

The profile of students' mathematical representation in constructing line equation concept

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Abstract. Mathematical representation is the way from students to express their ideas in understanding and solving mathematical problems in the form of images, words, and symbols. This research aimed to know the profile of students' mathematical representation in constructing the straight-line equation concept. This research used a qualitative approach with descriptive research type. The subjects were 36 junior high school students at Jember. Data were obtained from the test, observation, and interview. Data triangulation was done by comparing data from the analysis of the answer sheet with interview data. The results showed in the activity of defining the concept of slope and straight-line equation, students made a visual representation during the process of finding slope and made verbal representation when defining straight-line equation. In the activity of determining a straight line equation, students made a symbolic representation and carrying out visual representation with among of them doing unique guesses in making an overview of the requested line position. In solving problems related to the concept of the straight line equation, some students chose visual representation to solve the two different problems. Some of the other students chose symbolic representation with some inaccuracy, and errors in the algebraic concept. While students who have been identified in the previous process have low ability tend to choose to use verbal methods and made guesses about the number of patterns.

1. Introduction

In mathematics learning, the ability to express mathematical ideas is one of the important things for everyone who wants to study mathematical concepts. Goldin [8] suggests that representation is a configuration (arrangement) that can describe, represent, or symbolize idea in a certain way. In this regard, the National Council Of Teacher Mathematics [13] recommends that there are five main competencies students must possess when learning mathematics. The five competencies are problem-solving, communication, connection, reasoning and proof, and representation. The reasons for the inclusion of standardized representation processes in Principles and Standards of School Mathematics are: (1) fluency in translating between representation is a basic ability that needs to be possessed to develop mathematical concept and thinking; (2) the mathematical concept presented by the teacher through various representations will have a huge influence on student's understanding in learning mathematics; (3) students need to practice in building their representation so that they have strong and flexible conceptual abilities and can be used in solving the problems.



Representations are divided into two types, namely: Internal Representation and External Representation. The process of Internal Representation is the process of thinking about mathematical ideas which in essence is related to the process of regaining knowledge that has been obtained, stored and relevant in memory to be used when needed [9]. The process certainly cannot be observed in plain sight and cannot be assessed directly, because it is a mental activity inside of their mind. Someone needs the External Representation to find out what is being think,. External representation is the result of embodiment in describing something that students do and think internally. Hwang, et. al [10] divide external representation into five representation systems used in mathematics learning, namely: real-world object representation, concrete representation, arithmetic symbol representation, spoken-language representation, and pictures or graphics representation. Among the five, the last three representations are more abstract and a higher level of representation. These three types of representation are the focus of the researchers were the type of verbal, visual, and symbolic representations.

Verbal representation is the expression of an idea in the form of words and writing. The right activity when using verbal representation were able providing a definition of a concept, making a summary or conclusion, re-explaining, and presenting the knowledge obtained in public. Visual representation is the expression of ideas in the form of figure and graphic. Visual representation helps in understanding an abstract concept. In mathematics, visual representation is concrete with figures, graphics of an algebraic form, graph of the problem with the story inside, and diagram (stem, line, and circle). Symbolic representation is a form of expression or mathematical notation consisting of variable, constant, and coefficient that represents ideas in the concept of a line equation [7].

There is a connection between mathematical understanding and mathematical representation. On the other hand, mathematical understanding is very important in studying mathematics since it will be ease solving mathematical problem, even it will sharpen problem solving [12]. The ability of representation is needed in understanding and solving mathematical problems. Utami [6] revealed that the low student learning outcomes in the geometry test were due to the lack of equal ability of students' mathematical representations so that they affected students' skills in finding solutions to these geometry problems. Students rarely ask their teacher about the material they do not understand. Students only do the questions as exemplified by the teacher [12]. Yet the ability to solve problems requires creative independent practice. The solving of mathematical problems also requires integration of some cognitive processes. Not only visual skills, but also words in which the students need to understand the language and factual information in the problem, translate the problem by using relevant information to create the appropriate mental representation [16].

