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Analysis of Student's Difficulties on Generalizing Linear Equation

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ABSTRACT
One of the essential aspects of reasoning mastered by students is generalization. By learning generalization type mathematical abstraction skills, students can provide arguments or conclusions based on facts from the relationships between the rules found. This type of research is a descriptive study that aims to describe the generalization ability of the material on straight-line equations through the CPS learning model assisted by learning videos. The instrument uses the Creative Problem Solving learning model and is administered by teaching videos. The instrument is in the form of written test questions regarding the material of straight-line equations and interview guidelines to measure the generalization ability of students. What will analyze the results of the tests and interviews to get a conclusion. Keywords: Generalization, Straight Line Equations, Creative Problem Solving, Learning Videos.

Keywords: *student's difficulties; generalization; linear equation.*

1. INTRODUCTION

The low PISA score in Indonesia is caused by many students who adhere to the paradigm that mathematics is complicated [1]. Mathematics is considered difficult because the material in mathematics is abstract mainly and confusing [2]. To overcome this, students need to be invited and led to become sensitive to the same characteristics in their experience. This experience is used as the basis for classifying to explore new experiences [3], so that students can understand abstract concepts or situations to build a problem situation model [4]. One of the characteristics that students can do abstract thinking is that students can make generalizations.

Generalization is a conclusion from a specific thing to be more general by taking a related relationship from the particular item based on available information. A general conclusion is obtained and applies to the whole [5].

The generalization indicators are Perception of generality, Expression of generality, Symbolic Expression of generality, and Manipulation of generality. Perception of generality describes how students recognize, perceive or identify a rule or pattern, and know that the problem presented can be solved by a rule or pattern. Expression of generality describes how students use the rules or patterns that have been identified to determine the following structure and includes how students describe a rule or pattern numerically or verbally. Symbolic Expression of generality describes how students generate a general rule or pattern and formulate generality symbolically. Manipulation of generality explains how students use the results of generalizations to solve problems and apply the rules they have found to various issues.

But in fact, the generalization ability of students is low. Students' ability in the category of low mathematical generalization has many difficulties in each indicator [6]. Students do not understand the problem, find it difficult to connect between concepts, students are in a hurry to predict problem-solving without seeing existing patterns or rules, and students' difficulties in manipulating abstract mathematical objects [7]. The low mathematical generalization ability of students is caused by most students who still have difficulty in concluding the material they have obtained [8]. In the category of high generalization ability, students have mastered three aspects of generalization indicators: perception, expression, and symbolism of generality. Then students who have moderate generalization abilities can fulfill two elements, namely perception, and expression. Meanwhile, students with low generalization abilities have not been able to complete at least two aspects of generalization

indicators [9]. In addition, the factors that influence the low generalization ability of students are the use of inappropriate learning models [10]. So it takes the role of the teacher to use the suitable learning model to direct students in bringing up the generalization process of students [11]. When it comes to the material, most students not only have difficulty understanding the material for straight-line equations, but they also have difficulty solving contextual problems related to straight-line equations material [12]. In addition, students also often make mistakes ranging from using mathematical symbols to errors in changing the form of equations, determining intersection points, and drawing graphs on straight-line equations.

In NCTM [13], most mathematical concepts or generalizations can be found effectively using problem situations. Through problems, students are led to be able to clarify issues so that they can find conclusions. One learning model that fits this is creative problem solving because through this model, students are trained to reason, construct, and be able to make generalizations from a specific pattern or rule. The stages of this CPS Learning Model are (1) Finding a vision or goal (2) Finding facts (3) Finding problems (5) Finding ideas (6) Finding solutions (7) Finding acceptance [14]. In addition, to stimulate learning to be more effective, efficient, and engaging, learning media are needed, for example, videos [15].

Based on this description, the researcher will analyze the difficulties experienced by students in making generalizations after learning using the CPS model assisted by learning videos. The analysis of the difficulty in making this generalization is specified in the material of straight-line equations.

2. RESEARCH METHOD

The subjects of this study of this study were 3 student of SMP IT Ulil Albab Palembang. This research is a qualitative descriptive study. The stages of the research consist of three stages, namely: preparation, implementation, analysis, and conclusions which are illustrated in Figure 1.

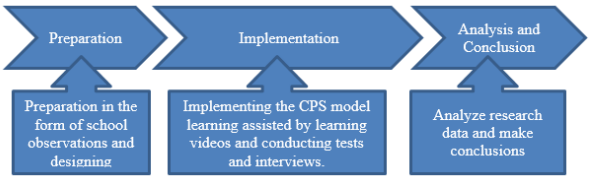

Figure 1 Research stages.

Data collection techniques used in this study were tests and interviews.

