, and 1 kg of rice type C as z. continue the first mixed rice as equation 1, the second mixed rice as equation 2 and the third mixed rice as equation 3. So, you can get the equation like that.

In this question, the subject of AN has also fulfilled indicators A4 and indicator A5 where the subject has been able to translate SLETV problems related to daily life using the substitution, elimination, and combination methods, able to interpret e SLETV problems related to everyday life using the substitution method, elimination and mix as well as being able to solve e SLETV problems related to daily life using substitution, elimination, and combination methods. This is evident from the results of the answers from AN's subject and has been confirmed through interviews.

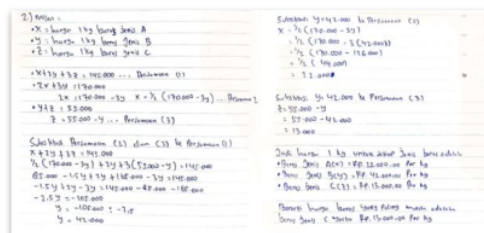


Figure 6 Answer from subject AN

Q : Keep trying to explain why your workmanship is like that and you What methods do you use to solve this problem?

AN: I use the substitution method. Because I think the substitution method is easy to use.

Q : Keep asking, why is this equation changed to be like this? ( $x = 1/2 (170,000 - 3y)$ )

AN: because I used the substitution method, so I first looked for equations, which can be changed to  $x$  equal to and  $y$  equal to

Q : If you use other methods cannot solve problem number 2?

AN: looks like you can, use elimination or combined methods

Q : Have you already described some of the information you get, well that information cannot be used in solving this number 2 problem?

AN: can be sir, like the type of rice that was converted into 3 mathematical equations after it was solved using the substitution method

P : These are the values  $x$ ,  $y$  and  $z$  already got. Try to sort the most expensive rice to the cheapest.

AN: So, type B rice is the most expensive, after that type A rice and the cheapest is C type rice.

3.1.2. Analysis of Understanding Mathematical Concepts of RA Subjects

RA subjects are categorized as moderately capable subjects. because the subject only meets three indicators of understanding mathematical concepts from five existing indicators. The following is an analysis of understanding mathematical concepts of RA subjects:

In question number two, the subject of RA has met the A3 indicator where the subject has been able to change a problem related to everyday life into a mathematical model. This is evident from the results of the answers from RA's subject and has been confirmed through interviews.

$A + 2B + 3C = 145.000 \dots (1)$	$A = x = Rp 22.000$	Tak losses dengan
$2A + 3B = 170.000 \dots (2)$	$B = y = Rp 42.000$	harga paung merah
$B + C = 55.000 \dots (3)$	$C = z = Rp 13.000$	adonan C. Rp 13.000

Figure 7 Answer from subject RA

Q : In question number 2, a problem is given. What information is there about this?

RA: So that's where I see there are 3 types of rice mixed. Rice with the first mixture consists of 1 kg of type A rice, 2 kg of type B rice and 3 kg of type C rice and sold for Rp145,000. Rice with the second mixture consists of 2 kg of type A rice, 3 kg of type B rice and sold for Rp170,000. Rice with the last mixture consists of 1 Kg of type B rice and 1 Kg of type C rice and is sold for Rp55,000.

Q : From the answer you wrote, why get the equation  $A + 2B + 3C = 145,000$ ,  $2A + 3B = 170,000$ , and  $B + C = 55,000$ ?

RA: So, like this, from the problem I suppose the price of 1 kg of type A rice as A, 1 kg of rice type B as B,

and 1 kg of rice type C as C. continued later for A, B and C it was changed to  $x$ ,  $y$ , and  $z$

In this question, the subject of RA has also fulfilled indicators A4 and indicator A5 where the subject has been able to translate SLETV problems related to daily life using the substitution, elimination, and combination methods, able to interpret SLETV problems related to everyday life using the substitution method, elimination and mix as well as being able to solve SLETV problems related to daily life using substitution, elimination, and combination methods. This is evident from the results of the answers from RA's subject and has been confirmed through interview.

$x + 2y + 3z = 145.000 \dots (1)$	$z = 13.000$
$2x + 3y = 170.000 \dots (2)$	$4z = 52.000$
$2x + 4y + 6z = 290.000$	$4 + 13.000 = 55.000$
$2x + 3y = 170.000$	$4 = 55.000 - 13.000$
$4y + 6z = 120.000$	$4 = 42.000$
$4y = 58.000$	$4 = 42.000$
$4y = 120.000$	$2x + 3y = 170.000$
$-5y = -62.000$	$2x + 84.000 = 170.000$
$y = -12.400$	$2x = 170.000 - 84.000$
$-5$	$2x = 170.000 - 120.000$
$x = 13.000$	$2x = 44.000$
	$x = 22.000$
	$z = 22.000$

Figure 8 Answer from subject RA

Q : Keep trying to explain why your answer is like that and what methods did you use to solve the problem?

RA: I used the elimination method. After obtaining the value  $z$ , I substituted  $z$  value to the existing equation.

Q : If you use another method, can you not solve problem number 2?

RA: It looks like it can be sir, but it's easier to get elimination.