Several studies have been conducted related to the type of representation that students use in mathematical concepts. In communicating mathematical ideas, some students choose verbal or visual representation (concrete), while other students choose symbolic representation (abstract). Akkuş, O & Çakiroğlu, E [1] through their research showed that in solving the three algebraic questions given, the subjects of the study consisting of 21 students of 7th grade were more likely to use symbolic representation.

Neria & Amit [14] in their research states that there are a few students who choose symbolic representations in communicating mathematical ideas. Students prefer to use verbal representations or use representations other than symbolic. Furthermore, they reiterated that "focusing on the result, it is evident that the students, who choose algebraic representations, are students who achieved high scores in the test". That students who choose to use algebraic (symbolic) representations are students who have high abilities.

Research conducted by Aryanti et al [3] on the tendency of students' mathematical representation according to their level of ability to solve quadratic material story problems in junior high school concluded that both students at upper ability, intermediate ability, and lower ability levels were more likely to choose enactive representation in form of a real illustrative picture in solving the story about the rectangle. According to students, the use of concrete object is easier to answer those problems.

Regarding the translation between representations, the ability to change form from one type of representation to another also greatly determines the process of building a conceptual framework in students. Rahmawati, Dwi. et. al [15] showed that students with high academic abilities are able to change verbal representation into graphic representation in the application of the line equation concept in the concept of determining the relationship between distance and time. Those are complex process that involves symbolic representation in the form of scheme, equation and numeric.

From the results of these studies, it can be concluded that some students have a tendency to choose certain types of representation to solve the given problem. However, from the results of the study, it can also be found that there are some difficulties experienced by students who make the type of representation chosen in solving mathematical problems. One of the difficulties is that students do not master the basic concepts and sub concepts that build relevant concepts to solve problems. A new or different research is needed about how students' representations in constructing basic concepts and sub concepts which build key concepts that are relevant to existing mathematical problems.

Related to that reason, researchers have conducted research on mathematical representation activities built by 8th grade students in constructing the concept of straight line equations and several factors which influence the selection of the representation model. The type of representation chosen is the representation of words, images, and mathematical symbols. The concept chosen is the concept of straight line equations which have complex structures in the subgroups of algebra and geometry. An ability to choose the right type of representation and to carry out an algebraic process that is also appropriate is needed so that the construction of relevant sub-concept can work very well. If the concept construction process can run well, then students will be able to understand the existing concepts and apply them to problems. This is something that has not been observed by previous research.

2. Research Method

This research used descriptive research with a qualitative approach. In this study, the population was 36 students from junior high school in East Java, Indonesia. They consist of 19 women and 17 men with heterogeneous abilities. Data analysis conducted by researchers was adopted from Miles and Huberman [11] with three stages in analyzing qualitative research data, namely data reduction, data exposure, and conclusion drawing.

The steps in this study were divided into several stages, namely the research preparation stage, the implementation stage and the stage of data collection and processing. At the preparation stage, the researcher determined the location of the study, conducted dialogues with the principal and mathematics teacher, made instruments of research instruments consisting of student task sheet and interview guidelines, conducted research instrument validation, revised research instruments according to the validator's suggestion. The second stage was the implementation stage. The researcher conducted a follow-up dialogue at this stage with the mathematics teacher, then the research was conducted by giving the assignment sheet that was done by students in four indicators, analyzing the results of the students' work, and interviewing 3 students who were coded EL, AV, and MU. In the final stage of the activity, grouping data was done by the researcher based on the results of tests and interviews, describing the results of data processing, making a conclusion, and preparing the research report.

3. Results

Before conducting the research, we first prepare a research instrument and then test the validity of the instrument. From the results of testing by two validators, a score of 4.5 is obtained. This score indicates that the instrument is valid and ready to use. The method used in this research is to observe the process of mathematical representation of students in constructing the concept of straight-line equations consisting of 4 aspects. Namely: defining gradients, defining straight line equations, constructing line equations based on definitions made, and applying concepts in solving everyday problems. The following is an analysis of the results of the four aspects of the research :

