

The Analysis of Students' Difficulties in Solving Systems of Linear Equation Problems in Two Variables

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Abstract

This study aimed to determine the difficulties experienced by students and the factors that cause students to experience difficulties in solving questions related to systems of linear equation in two variables (SPLDV). This study used a qualitative approach by applying the descriptive research. The subjects in this study were students of class IX1 at SMP Negeri 1 Bontomarannu. Data collection techniques used diagnostic test material of systems of linear equation in two variables and interviews. Data analysis techniques used qualitative data analysis consisted of data reduction, data presentation and drawing conclusion. The results revealed that: (1) Difficulties experienced by students of class IX1 at SMP Negeri 1 Bontomarannu in solving questions regarding to systems of linear equation in two variables consisted of the first is the concept difficulty which lies in the students' mistakes in giving reasons whether it is systems of linear equation in two variables or not, the students cannot determine the variables in a system of linear equation in two variables, errors in writing the set of resolutions and students do not understand the notion of the combined method of solving systems of linear equation in two variables. The second is the difficulty of principle; it lies in errors in changing into standard form, mistakes in changing an equation and errors in using formulas in general in the completion of the combined method. The third is the difficulty of the skill, which lies in errors in writing the standard form, errors and difficulties in operating numbers and student errors in writing questions when completing answers. (2) Factors that cause students to experience difficulties in completing systems of linear equation in two variables questions consisted of having no interest in learning material in mathematics, having a lack of ability to acquire, understand and solve systems of linear equation problems in two variables, families do not provide motivation to students to be more active in learning, lack of learning routines, they could not calculate correctly.

Keywords: *difficulty analysis, two-variable linear equation system*

Introduction

Improving the quality of human resources nowadays is getting serious attention. History has proven that a nation that is poor with natural resources but has superior quality in human resources has succeeded in becoming a prosperous, rich and powerful country. Conversely, a nation that relies on natural resources, if handled by human resources that are not qualified at a time will experience disappointment. Not surprisingly, today, every nation is increasingly diligent in developing human resources through education. Education is a mode for developing human resources. This is in line with the philosophy that humans need education, without education, human would not be a complete human being. In line with the development of

science and technology and government policies, improving the quality of education for all levels of education is a priority in the effort to educate the nation's life.

Education is a human need, because with education one can build a better future. Education that is able to support development in the future is education that is able to develop the potential of students, so that those concerned are able to face and solve the life problems they face (Trianto, 2010). Therefore, education needs to get attention, handling, and priorities well by the government, families and education managers.

Mathematics education that is taught on the school is a very basic education and is needed in order to master science and technology. Realization of the importance of Mathematics that taught to students is reflected by the placement of Mathematics as a basic science for all types and levels of education. Mathematics is one of the subjects taught at every level of school, elementary, secondary and tertiary levels (Jamal, 2014). The main reason learning Mathematics is the belief that mathematics is useful in everyday life and can help achieve a better level of life.

Based on the results of preliminary interviews with mathematics teachers at SMP Negeri 1 Bontomarannu on October 27, 2018 where at that time the research subjects were still in class VIII, it was found that students had difficulty learning in the field of mathematics study. This is indicated by the inability of students to solve the questions given by the teachers, especially on the subject matter of the systems of linear equation in two variables. Considering to the daily math test of students which showed an average value of students was 60.8 out of a maximum score of 100. As for the 30 students who took the test, there were only 11 people who reached the Minimum Mastery Criteria (KKM) set by the school which score was 75.

The main obstacle in the learning process is students tend to acquire whatever is explained by the teachers, silent and do not want to raise questions or opinions. In solving questions of two-variable linear equations system, students lack mastery of the material, students are in a hurry and not careful in solving problems, and do not master the concepts and principles of two-variable linear equations system. Therefore, when students are giving assignments and daily tests, they have difficulty in solving the questions given.

Referring to this fact, various efforts have been conducted to improve learning achievement. Efforts are conducted and are expected to always be improved, such as improving understanding of Mathematics concepts, understanding, and using mathematical principles, knowing the skills of manipulating Mathematics and knowing the difficulties of Mathematical algorithms. One of the things that need to be considered in connection with these efforts is to look at the difficulty factors experienced by students in solving a Mathematical problem. The aim is to find out whether students learning Mathematics consciously have the expected abilities, such as the ability to solve Mathematical problems. This is important because many students find difficult to solve mathematics questions.