3. RESULTS AND DISCUSSION

The researcher's preparation is school observation to discuss with subject teachers on the subject to be studied. The results of discussions with the principal and teachers, namely the researchers, took data in class VIII.1, which consisted of 22 students. Learning indicators consist of (1) students can use graphs, and pairs of sequential tables in solving problems related to straight-line equations, (2) students can analyze everyday problems related to straight-line equations, (3) students can generalize a problem related to the equation of a straight line. Then the making of instruments in the form of test questions and interview guidelines. The instrument that has been made by the researcher was validated by two lecturers of mathematics education, Faculty of Teacher Training and Education, Sriwijaya University. The following are the learning process in class, validated problems, and analysis of student answers. The results of the subject's answers were then analyzed descriptively qualitatively.

Figure 2 The learning process in the classroom.

Problem 1

An employee uses a car as a daily vehicle, the car is filled with 39 liters of gasoline. The car is used to work at a steady speed. Gasoline used is 0.05 liters per km. The employee travels every day is 6 KM. Does 130 days later the car have to refuel again?

Problem 2

Several mobile phone operators apply different rates each time they communicate. The tariff for calling another cellular phone is Rp. 2000,- for the first minute, for 2 minutes, it becomes Rp. 3,500, - and the next minute, it becomes Rp. 5,000, - and continues to increase constantly. Someone has Rp. 200,000, -. Is it enough to call her mother on another cell phone for 2 hours?

Figure 3 Problems given to 3 students.

3.1. Subject 1: MRF

3.1.1. Problem 1

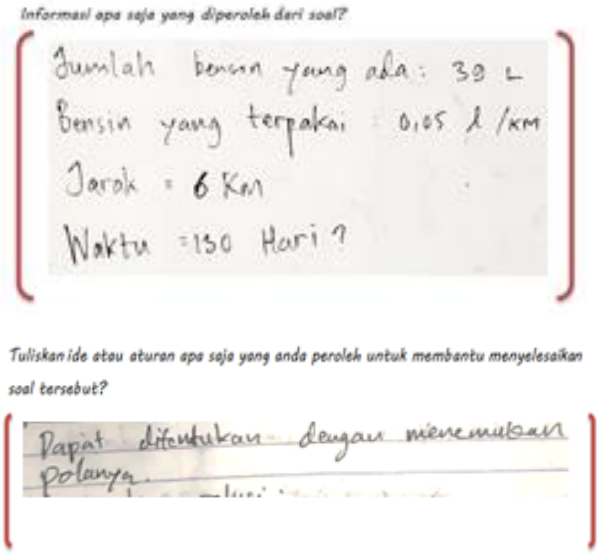

Figure 4 MRF subjects identify problems.

At this stage, the MRF subject has met the Perception of generality indicator, which can already identify a rule or pattern. Besides that students know that the problem presented can be solved by a rule or pattern. This is in line with research that states that students still make mistakes in implementing the planned procedures so that they still experience errors in doing calculations [16].

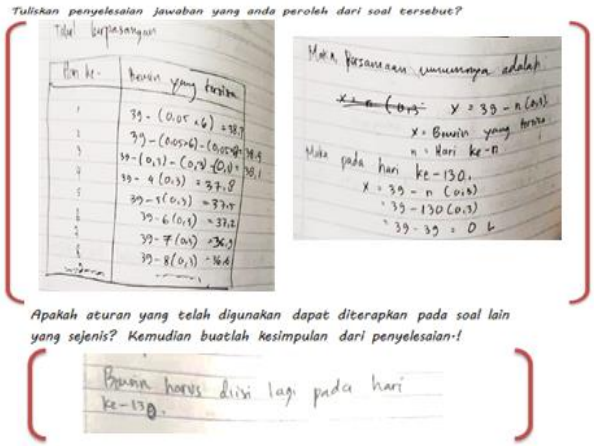

Figure 5 MRF subject completion results.

MRF subjects write solutions based on ideas and problem solving that has been reported. From the results written, the MRF has met the expression of generality indicator. Students can use the rules or patterns identified to determine the following structure and the Symbolic expression of generality indicator, namely students can formulate generality symbolically. As well as meeting the Manipulation of generality indicator, students can use the generalization results to solve problems and apply the rules they have found. The results of the students' answers have made conclusions correctly.

3.1.2. Problem 2

The following is the result of MRF's answer to the second problem. MRF subjects have met the indicators of Perception of generality, Perception of generality, Symbolic expression of generality, Manipulation of generality. However, there is an error when making the pattern, resulting in the general equation being made incorrectly, and the conclusions given are also inaccurate.