3.1 The Representation of Students in Defining Slope from Straight Line

The process of defining Slope started by giving part 1 of the worksheet to all subjects. On the worksheet, students have started with a visual identification of several roofs that have unequal conditions. From this example, students concluded the factors that influence the difference in slopes of the rooftop and made an initial conclusion about the definition of the slope of a rooftop picture. The following diagram, presented the process of forming the slope definition of three subjects named EL, AV, and MU :

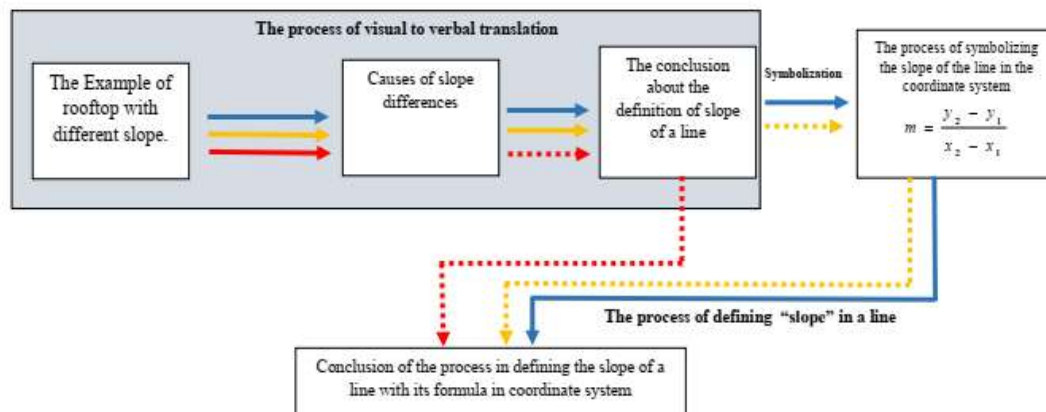


Figure 1. The Representation Process of Defining Slope of a Line

Information : EL = →
 AV = →
 MU = →

In the picture, there are 3 colors of arrows. The blue color indicates the process that is passed by Subject with Initial Name EL, the yellow color indicates the process that is passed by Subject with initial name AV, and the red color is the process that is passed by subject with initial name MU. While the process is not completed or students make some mistakes in it are marked by the color of the dotted line.

The process starts from the left to the right and then all comes down to the conclusion of the process of defining the slope of the line. At the beginning of the activity, students identified three examples of pictures of roofs of houses that have different slopes. The process is depicted in the gray box group in the image above and labeled "visual to the verbal process." The roof of the house is then separated into 2 pairs. Pair the roof of the house with the same base but different in height, and the pair of the roof of the house with the same height but have the same base. From these two conditions, students conclude the factors causing the slope are not the same which leads to the process of defining the slope of a straight line verbally. In the picture above, from the color it appears that there are differences in the process carried out by MU, where MU only comes to the process of identifying the factors causing the differences in the slope of the 3 rooftops.

After the stage in the gray box, students go through to the next step called Symbolization. At this stage, students put the roof of the house which has become a straight line drawing into grid paper. The line goes through point A and point B with certain coordinates. From these coordinate numbers, students determine the vertical distance and horizontal distance so that the gradient value of the line is obtained. The coordinates are then changed to (x_1, y_1) and (x_2, y_2) so, that the gradient value becomes a symbolic form. In population of 36 students, MU students who are representatives of students with low ability are not able to pass the symbolization stage. Students are only able to identify some of the factors that influence differences in roof slope. then, they use some of those factors to define the slope of the line with verbal representations.

EL, the subject with high ability carried out diverse representations that lead to high visual when representing the process of determining the slope of a house roof along with the factors that influence it. Students also carried out visual representation in the form of conjecture of upright distance and horizontal distance from a line through two points on the Cartesian coordinates. Students then translated representations from visual to symbolic in making a symbolic shape of the slope of a line through two points on Cartesian coordinates. In another process, students experienced difficulties and made mistakes when explaining all of these activities into verbal conclusions. AV was able to do a portion of the visual representation in stating the roof's slope of the house and stating the factors that affected the slope of a line. However, she has not mastered the concept of comparative value which was the core in identifying the components of the house's roof and expressed the symbolic shape of the line's slope through two points without proving visually.

