Students' Mathematical Connection Based on Levels of Mathematical Abilities:

Qualitative Study in SLETV

Usman Mulbar
Faculty of Mathematics and Science
Universitas Negeri Makassar
Makassar, South Sulawesi, Indonesia
usman.mulbar@unm.ac.id

Purnamawati
Faculty of Engineering
Universitas Negeri Makassar
Makassar, South Sulawesi, Indonesia
purnamawati@unm.ac.id

Nasrullah
Faculty of Language
Universitas Negeri Makassar
Makassar, South Sulawesi, Indonesia
nasrullah@unm.ac.id

Abstract—**This research aims to illustrate the way for students to apply mathematical concepts to the given problem, for example, System of Linear Equations with Two Variables (SLETV). There were three students of SMP Negeri 3 Watansoppeng getting engaged to be research subject. There were two instruments used in this research which are math ability test and mathematical connection capability test. The results of this study showed that the ability tests of mathematics, three students classified into the ability of higher, middle and lower. With problem of SLETV given, subject with a high level of mathematical ability was able to connect with both the mathematical concept known by the given problem, compared with students who have other ability in mathematical connections. In addition, the ability of mathematical connections affects the answers given by the subject, i.e. there were the right answer and wrong answer, and no response at all.**

Keywords: mathematical connection capabilities; system of linear equation; high school students

I. INTRODUCTION

The ability to associate between concepts in the study of mathematics is the basic capabilities not only in problem-solving [1]. It also recognizes and applies mathematics in contexts outside of the subjects (linking mathematics with other disciplines [2]. In line with this statement, curriculum 2006 issued the government confirmed that one of the performance capabilities is to make learners know and understand how to apply the connections between concepts in mathematics and its use in solving problems.

According to Rohendi, the mathematical connection capability relies on high-level thinking skills [3]. Mathematical connection means capacity at the top of the information provided, with a critical attitude to evaluate something and have metacognitive awareness and problem-solving skills. In line with this, Aksela suggested that the higher-level thinking includes the aspects of organizing, analyzing, build, investigate and evaluate [4]. Furthermore, Webb and Coxford explained that the higher-level thinking involved understanding the mathematical ideas more deeply, with data test and explore ideas, make allegations, apply analogy and generalization, logical reasoning, problem-solving, communicating in mathematics, and connecting mathematical ideas with other intellectual activities [5].

Everyone can learn mathematics, although in some cases, some children learn and make connections quicker than others. Everyone has some math skills, but some children have potential far beyond what most people are ready to believe [6]. According to Questions *et al.* mathematical ability is divided into three dimensions, namely, conceptual knowledge, procedural knowledge, and problem-solving [7].

This article aims to describe the ability of students' mathematical connections by mathematical abilities topic two variable system of linear equations. It has become a common conversation that every child has the ability to learn mathematics, but adaptation is faster not all do. Similarly, every child has the math skills, but some children have potential far beyond what most people know so far [6].

Therefore, in this paper are given information about how the three levels of mathematical ability is represented by three students with different abilities, rather high, medium, and low. They would show how to syntesize solutions of systems of linear equations about two variables given. Then how the response of learners with a given problem, a matter which is first impressed mechanistic but involve factual knowledge, procedural knowledge, and problem solving, known as 3P. Then the second question involves 3P remain in charge of content, with the difference attributed to problems in everyday life. This article is interesting to express what the mathematical connections of learners based on their level of mathematical ability, especially on the material system of linear equations in two variables? As the studies presented in the subsequent explanation.

II. METHOD

This study was a qualitative descriptive research conducted in SMP Negeri 3 Watansoppeng. The subjects were students of SMP Negeri 3 Watansoppeng grade VIII. By using math skills test, subjects are identified to be classified into the category of students with high math ability, medium and low.

Furthermore, with task-based interviews, the works of three students were being analyzed and explored to reveal how they construct the solutions of the given problem. The topic is System of Linear Equations Two Variables (SLETV). By collecting information from this activity, this study describes the result of triangulation from some sources, which are the student's written answers, interview, and observation data during the learning activity.