Previous relevant research result that is consistent with this study is the research conducted by (Widodo, 2018) regarding to the analysis of students' difficulties in solving questions on the material system of two-variable linear equations at SMP Negeri 5 Lubuklinggau in 2017/2018 academic year. From the results of the study, it can be concluded that the types of difficulties experienced by students were mostly difficulties in remembering facts and understanding principles. This was revealed from the descriptive statistical results obtained by the percentage of students who have difficulty remembering the facts (i.e., 76.67%) and difficulty understanding principles (i.e., 46.67%).

Method

This study was categorized as a descriptive qualitative research. In this study, a descriptive qualitative approach presented a description of the difficulties experienced by students, namely difficulty of understanding mathematical concepts, difficulty of understanding and using mathematical principles, and the skills to do mathematical manipulation in solving problems of two-variable linear equation systems in class IX1 at SMPN 1 Bontomarannu.

The subjects of this study were students of class IX at SMPN 1 Bontomarannu. The determination of the subject in this study was specifically for students of class X1, consisting of 30 students. The reason for taking this class was because it is seen from the average value of daily tests in the material system of two-variable linear equations still below the Minimum Mastery Criteria set by the school. From 30 research subjects, 6 students were chosen based on their high, moderate and low abilities to conduct interviews with each qualifier taken by 2 students. The selection was based on student answers and teachers' considerations with the aim of getting more accurate data and equitable research.

The instruments were in the form of a mathematical diagnostic test and interview guideline on the subject of the two-variable linear equation system. Diagnostic test was conducted to determine the difficulty of students in solving problems of two-variable linear equations systems and interview guideline was conducted to find out the factors that affect students' difficulties in solving problems of two-variable linear equation systems. Meanwhile, data analysis was conducted in three stages, namely data reduction, data display, and drawing conclusions.

Results

This research was conducted at SMP Negeri 1 Bontomarannu. The activity of giving a diagnostic test of material on a two-variable linear equation system was carried out in class IX.1 at SMP Negeri 1 Bontomarannu on Friday, August 9, 2019 and was attended by 30 students. Out of the 30 subjects, 6 high, moderate and low ability students were selected based on the results of students' answers and considerations from the teachers for interviews. The selected research subjects are presented in the following Table 1.

Table 1. Selection of interview subjects

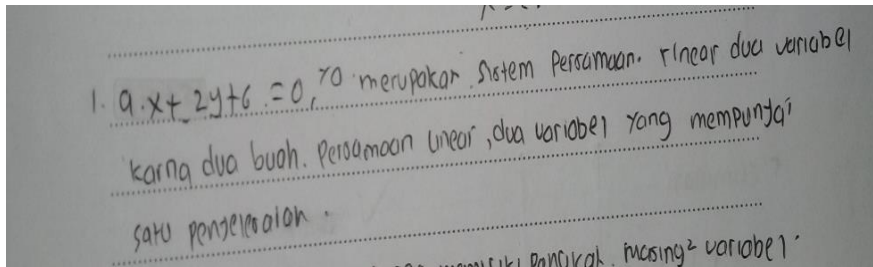
No	Student's Ability	Code
1	High	SP
2		NI
3	Moderate	MYE
4		BAP
5	Low	MI
6		KPS

Based on the results of students' diagnostic test, the following are examples of students, who experience the difficulty of concept, the difficulty of principle, and the difficulty of skill.

Students Who Have Concept Difficulties

Students have difficulty in concept because they made a mistake in writing a two-variable linear equation system. One of the students wrote only one linear equation, namely $x + 2y + 6 = 0$ which should be $\begin{cases} x + 2y + 6 = 0 \\ 2x - 3y - 12 = 0 \end{cases}$ In this case, students experience concept difficulties

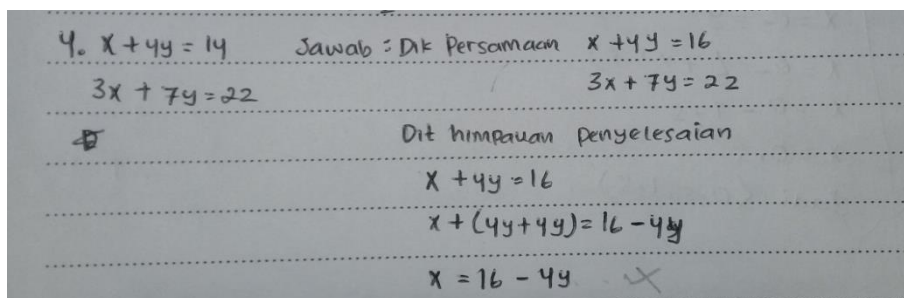
because they do not understand how to write a two-variable linear equation system, even though the concept has been explained in its line.