We can conclude that students make visual and symbolic representations in defining the slope of a straight line. Students who have high visual analysis skills will be able to pour the visual representation into symbolic and even verbal form as well as possible. While students who have low visual analysis skills will immediately define it in the form of verbal representation with much mistake. This indicates that the low symbolic ability will cause low verbal ability. Based on those results, we have many different with Cahdriyana [4], and Alkhateeb [2]. We will see these differences in Discussion.

Based on these findings, we suggest that classroom learning begin with the inculcation of the process of real objects into visual symbols, as well as the translation between representations, especially into symbolic representations. In line with Napitulu [12], the process of making questions, creativity in mathematics classrooms, and students' self-confidence must be more inculcated in the form of fun learning activities.

3.2 The Representations in Defining Line Equation.

In this activity, student assignment sheet contained the activity of looking for a general form of a straight line equation from a symbolically defined slope through the two points which has been made in previous activity. This picture was a process diagram forming the definition of a straight line equation based on mastery of the concept from previous indicator.

EL had the tendency for high symbolic representation by looking for slope from line that passed through points (x,y) and $(0,0)$ based on the procedure of the activity looking for slope from the two points in the previous indicator to form $y = mx$, but EL still did not know that the equation they have created was a straight line equation. Students then chose $m = 3$ values, then operated the equation so that it is obtained $y = 3x$ and drawn a graph in the form of a straight line. Students concluded that the equation was an equation in which the graph was a straight line. Students were then drawn graphics $y = -4x + 1$ with the starting point equal to the graph $y = 3x$. straight line equation. Students did not mention example number 6. She mentioned an example and not an example similar to the equation they have made, then concluded the definition of a (namely $x = 1$) as an example of a straight line equation so that it affected the final conclusion.

Students with the AV code had a tendency to medium verbal representation because they were able to mention only a part of the sample but not the sample according to their work in numbers 1.a to 1.c, they were able to draw conclusion in line equation only from the line they made but unable to mention the general form of the equation. When the process of looking for line slope through $(0,0)$ and (x,y) , students did the process of selecting $m = 1$. AV value, performing symbolic representation by mentioning the general form of straight line equation, and changing it to another form but not be able to change the symbolic representation of the altered equation into a visual form in form of a straight line graph again. The reason for students was that this form was very different from the initial form which results in a difficult value substitution process of x and y .

The mathematical representation of MU students when defining straight-line equations was the verbal representation, they mentioned the characteristics of the examples and the conclusion students made. However, the representation was incomplete because students were less capable in the process

of symbolizing the general form of a straight line equation. The concept was not right and caused students to be less able to distinguish between examples and not examples of question number 1g. If students mentioned the example 2 also as an example of a straight line equation, then the definition made was not fixed on x and y variables only. Students also did not involve the result of straight line figure into the characteristics that they made.