III. RESULT AND DISCUSSION

To support these research activities, the subject material of System of Linear Equations Two Variables (SLETV) has been given to the students. Two of the given problems can be divided into two parts, the first question is given in the form of mechanistic questions, both in the shape of issues relating to everyday life.

A. Student with Higher Ability (SHA)

Moreover, the work in writing and interviews show that the subject is capable of high mathematics can associate between mathematical concepts well. At the stage of mentioning the information contained in the matter, a subject capable of complex mathematical concept can understand the given problem and mention what is known and asked smoothly. The subject would find questions that look similar to a given problem so that the topic is more easily to be solved.

It is also better to link the concept of equality of non-linear two variables with a linear equation of two variables. The subject who is capable of complex mathematic can relate what is known and what is asked in the problem by finding the relationship between various representations of concepts. The interviewed subject can mention smoothly on how to relate and asked the question. When writing on the answer sheet, subject wrote the answers neatly. The subject can reconstruct the given problem. Subject can make analogy x and y correctly. It showed that a subject can link the existing information between the concept and the given problem. Furthermore, the subject can make a mathematical model of the problem by linking information of the equation system of linear equations of two variables, and derived two equations. Subjects can explain the two equations that he created in detail. Subject planned to resolve the problem by using the elimination method, namely equating the coefficients of one variable equation to form a new equation. The subject stated that he used the method of elimination because he thinks it is the easiest way to solve the problem.

On the stage of solving the problem, a subject who capable of higher mathematics did not write down the answers steps by steps. The subject would use the elimination method that he plans previously. In solving the problem, a subject used the elimination method to determine the value of the variables x and y variables. First of all, subject would eliminate the subject of equality. At this stage, the subject will find the value of the variable x. Subject removed the variable y by means equalizer coefficient y in the second equation, add two further subjects to the equation so that the value of the variable x is derived. To find the value of the variable y, subject eliminates the

variable x by equating coefficients of x in the second equation. Then, the subject subtracts the equation so that the value of the variable y is derived. Once a subject has discovered the value of x and y values, and the subject interprets it or write down the answers. The conclusions replace variables x and y in analogy before, so that the subject can determine the set of the settlement of the matter. Furthermore, subject will re-examine the answers of the results of the process to convince himself that the answer is correct.
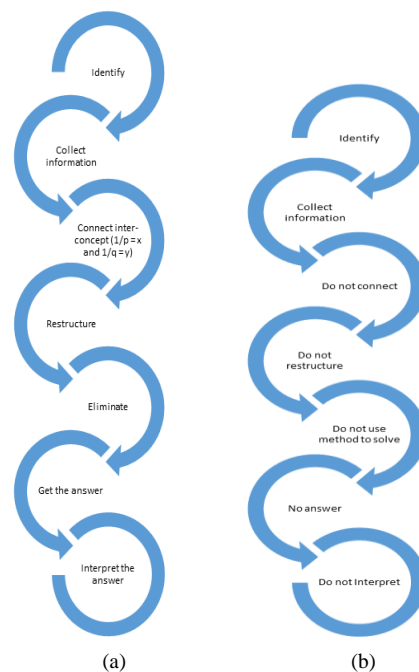

Fig. 1. (a) The steps of SHA   (b) The steps of SMA and SLA

B. Student with Middle Ability (SMA)

Based on data from the results of the written and interview process, the subject with math ability was not able to associate mathematical concepts well. At the stage of collecting information, the subject with middle mathematical ability didnot understand the given problem but can mention what is known and asked smoothly. In linking the concept of non-linear equations into linear equations of two variables, the subject cannot associate what he know into the question. The subject was unable to associate an existing concept in question. Similarly, in the interview subject cannot mention how to relate the concepts related to the matter. On the answer sheet, the subject did not write anything. Subject admitted that he did not know how to do the problems that he cannot restructure the given problem.