Picture 1. The form of students' difficulties in mastering concepts

Students Who Have Principle Difficulties

Based on students' answers, they had difficulty in principle in problem number 4 because they were wrong in changing an equation. One of them was also wrong in writing questions when completing answers. When he wrote the answer, what is written was $x + 4y = 16$ which should be the correct question was $x + 4y = 14$. Then in changing an equation the two segments should be subtracted by -4 but they add up to the left and subtract the right. Because using the wrong principle, the final result was also wrong.



Picture 2. The form of students' difficulties in mastering principle

Students Who Have Skill Difficulties

Students experience difficulty in skills due to errors in operating numbers, which is seen in the picture 3 which students in the next step did not decrease the negative sign on the number 5. So that it causes the wrong end result. In substituting, the value of y also students experience errors. The correct answer should be:

$$\begin{aligned} x &= 14 - 4y \\ x &= 14 - 4(4) \\ x &= 14 - 16 \\ x &= -2 \end{aligned}$$

Substitusi nilai $x = 14 - 4y$ ke persamaan $x + 7y = 22$

$$3x + 7y = 22$$

$$3(14 - 4y) + 7y = 22$$

$$42 - 12y + 7y = 22$$

$$42 - 5y = 22$$

$$(42 - 42) - 5y = 22 - 42$$

$$-5y = -20$$

$$y = -20$$

$$y = -4$$

Substitusi nilai x persamaan

$$x = 14 - 4y$$

$$= 14 - (4 \times -4)$$

$$= 14 + 12$$

$$= 26$$

Picture 3. The form of students' difficulties in mastering skills

Discussion

Based on the results of the study obtained difficulties experienced by students in solving problems of two-variable linear equation systems including the difficulty of concept, the difficulty of principle, and the difficulty of skills and the factors that cause it, then researchers can describe it as follows:

Students' difficulty level

The difficulty of concept

The concept refers to a basic understanding. Students develop concepts when they are able to classify objects or when they can associate a name with a certain group of objects. Based on this understanding, students who experience the difficulties of concept are students who experience errors in classifying certain objects. Based on the analysis of students' answers, the difficulty of the concept lies in the students' error in giving reasons whether it includes two-variable linear equations or not, cannot determine the variables in a system of two-variable linear equations, errors in writing the set of completions and students do not understand the notion of a combined method in solving system of two-variable linear equations. These difficulties are not only done by students with low ability, but students with high ability also experience them.

This reflects that concept understanding is very important. Errors in one concept will lead to errors in another, resulting in students experiencing the difficulties of concept. This is consistent with Suherman's (2003) opinion that in mathematics there are prerequisite topics or concepts as a basis for understanding the next topic or concept.

The difficulty of principle and skills

The difficulty of principle is a condition where students know what the formula is and use it, but do not know where or in what context the principle is used or is wrong in associating the concept with an operation. Students are said to have difficulty in principle, if the students cannot identify the concepts contained in the principle precisely and cannot develop as new knowledge. Based on the analysis of students' answers, the difficulty of the principle lies in errors in writing the form of a two-variable linear equation system, errors in changing into standard form, errors in changing an equation and errors in using formulas in general in solving the combined methods.

The difficulty of skills

Mathematics skills are the ability of someone to carry out procedures or operations in mathematics quickly and precisely (Johnston-Wilder, 2016). Based on this understanding, students who experience difficulty in solving problems in the two-variable linear equation system are students who cannot perform procedures correctly and precisely. Based on the analysis of students' answers, the difficulty of the skills lies in errors in writing the standard form, errors and difficulties in operating numbers and students' errors in writing questions when completing answers. The difficulty of skill is done by students because they are not careful in doing it and the lack of variety and frequency of exercises. This is consistent with (Mulyono, 2010) opinion that skills tend to develop and can be improved through practice.

Factors that cause students' difficulties

The difficulty of concept

The factors that cause students to experience the difficulty of concept are due to their lack of ability and interest. It is undeniable that a high level of student ability or intelligence provides opportunities for students to better understand the material well. This is consistent with (Subini, 2012) opinion that students with low intelligence tend to be slower to acquire information/material so that the opportunity for learning difficulties becomes greater than students who have high intelligence.

Another factor that causes students to experience the difficulty of concept in solving problems of the two-variable linear equation system is lack of interest. This is in agreement with (Djiwandono, 2010) that the lack of students' interest in mathematics will cause students learning difficulties in learning mathematics. Based on this, the students had difficulty in solving mathematical problems, especially the material system of two-variable linear equations.

The difficulty of principle and skills

Factors that cause students to experience difficulty in principle and skills are due to low memory ability and unstable learning habits. Students who have low memory ability will work on problems slowly and very difficult. This is consistent with (Subini, 2012) opinion that memory greatly influences learning outcomes. If a student has worked hard, but he/she has low memory ability, the average result will be inferior to students who have high memory ability. Students who are accustomed to learning will be trained to work on problems so that they do not experience difficulties and can work on problems calmly so that writing errors and answers do not occur, and if the opposite occurs then students will experience difficulties so they are nervous while working and results in writing errors.