Q : I want to ask you. Here, you write. That's what's wrong, isn't it?  $1x + 2y + 3z = 145.000$

RA: Oh yes sorry I wrote it wrong because I want to finish quickly

Q : Keep trying to see exactly what you wrote this section?  $\left(\frac{z = -65.000}{-5}\right)$

RA: It's been sir

Q : Actually, that's not right. It is allowed to be written like that but it must be like this writing means that the left side is and the right side is equally divided with. But if you want to write it like this  $\frac{-5z = -65.000}{-5} - 5z - 65.000 - 5z =$

RA: Ok, sir.

Q : Continue 1 more in this section you will find the value of variable  $x$ , it suddenly changed to  $z$ . so please check again well when it is finished

### 3.1.3. Analysis of Understanding Mathematical Concepts of CM Subjects

CM subjects are categorized as low-skill subjects. Because the subject only meets one indicator of understanding mathematical concepts from the five existing indicators. The following is an analysis of understanding mathematical concepts of CM subjects:

In question number one, the subject of CM has fulfilled A2 indicator. This is evident from the results of the answers from CM's subject and has been confirmed through interviews.

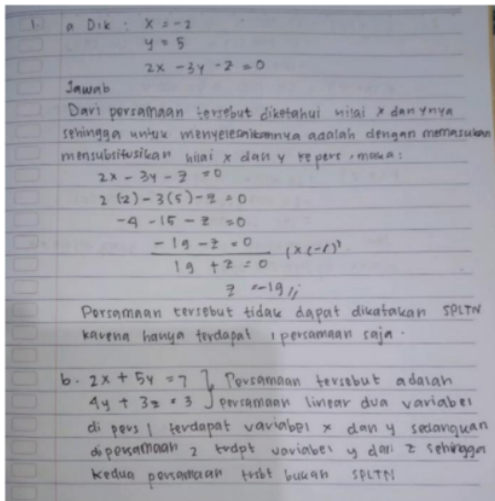


Figure 9 Answer from subject CM

Q : For the second question in part a, try to note that something is wrong or not with what you are doing?

CM : Oh, yes sorry. It was wrong to write. It should have been 8 but wrongly written so 0

Q : Try to do if the 0 replaced by 8, whether the three equations are System of Linear Equations in Three Variables or not?

CM : Yes, all three equations are System of Linear Equations in Three Variables because they get the value  $x = -2, y = 5, z = -27$  and if all the values of the variable are substituted to the existing equation, the result is equal to 8.

Q : Well, so next time you have to be careful again. Next, for part b, why is your answer like that?

CM : Because both equations include linear equation in 3 variables where both equations have two variables.

The results showed that of the 5 indicators of mathematical concept understanding ability used, there are three indicators that are met by almost all subjects including presenting concepts in various forms of mathematical representation, using, utilizing, and

choosing certain procedures or operations and applying concepts or algorithms to problem solving. Indicators that have not been dominant appear on all subjects are to give examples or not examples of the concepts studied and restate a concept that has been studied.

Indicators present concepts in various forms of mathematical representation is one of three indicators that appear in almost all subjects. In this indicator almost all subjects are able to make a mathematical model of the given problem as in problem number 2. There is a story that contains activities in everyday life. From the problem it appears that the subject of AN and RA has been able to turn the problem into three linear equations of three variables which the three parties can use to solve the given problem. This is in line with what Syafri said that the forms of mathematical representations are one of which is to make a mathematical model of a given problem and is able to solve the problem using a mathematical model that has been created [14].

The next indicator is to use, utilize, and select a specific procedure or operation. In this indicator the subject of AN and RA is able to use the right steps in solving the problem given to problem number 2. Like an AN subject that uses substitution methods and RA subjects that use elimination methods in solving problems in problem number 2. This is in line with what sari said that learners are said to be able to use the right steps if the learner is able to solve a given mathematical problem with mathematical steps that are also appropriate so that a solution of the problem is obtained mathematically [15].

The last indicator that almost all subjects meet is to apply concepts or algorithms to problem solving. Although this indicator is almost fulfilled by all subjects but there is a slight difference from each subject. Where the subject AN has been able to mention the details of the unit price of every 1 kg of rice types that exist and the subject RA only mentions the value of the faithful variable only, not written variable  $x, y,$  and  $z$  as what.

The indicator restating a concept that has been studied is an indicator that has not been dominantly met by the subjects. Only AN subject has fulfilled the indicator. Where the subject an is able to explain the definition of SLETV precisely using its own language. Other subjects were able to answer but what they said about the definition of SLETV was less precise. They only mention the definition of linear equations in three variables instead of SLETV.

The last indicator is an indicator that provides an example or not an example of a learned concept. This indicator is also not dominantly met by the subjects. In this indicator and from the problems given the subject is expected to be able to distinguish which examples and



not examples from SLETV and can give reasons for their answers. In this indicator only an and CM subjects are able to distinguish which examples of SLETV and why and also not examples of SLETV and why.

#### 4. CONCLUSION

Of the 5 indicators of mathematical concept understanding ability used, there are three indicators that are filled by almost all subjects including presenting concepts in various forms of mathematical representation, using, utilizing, and choosing certain procedures or operations and applying concepts or algorithms to problem solving. Indicators that have not been dominant appear on all subjects are to give examples or not examples of the concepts studied and restate a concept that has been studied.

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