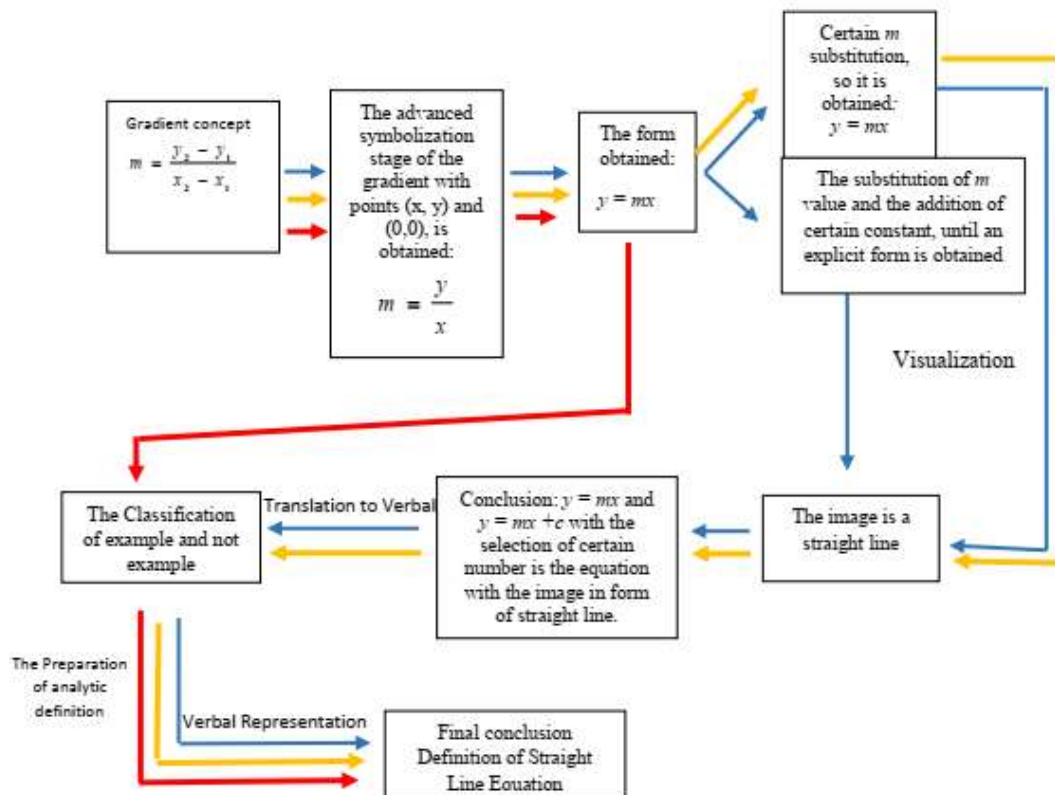


Figure 2. The Representation Process of Defining The Straight-Line Equation

Students with high self-efficacy tend to use multiple representations of sketches and mathematical models, whereas students with low self-efficacy tend to use single representations of sketches or mathematical models only in mathematical words or verbally [16].

3.3 The Representations Determining Straight Line Equation

In the activity of determining the line equation from several known conditions, the task sheet is divided into 4 conditions. Namely the condition of the line equation known as the slope and one point passed by, the line through two points, the parallel line from the line in which the equation is known, and the line perpendicular of the line which the equation is known.

The following was a table of mathematical representation of three students. They are : EL, AV, and MU in all four conditions :

Table 1. The Representation Process of Building Line Equation with Known Situation

Sub	One point with a slope	Two points without known slope	Parallel to the known line	Perpendicular to the known line
EL	Made the equation of a line from the	Made a visual image of point C	Students painted line that was parallel	Students used a protractor to prove

Sub	One point with a slope	Two points without known slope	Parallel to the known line	Perpendicular to the known line
	slope through (x,y) and (x_1,y_1) until it is obtained $y - y_1 = m(x - x_1)$	between line \overline{AB} , and made interpretation of $\frac{y - y_1}{x - x_1} = \frac{y - y_2}{x - x_2}$	through point $E (-6.0)$ with a particular technique. Then students analyzed the slope of two parallel lines and made a conclusion.	constancy, then looked for the slope from both lines and drawn the conclusions.
AV	They were able to do the same thing with EL and made the conclusion.	Made a visual image of point C outside the line \overline{AB} , and did not make the symbolic interpretation.	Did not paint another line that was parallel and through (-6.0) , and did not analyze the slope to make a conclusion.	The student used the slope concept to find the slope values of the two lines and concluded that the slope values were different.
MU	Students were not able to form equation symbolically from the line through (x, y) and (x_1, y_1)	Students made simple sketches about A, B and C points but were not able to make symbolic representations of the three points.	Students were not able to present the reason why two lines were parallel for obvious reason and did not paint other lines that were also parallel.	The student did not use the slope concept to find slope differences from the two lines presented.

Students with EL code perform symbolic representations with high ability, in condition 1 and condition 2 with the reason: students make equations from lines through (x, y) and (x_1, y_1) based on the Gradient concept, and operate algebraically until a form is obtained : $y - y_1 = m(x - x_1)$. In the second condition, students make translational visual representations to symbolic illustrations of 3 points: A, B, and C so as to produce three forms of comparable value, namely :

$$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{y - y_2}{x - x_2}.$$

From these three comparisons, students make the conclusion : $\frac{y - y_1}{x - x_1} = \frac{y - y_2}{x - x_2}$.