Efforts that are conducted to overcome students' difficulties

In order to students do not experience difficulties in solving the problem of two-variable linear equations system, the efforts conducted by students to overcome their difficulties are as follows:

The difficulty of concept

To overcome the difficulty of the concept in solving problems of two-variable linear equation systems, one of the efforts that can be conducted is by reading repeatedly. Students who experience concept difficulties tend not to understand the basic knowledge of the two-

variable linear equation system material. The best way to identify the cause of difficulties is to have students read mathematics problems aloud and then ask students to interpret per sentence (Johnston-Wilder, 2016). After knowing the students are having difficulties, then efforts are needed to overcome them. One of them is by reading the material repeatedly until students understand the concepts in the material. This is consistent with Bond opinion quoted by (Mulyono, 2010) that reading is the introduction of written language symbols which is a stimulus to help the process of remembering what is read, to build an understanding through the experience they have.

The difficulty of principle and skills

To overcome the students' difficulty of principle skills in solving problems of two-variable linear equation systems, the following efforts are needed:

The first is by giving exercises. Students who always practice working on the problems of course the results will be different from students who do not practice. Students who are accustomed to practice will more quickly solve the problems given so that they do not experience difficulties. It is congruent with (Mulyono, 2010) opinion that if students are required to be able to apply various concepts almost automatically, then they need a lot of practice and repetition.

The second is by providing varied questions. Teachers should provide new and varied problems and questions so students can face different new problems. This is consistent with (Mulyono, 2010) opinion that students should get enough opportunities to generalize their skills into many situations with the aim that students gain skills in recognizing and applying them to different new situations.

Conclusion

Based on the results and discussion that have been described, the following conclusions are presented: The difficulties experienced by students in solving problems of two-variable linear equation systems included: The difficulty of the concept lies in the errors of students in giving reasons whether it includes two variables linear equation or not, cannot determine the variables in a two-variable linear equation system, errors in writing the set of solutions and students do not understand the notion of a combined method in solving systems of linear equation in two variable. This difficulty is not only done by students with low ability, but students with high ability also experience it. The difficulty of the principle lies in errors in writing the form of a two-variable linear equation system, errors in changing into standard form, errors in changing an equation and errors in using formulas in general in solving the combined methods. The difficulty of the skill lies in errors in writing the standard form, errors and difficulties in operating numbers and students' errors in writing questions when completing answers. The factors that cause students of class IX1 at SMP Bontomarannu have difficulties in solving the problems of two-variable linear equation system included: Have no interest in studying material in mathematics Having a lack of ability to accept, understand and solve problems of two-variable linear equation systems The family does not motivate students to study harder Lack of study routines, Cannot calculate correctly. The efforts are conducted to overcome the students' difficulties of class IX 1 at SMP Negeri 1 Bontomarannu in solving problems of two-variable linear equation systems, namely: Study hard, read repeatedly, give practice questions, provide varied questions, discuss or work in groups with friends, ask the teacher, re-understand the explanation from the teacher.

References

- Djiwandono, S. E. W. (2010). *Psikologi-Pendidikan*. Rineka Cipta.
- Jamal, F. (2014). Analisis Kesulitan Belajar Siswa Dalam Mata Pelajaran Matematika Pada Materi Peluang Kelas XI IPA SMA Muhammadiyah Meulaboh Johan Pahlawan. *Jurnal MAJU (Jurnal Pendidikan Matematika)*, 1(1), 18–36.
<http://www.ejournal.stkipbbm.ac.id/index.php/mtk/article/view/232>
- Johnston-Wilder, S. (2016). Learning to Teach Mathematics in the Secondary School. In *Learning to Teach Mathematics in the Secondary School*.
<https://doi.org/10.4324/9781315672175>
- Mulyono, A. (2010). *Pendidikan Bagi Anak Berkesulitan Belajar*. Rineka Cipta.
- Subini, N. (2012). *Mengatasi Kesulitan Belajar pada Anak*. Mentari Pustaka.
- Trianto. (2010). *Mendesain Model Pembelajaran Inovatif-Progresif*. Kencana Prenada Media Group.
- Widodo, B. A. (2018). *Analisis Kesulitan Siswa Dalam Menyelesaikan Soal-Soal Pada Materi Sistem Persamaan Linear Dua Variabel Di Smp Negeri 5 Lubuklinggau Tahun Pelajaran 2017/2018*.