The analysis of students’ mathematical understanding ability in solving two-variables linear equation system during the Covid-19 pandemic

L M A Syati¹ and N Priatna²

¹ Program Studi Pendidikan Matematika, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Jl. R. Setiabudi No. 229, Bandung 40154, Indonesia
² Department Pendidikan Matematika, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Jl. R. Setiabudi No. 229, Bandung 40154, Indonesia

E-mail: lmikhlasulamalsyati@upi.edu

Abstract. This research aims to determine the mathematical understanding ability of junior high school students about the Two-Variable Linear Equation System (SPLDV) during the Covid-19 pandemic. This research is a qualitative descriptive study. Subjects in analyzing the mathematical understanding ability of junior high school students were grade IX students. The research was conducted at the beginning of the odd semester of the 2020/2021 school year in Bandung. The instrument in this study was a written test consisting of 4 essay questions that were given online via a google form. Each question represents indicators to be measured. The indicators measured are defining a concept, indicator of identifying and making example and non-example, indicator of using, utilizing, and choosing appropriate procedure and indicator of applying concept or algorithm toward problem-solving. Based on the research conducted, it was found that the level of students' mathematical understanding ability for each indicator could be achieved well. However, especially for an indicator of applying concept or algorithm toward problem-solving, students have not been able to interpret the problem.

1. Introduction

Education is an aspect that has a very important role in daily human life that can affect the development of Human Resources (HR) in every country. Education that is carried out by a person or group makes the personality of a person or group mature or achieve a better level of living. We have encountered education from an early age, both formal and non-formal education. In formal education, both in elementary school, junior high school and senior high school, mathematics is a frightening spectre for students even though mathematics is one of the important subjects and can train students to link one concept to another in solving problems logical, analytical, and systematic.

Learning mathematics has a goal according to the National Education Department (Depdiknas) No. 22 of 2006 makes students have the ability (1) Understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms, in a flexible, accurate, efficient and precise manner, in problem-solving. (2) Using reasoning on patterns and properties, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements. (3) Solve problems which include the ability to understand problems, mathematical design models, solve models and interpret the solutions obtained. (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. (5) Having an
attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in studying mathematics, as well as being resilient and confident in problem-solving [1]. This is in accordance with the learning objectives formulated by the National Council of Teachers of Mathematics (NCTM) (2000: 29), such as learning to communicate, learning to reason, learning to solve problems, learning to link ideas and learning to represent ideas [2]. Not much different from the 2013 curriculum, which contains the objective of emphasizing the modern pedagogical dimension for learning using a scientific (scientific) approach where the activities carried out to make learning meaningful, namely asking, trying, observing, reasoning, presenting, and creating in mathematics learning [3].

Based on the description above, there is a mathematical understanding which is the goal of learning mathematics and is important if it is developed. Mathematical understanding translated into mathematical understanding is a very important mathematical ability that students must have in learning mathematics. The importance of having a mathematical understanding was stated by Santrock (Hendriana, et al. 2017: 3) that a key aspect of learning is understanding concepts [4]. Likewise, an important foundation in thinking to solve mathematical problems or problems in real life is mathematical understanding. In addition, the ability to understand mathematics also supports other mathematical development such as reasoning, critical thinking, creative thinking, connection, communication, representation, problem-solving and other mathematical thinking.

Sumarmo (Hendriana, et al. 2017: 4) argues that there are 4 levels of mathematical understanding consisting of mechanical understanding, inductive understanding, rational understanding, and intuitive understanding. If a person can remember and apply concepts correctly, it can be said that he has a mechanical understanding. If one can show the concepts that apply in simple cases and believe in them, then one can say that one has an inductive understanding. To be said to have a rational understanding if someone can prove the truth. Furthermore, if someone believes in the truth of a certain concept without doubting it, then it can be said that someone has an intuitive understanding [4].