Students with the initials AV represent the symbolic medium with the reasons: Choose the values of $m = 1$ and $m = 3$, then mention that the equation is a straight line equation because it is similar to the example he worked on in the previous activity. Students are not able to change these forms into implicit forms like what the EL code students have done. The third reason In Condition 2, students provide a different visual representation by placing point C outside the line segment, but she has difficulty when making symbolic and verbal conclusions from the condition.

In Conditions 3 and 4, EL represents visually because: (1) presents the alleged proof of alignment (condition 3) and alignment (condition 4) two lines. (2) presenting visual allegations and drawing other devices parallel to condition 3, (4) making a visual to symbolic translation by looking for the requested line equation according to their respective positions. Students with AV codes also make visual representations with sufficient ability, because: (1) does not present proof of the alignment of two lines, (2) is able to draw another line perpendicular to the known line. (3) unable to mention the relationship of the two gradients of a line that intersects perpendicularly. Symbolic representation is lacking because it is able to use the concept of gradients to find the value of the slope of two lines that

are parallel and perpendicular, but is not able to understand and look for other similarities that are parallel and perpendicular to the known line.

Students with MU code have a low tendency of visual and verbal representation because they are unable to present the reasons of two lines that are parallel with clear reasons, and are not able to find the equation of lines that are parallel and perpendicular to the known line.

We observe in Conditions 3 and 4. Students with the initials EL represent visually because: (1) presents the alleged evidence of alignment (condition 3) and alignment (condition 4) two lines. (2) presenting visual allegations and drawing other devices parallel to condition 3, (4) making a visual to symbolic translation by looking for the requested line equation according to their respective positions.

AV also make visual representations with sufficient ability, because: (1) does not present proof of the alignment of two lines, (2) is able to draw another line perpendicular to the known line. (3) unable to mention the relationship of the two gradients of a line that intersects perpendicularly. Symbolic representation is lacking because it is able to use the concept of gradients to find the value of the slope of two lines that are parallel and perpendicular, but is not able to understand and look for other similarities that are parallel and perpendicular to the known line.

3.4 The Representation in Applying the Concept of Straight Line Equation in Real World Problems

3.4.1 EL Mathematical Representation of Real World Problem

In this sub category, the researcher presented 2 problems related to the concept of the straight line equation. The first problem was population growth over a period of time assuming a constant growth rate. Meanwhile, the second problem was about the unit price of several types of goods.

EL, student with high ability performed visual representation in question number 1 by illustrating the condition of the problem in a straight line graph. then, by using the slope concept at two points, students looked for Slope from the starting point ie (2006,600,000) and (2012,900,000). From the results of the slope, students looked for the coordinates of the point searched, namely (2019, y), assuming that the slope was the same. It obtained that y value which was the solution to the problem, $y = 1,250,000$. The indicators of visual representation that were filled with students were: (1) translating the problem language into point coordinates in the cartesian coordinate system, (2) drawing a straight line graph correctly, (3) choosing a slope search method based on the results of the work they have done in Indicator 3 number 3a. which brought students to the conclusion that the line segments that were in line have the same Slope. The following are the images of the student worksheets.

In question number 2, which was about determining the price of a certain unit of goods, EL solved the problem by making a visual representation of a simple book and pencil. By using the image streamline according to the existing equation, students found that the price of 1 pencil was Rp. 2000, and the price of 1 book was Rp. 4,000. Students represented ways to find solution with high visual abilities, with the following reasons: (1) made simple illustration to clarify the existing problems, (2) made a strategy to solve the problem systematically using simple images correctly, (3) made a review step of the result done that has fulfilled two known conditions.

3.4.2 AV Mathematical Representation of Real World Problem

Student with AV code of initial have represented of middle ability group student. The following was presented the process of mathematical representation of AV students on problems in situation of number 1 and number 2 below.