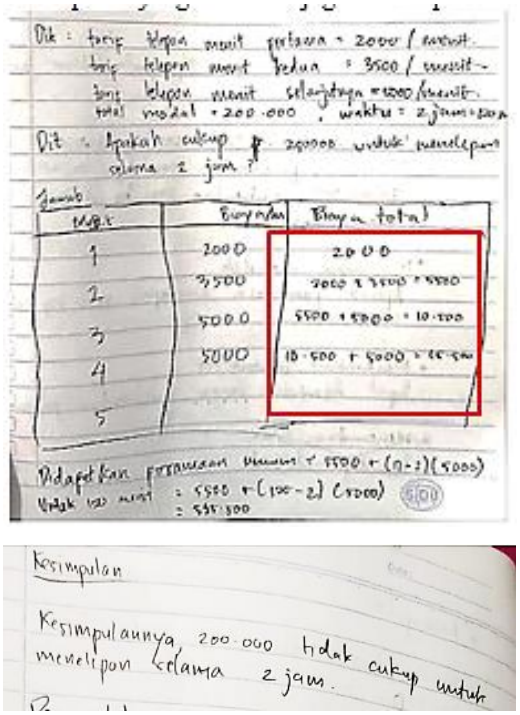

Figure 6 MRF subject completion results.

3.2. Subject 2: Z

3.2.1. Problem 1

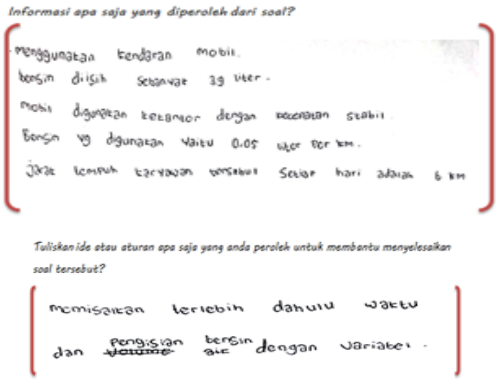

Figure 7 Subject Z identifies the problem.

The following is the result of MRF's answer to the second problem. MRF subjects have met the indicators of Perception of generality, Perception of generality, Symbolic expression of generality, Manipulation of generality. However, there is an error when making the pattern, resulting in the general equation being made incorrectly, and the conclusions given are also inaccurate.

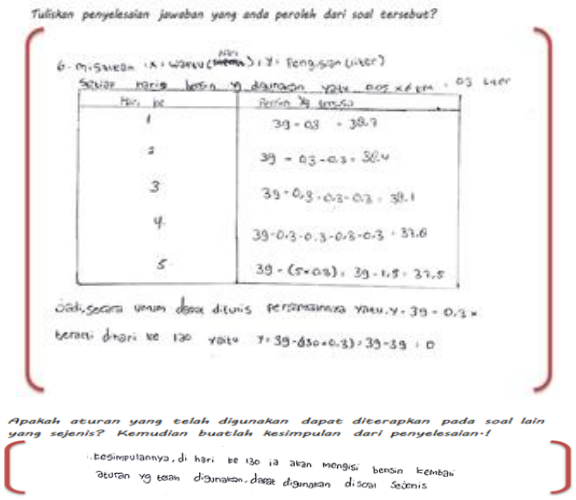

Figure 8 Subject Z completion result.

Subject Z wrote a solution based on the ideas and problem-solving that who had registered. From the results, Z has met the indicators of expression of generality, Symbolic expression of generality, Manipulation of generality. The results of the students' answers have made conclusions correctly.

3.2.2. Problem 2

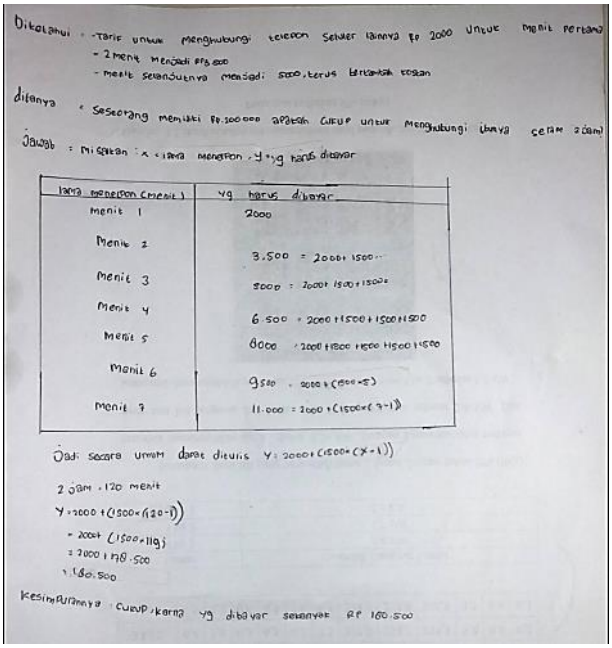

Figure 9 The result of the completion of the subject Z.

The following is the result of Z's answer to the second problem. MRF subjects have met the indicators of Perception of generality, Perception of generality, Symbolic expression of generality, Manipulation of generality. And students have been able to draw conclusions about the problem correctly.