Mathematical abilities for Indonesian students are low. According to the 2015 Program for International Student Assessment (PISA) report, Indonesia is in position 63 out of 70 countries, which means that it is ranked 8th from the bottom and this is very concerning for the mathematical ability of students with an average score of 386. At the same time, the international average score is 490, which means that Indonesia's average score is still below the international average score [5]. Even most recently, the citation on the Kompas page (4/12/2019) in 2018 the PISA (Program for International Student Assessment) score for Indonesia's mathematics score got a score of 379 where the average international score of the OECD (Organization for Economic Co-operation and Development) for mathematics is 489 [6]. This shows that Indonesia's mathematics score is still below average. In addition, a survey from the 2015 Trend in International Mathematics and Science Study (TIMSS) in Indonesia being ranked 6 from below, which means that Indonesia was ranked 45 out of 50 countries with an average score obtained of 397 where the international average score was 500. This means that Indonesia's average score is still far below the international average score [7].

Based on the results of the survey above, it shows that the mathematical abilities of Indonesian students are still low and far below the average score. The habits of students in this case in learning mathematics students only memorize formulas without paying attention to how conceptual understanding and conceptual relationships are. Thus the result is that students are not actively involved in building the concept of knowledge so that the concepts received by students do not last long. This is because teachers generally provide monotonous learning and do not involve students so that students do not like mathematics [8].

Covid-19 is a virus that is very detrimental to the world, especially in Indonesia which has an impact on health, economy, social and even education. The impact of covid-19, especially in education, which forces learning cannot be done face-to-face or in class. So that the learning method is carried out by the distance learning method. In this pandemic, it is not easy to achieve mathematical understanding because in addition to learning methods that are not commonly used by students and teachers as well. Therefore, in this pandemic, teachers must think about, design and carry out mathematics learning with methods,
models, theories or approaches that are able to make students achieve learning objectives, in this case, mathematical understanding.

One of the mathematics study in junior high school is a two-variable linear equation system. In learning, the two-variables Linear Equation System students can define a concept, identifying and making example and non-example, using, utilizing, and choosing appropriate procedure and applying concept or algorithm toward problem-solving. These indicators are indicators of mathematical understanding ability. To respond to this, it is necessary to conduct research to analyze of students' mathematical understanding ability in solving two-variables Linear Equation System during the Covid-19 pandemic.

2. Research Method
This research is a qualitative descriptive study which aims to determine or describe the determine the mathematical understanding ability of junior high school students about the Two-Variable Linear Equation System (SPLDV) during the Covid-19 pandemic. This research was conducted at the beginning of the odd semester of the 2020/2021 school year. The population in this study were all students of class IX in one junior high school in Bandung with a total sample of 28 students. The research instrument used was in the form of mathematics comprehension test questions for junior high school students which contained two-variable linear equation system material with 4 questions in the test instrument and for each question contained each indicator of mathematical comprehension ability. The 4 indicators that are measured are defining the concept in SPLDV, identifying and making examples and not examples on SPLDV, Using and utilizing and selecting certain procedures or operations in SPLDV and applying concepts or algorithms to problem-solving in SPLDV. Giving questions to students is given online via google form because in the Covid-19 pandemic where learning is carried out using the distance learning method.

This research begins by providing learning materials that contain an online two-variable linear equation system (SPLDV) due to the Covid-19 pandemic, which requires learning with distance learning methods. In addition, students are also directed to be able to access the material of the two-variable linear equation system (SPLDV) anywhere and anytime, be it from websites, journals, books or the like which contains a two-variable linear equation system (SPLDV) not only from teachers or researchers. By providing material for the two-variable linear equation system (SPLDV), it aims to make students recall the material for the two-variable linear equation system (SPLDV) and prepare themselves to be given a test instrument.

The scoring rubric in analyzing the mathematical understanding ability used to score is presented in table 1.

| Level of Understanding       | Criteria                                                                 | Score |
|------------------------------|--------------------------------------------------------------------------|-------|
| Do not understand            | Answers are just repeating questions                                      | 0     |
| Misconception                | Answers indicate a misconception with what is being learned               | 1     |
| Partial misconception        | Answers provide partially correct information but indicate a misconception in the explanation | 2     |
| Partially understood         | The answer is correct and contains at least one scientific concept and does not contain one misconception | 3     |
| Fully understand             | The answer is correct and contains all scientific concepts                | 4     |

Table 1. Student Mathematical understanding Assessment Rubric.
The students' mathematical understanding measured by the combined ability assessment is represented by a value calculated using the percentage formula as follows.

\[
\text{Value} = \frac{\text{Student's score}}{\text{Ideal score}} \times 100\%
\]

The following are the criteria for students' mathematical understanding, which are presented in table 2 (adapted from Rahayu and Pujiastuti [9]).