AV did the symbolic representation in question no. 1 by determining the line equation passed by (2006,600,000) and (2012, 900,000) using a symbolic form that they have defined in indicator 3. From the equation that has been produced, students then entered 2019 as an x new variable, so there was a solution for the population (y). Students made the first mistake by mistakenly multiplying the two fraction numbers in two segments. Students then made the second mistake with the students lacking in studying the multiplication of large numbers. These student's errors and inaccuracies made the results obtained by students not different from code EL students, and these results did not meet the second

equation. The representation shown by students was a symbolic representation. For reasons: (1) students did not make straight-line illustrations through (2006,600,000) and (2012,900,000), (2) students used symbolic formulation of line equation through two points in the coordinate system, (3) students formed line equation with Implicit and Explicit forms, (4) stated $y = f(x)$ as a function that showed the number of population with x as a variable of the year. Then students substituted (2019) as x to find the wanted population.

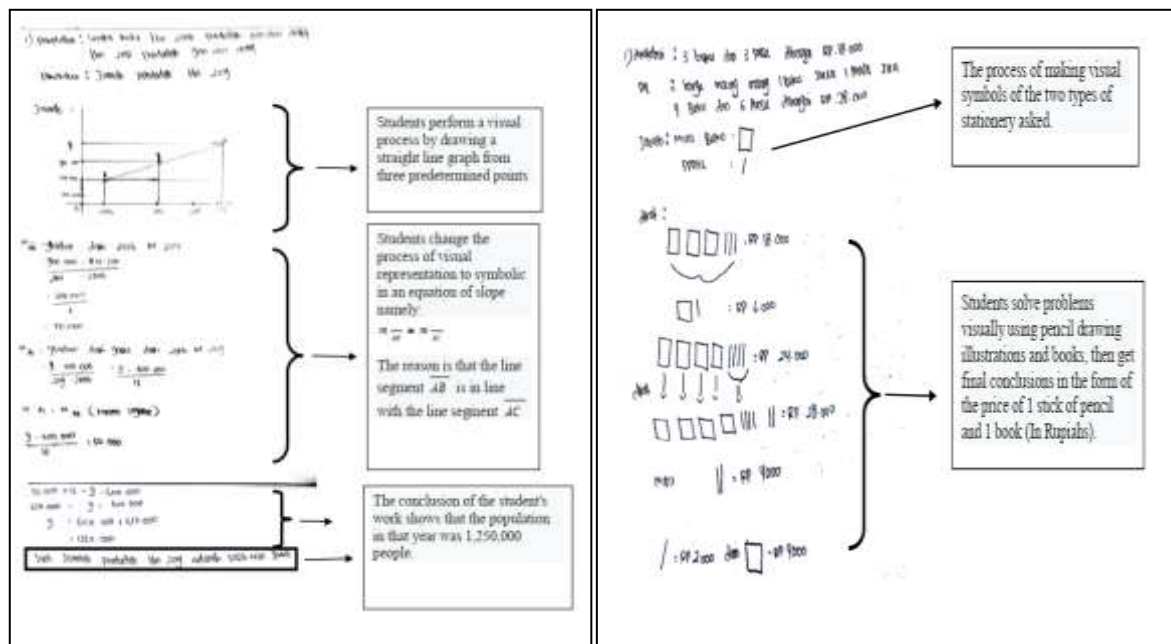


Figure 3. The Process Of Solving Real World Problems from EL With Visual Skill

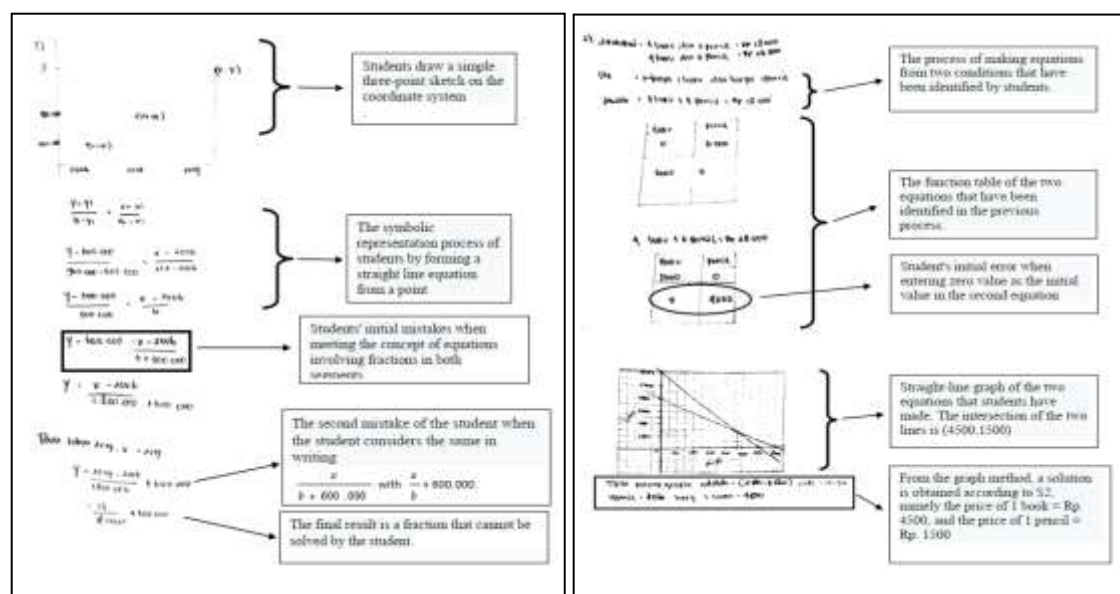


Figure 4. The Process Of Solving Real World Problems from AV With Symbolic Skill

AV students represented a strategy to find the solution of the problem number 2 with a straight line graph intersection method. Students were able to change existing conditions into an implicit form of straight line equation with "book" and "pencil" variables. Then students made a table which was a table of function with these variables by filling them with various possible prices. From the table, students made two straight-line graphs drawn in one coordinate system. Students made mistakes when doing cross multiplication between two fractions in an equation, and errors in the form of student inaccuracy in calculating the values of the two variables. This error has an impact on the image which ultimately was not as wanted. Students with AV code represented a way to find solution symbolically with medium visual ability, the reasons were: (1) creating a function table to clarify existing problem, (2) making strategy to solve problem systematically by using the intersection of straight line graph, (3) Making mistake in calculations and conceptual errors when carrying out operation involving fraction of both equations (4) did not take step to review the result so it did not know whether the answer fulfilling two conditions of the problem or not.