3.3. Subject 2: MF

3.3.1. Problem 1

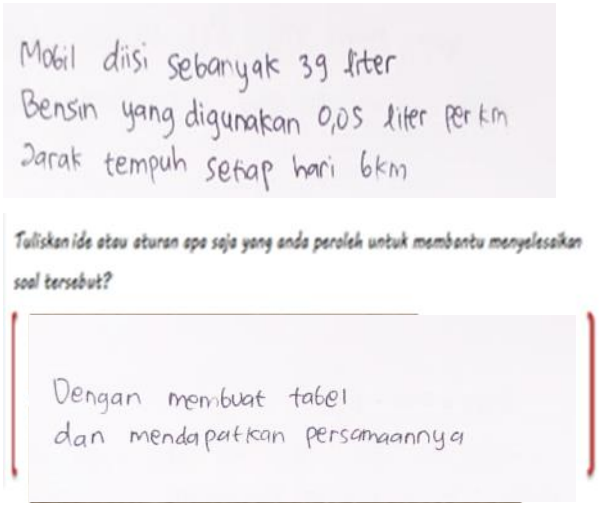

Figure 10 Subjects MF identify problems.

At this stage the MF subject has met the Perception of generality indicator, which is already able to identify a rule or pattern besides that students know that the problem presented can be solved by a rule or pattern.

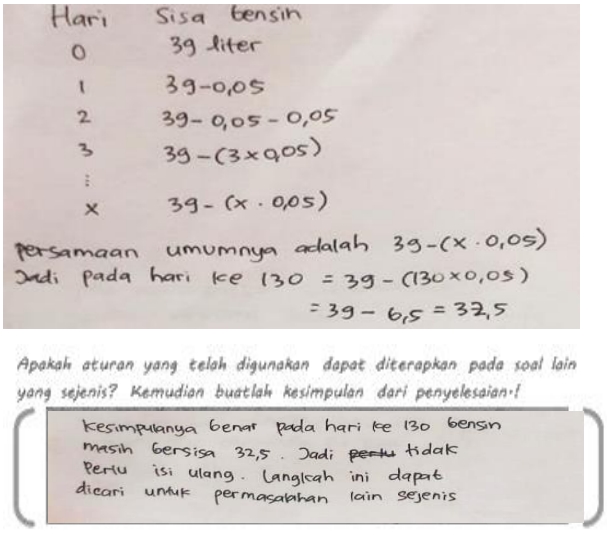

Figure 11 Subject MF completion results.

MF subjects write solutions based on ideas and problem solving that has been reported. From the results written, Z has met the indicators of Expression of generality, Symbolic Expression of generality, Manipulation of generality. However, there are errors when making patterns so that the general equations and

conclusions are written are not correct. According to research, students do not understand in understanding every meaning of a sentence in a given problem [17].

3.3.2. Problem 2

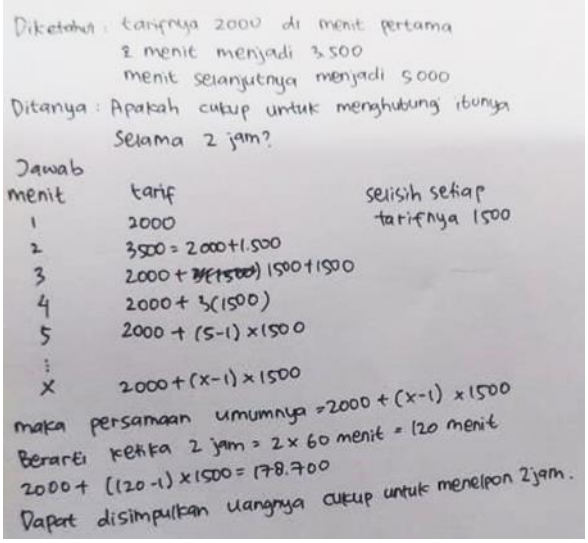

Figure 12 Subject MF completion results.

Following are the results of MF's answer to the second problem. MF subjects have met the indicators of Perception of generality, Perception of generality, Symbolic expression of generality, Manipulation of generality. However, students are wrong in writing the final calculation results, so that the conclusions written are not correct.

4. CONCLUSION

Based on the results of my research, it can be seen that subject 1 has been able to generalize to problem 1, and it can be seen that in problem 2 there is an error when making problem patterns. Subject 2 was able to generalize correctly both in problem 1 and in problem 2. Subject 3 was not correct in making patterns in problem 1, and Subject 3 in problem 2 was able to generalize the problem, but the answer was not accurate due to errors in calculations.

So it can be concluded that for each aspect of mathematical generalization, students have the ability to generalize on the material of straight-line equations through the CPS model assisted by high category learning videos. Based on the observations of researchers, students need total concentration in making patterns and in doing calculations.

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