Table 2. Mathematical understanding criteria.

| Score     | Criteria   |
|-----------|------------|
| 85% -100% | Very high  |
| 70% -85%  | High       |
| 55% -70%  | Moderate   |
| 40% -55%  | Low        |
| 0% -40%   | Very low   |

Table 2 shows there are five levels of mathematical understanding, namely very high, high, moderate, low, and very low [9].

3. Result and Discussion

Based on the analysis carried out, there were 16 students who got Very High scores, seven students were in the High score category, four students had sufficient scores, and only one student got Very Low scores with the highest student score being 100 and the lowest score was 37.5.

Following will be presented an analysis table of students' mathematical understanding ability in the material of the two-variable linear equation system (SPLDV):

Table 3. Junior High School Students' Mathematical understanding Ability on SPLDV Material.

| Indicator                                   | Percentage (%) |
|--------------------------------------------|----------------|
| Defining concept                           | 95.53          |
| Identifying and making example and not an example | 73.21          |
| Using, utilizing, and choosing appropriate procedure | 83.03          |
| Applying concept or algorithm toward problem-solving | 73.21          |

Table 3 shows the percentage for indicators of defining a concept, which is the highest at 95.53%. In indicators of identifying and making example and not an example, the percentage is 73.21%. Meanwhile, for indicators of using, utilizing, and choosing appropriate procedure, the percentage is 83.03%. In addition, the percentage for indicators of Applying concept or algorithm toward problem-solving is 73.21%. Based on the data above, the average percentage of students' mathematical understanding abilities is 81.25% which means that the average ability of students' mathematical understanding can be said to be high.

The following is an analysis of the mathematical understanding of the two-variable linear equation system (SPLDV) material for each indicator to be measured.

1. Indicators of defining concepts

In this indicator, research subjects are expected to define the concept of SPLDV in their own language.
Figure 1. Question number 1 on an indicator of defining the concept.

Figure 1 shows question number 1 with indicators of defining a concept.

Figure 2. Student’s answer for question 1 on the indicator of defining the concept.

Figure 2 shows one student's answer to question number 1 with indicators defining a concept. In analyzing student answers, overall, the students answered correctly with a percentage of 95.53%. This means that for this indicator, it can be said that the level of mathematical understanding is very high.

2. Indicators of identifying and making example and non example.
   In this indicator, research subjects are expected to be able to identify and make examples and non-examples of SPLDV and can provide a clear explanation of the problems in SPLDV.

Figure 3. Question number 2 on an indicator of identifying and making example and non-example.

Figure 3 shows question number 2 where in this question, the research subject is given two choices and is expected to be able to distinguish between example and not example of SPLDV and students are asked to provide answers with precise and clear reasons.

Figure 4. Student’s answer on question 2 on an indicator of identifying and making example and non-example.

Figure 4 shows that in the answer, the students answered correctly, which example was SPLDV and not SPLDV, but the reasons given were unclear. In this answer, it was seen that the students were wrong about the SPLDV concept. Maybe the student's intention for part (a) is not SPLDV, because it only has one equation, as well as part (b) SPLDV, because it has 2 equations. Overall the students answered correctly with a percentage of 73.21%, which means that the students' mathematical understanding ability was high or it could be said that it was achieved well.
3. Indicator of using, utilizing and choosing appropriate procedure.
In this indicator, research subjects are expected to be able to use, utilizing and to choose appropriate procedure

![Figure 5](image)

**Figure 5.** Question number 3 on indicator of using, utilizing, and choosing appropriate procedure.

Figure 5 shows question number 3 where students are made to think about Question number 3 on indicator of using, utilizing, and choosing appropriate procedure in determining the set of solutions from a two-variable system of linear equations.