C. Student with Lower Ability (SLA)

Based on data from the written and interview of math difficulties in linking between concepts, the subject with low math ability cannot associate mathematical concepts well. At this stage, collecting information on the question, students with low math ability did not understand the given problem but can mention what is known and questioned. In linking the concept

of non-linear equations with two variables, linear equations of two variables, subject of lower mathematical ability cannot associate the concepts in question. The subject of the interview cannot mention how to associate a note and asked the question. On the answer sheet, the subject did not write anything. Subject admitted that he did not know how to do the problems that he cannot restructure the given problem.

D. Students' Steps In Solving The Problems

To solve the given problem, there are some steps that the student apply to get the answer. Subject SHA solves problems associated with the system of linear equations with two variables. The students first read about a given subject, after collecting information from the subject by writing known and questioning. Afterward, the subjects look at what is asked on the issue; it was the subject of finding what he should do first is by letting the unknown in question with other variables. Subjects can associate the concepts because he understands the concepts that already exist, and then used the same idea to other problems. After letting or linking it to the other form, then return to the subject of restructuring the current equation in the problem. The subject then plans complete by a method of elimination. With the elimination method, subjects get a response, i.e. the set of answers obtained an interpretation of completion.

The SMA subject solves problems associated with the system of linear equations with two variables in several steps. First of all, he read about the given subject, after collecting information from the matter by writing the given information and questions. Afterward, the subjects look at what is asked on the issue, but the subject cannot find what he had to do first. Subjects did not know what concepts are interlinked in such a matter. The subject cannot connect concepts with others because he did not understand that the idea to link or he forget the previous lessons that he has learned. In the absence of an association between concepts that are enabled by subjects of mathematics, he would also not be able to restructure the given problem. As a result, he was using one of the methods of settlement in SLETV and did not get an answer, and no interpretation of the answers obtained.

Subject SML solves problems by relating to systems of linear equations with two variables with equal mathematics subject but in the simplest way. First, he read about a given subject, after collecting information from the matter and questioning it. Afterward, the subjects look at what is asked in the issue, but the subject cannot find what he had to do first. Subjects did not know what concepts are interlinked in such a matter. The subject cannot associate the idea with each other because he does not understand that the idea of one another can be linked or subject forgets the previous lessons he has learned. At the interview, the subject does not know to explain what it was in question number one. In the absence of an association between concepts, subjects would also not be able to restructure the given problem. He was using one of the methods of settlement SLETV and did not get an answer, and no interpretation of the answers obtained.

IV. CONCLUSION

The ability of students' mathematical connections related to its level of math skills. The students involved in this study demonstrate problem-solving abilities of each by using a mathematical problem of the material system of linear equations of two variables. Subjects with a high level of mathematical ability were able to connect with both the mathematical concept known by the given problem, compared with students who have capacity to moderate and low mathematical connections. Also, the ability of mathematical connections affect the answers given by the subject, i.e., there were the right answer and wrong answer, and no response at all.

V. ACKNOWLEDGEMENT

REFERENCES

[1] National Council Of Teachers Of Mathematics, *Principles and Standards for School Mathematics*, vol. 47, no. 8. National Council of Teachers of, 2000.

[2] W. Blum, P. L. Galbraith, H.-W. Henn, and M. Niss, *Modelling and applications in mathematics education*. Springer New York, 2007.

[3] D. Rohendi, 'Developing E-Learning Based on Animation Content for Improving Mathematical Connection Abilities in High School Students', vol. 9, no. 4, pp. 1–5, 2012.

[4] M. Aksela, *Supporting meaningful chemistry learning and higher-order thinking through computer-assisted inquiry: A design research approach*. Maija Aksela, 2005.

[5] N. Webb and A. F. Coxford, *Assessment in the mathematics classroom*, vol. 55. National Council of Teachers of Mathematics, 1993.

[6] A. Borovik and T. Gardiner, 'Mathematical abilities and mathematical skills Mathematical Abilities and Mathematical Skills', no. September, 2007.

[7] S. Questions, C. Context, R. Card, and D. Tools, 'NAEP - Mathematics 2011 : Test Yourself Grade 4 Results Grade 4 Test Yourself Results Question 1 Question 2 NAEP - Mathematics 2011 : Test Yourself Grade 4 Results Question 3', pp. 1–5, 2013.