![Figure 6](image)

**Figure 6.** Student’s answer on question 3 on an indicator of using, utilizing, and choosing appropriate procedure.

Figure 6 shows the answer from one of the students to question number 3 with indicators of indicator of using, utilizing, and choosing appropriate procedure. In the answer, it is seen that the students were wrong when doing the calculations. Which should be simplified if the two segments are divided in order to obtain. Besides that, the answer also shows that the set of solutions is not clearly written. Overall, the percentage of answers to this indicator is 83.03%, which means that the students' mathematical understanding ability is high or it can be said to have achieved well.

\[-13y = 13 - 13y = \frac{13}{-13} = -1\]

4. Indicators of applying concept or algorithm toward problem-solving
In this indicator, research subjects are expected to applying concept or algorithm toward problem-solving.
Figure 7 shows question number 4, students are asked to determine the amount of money that must be paid by Andi to buy 3 pencils and 2 rulers.

Figure 8 shows the answer from one of the students to question number 4 wherein the answer, it can be seen that students can make mathematical models and do calculations and students immediately write down answers, but students do not interpret the problem in this problem. Most students do the same in this problem. There are also some students who do not make mathematical models to solve the given problems, such as what is known in the problem, what they are looking for then do the solution. Most students answered correctly, but these students were not able to interpret the problem (did not clearly write the answer to what was asked), they just wrote down the answer.

Based on the analysis of students' mathematical understanding ability, each of the indicators above is high, or it can be said that it has been achieved well, but on the indicators of applying concepts or algorithms to problem-solving, it appears that students have not been able to interpret the problem, in this case writing answers clearly what is the purpose of the questions. In this case, it is in line with research conducted by Nurnisa, I., & Amelia, R. (2018) who said that the results of their research showed that students had moderate or good mathematical understanding skills even though the research was conducted with different learning materials.

4. Conclusion

Based on the analysis in this study, it can be concluded that: the students' mathematical understanding ability for each indicator was achieved well, in this case, the indicator defining the concept with a percentage of 95.53%, the indicator identifying and making example and non-example with a percentage of 73, 21%, indicators of using, utilizing and choosing the appropriate procedure with a percentage of 83.03%, and indicator of applying concept or algorithm toward problem-solving with a percentage of 73.21%. However, for indicators of applying concepts or algorithms to problem-solving, students have not been able to interpret the problem, in this case, they have not been able to clearly write down the answers to the objectives of the questions. In data collection, there were weaknesses, including the researcher could not ensure the honesty of students in solving the question instruments given because it was done online. In addition, researchers also did not conduct research prior to Covid-19 so they could not compare students' mathematical understanding abilities before Covid-19 and during Covid-19.
References

[1] Depdiknas 2006 *Kurikulum Tingkat Satuan Pendidikan (KTSP)* (Jakarta: Depdiknas)

[2] NCTM 2000 *Principles and Standards for School Mathematics* (USA: NCTM)

[3] Kemendikbud 2013 *Kerangka Dasar dan Struktur Kurikulum 2013* (Jakarta: Kemendikbud)

[4] Hendriana H, Rohaeti E E dan Sumarmo U 2017 Hard Skills dan Soft Skills Matematika *Siswa* (Bandung: Refika Aditama)

[5] OECD 2016 PISA 2015 *Results Excellence and Equity In Education* Volume I (Paris: OECD Publishing)

[6] Harususilo Y E 2019 Skor PISA Terbaru Indonesia, Ini 5 PR Besar Pendidikan Pada Era Nadiem Makarim [Link](https://amp.kompas.com/edukasi/read/2019/12/04/13002801/skor-pisa-terbaru-indonesia-ini-5-pr-besar-pendidikan-pada-era-nadiem-makarim) Accessed on October 10, 2020

[7] Mullis I V S, Martin M O, Foy P and Hooper M 2015 TIMSS 2015 International Results in Mathematics Boston College

[8] Cetin Y 2004 Teaching Logarithm By Guided Discovery Learning And Real Life pplications *Tesis* (The Middle East Technical University)

[9] Rahayu Y dan Pujiastuti H 2018 Analisis Kemampuan Pemahaman Matematis Siswa SMP Pada Materi Himpunan: Studi Kasus Di SMP Negeri 1 Cibadak Pasundan *J. Res. Math. Learn. Educ.* 3 98 Dipetik 2 Oktober , 2020