3.4.3 MU Mathematical Representation of Real World Problem

In line with the work of EL and AV students, in question number 1, MU students represented several indicators of representation that cannot be met properly, namely (1) translating the problem's language into a simpler and easier way for them to understand, (2) retelling the search solution procedure to the problems they worked on using simple number pattern.

In question number 2, MU represented number pattern and described the number pattern with words. MU performed part of the symbolic representation which was followed verbally because: (1) simplified the sentence of the question into a simple form into a certain pattern, (2) used a simple number pattern to predict the solution of the problem, (3) made a mistake in hastening the solution the right answer, (4) made conclusion from the result of the guess without making a process of reviewing the answers that have been generated.

Students with high abilities represented by AV can consistently represent the two problems presented using visual representations and obtain suitable results. While students with abilities are using symbolic representations on questions about population density, and visual-symbolic representations on questions about the unit price of goods. Whereas MU who represents students with low ability represents verbally. However, AV and MU students made some algebraic errors in their calculations so that the results were not appropriate.

4. Discussion

4.1 Pattern and Types Of Representation In Defining Concept

The activity of constructing concept definitions in this study was divided into two sequences. Those are activities to build the definition of the gradient concept (slope) of a straight line, and activities to build the concept of a straight line equation. Students who have high visual analysis skills will be able to pour the visual representation into symbolic and even verbal form as well as possible. While students who have low visual analysis skills will immediately define it in the form of verbal representation with much mistake. This indicates that the low symbolic ability will cause low verbal ability. Based on those results, we have many different with Cahdriyana [4], and Alkhateeb [2].

Alkhateeb [2] suggests that in the textbooks being taught, 38.24 percent should present verbal representations that interactively interact with the ability of written symbols. If the verbal ability is low, it could indicate that symbolic ability is also low. The results of research from Cahdriyana [4] about the mathematical representation of students in defining a system of two-variable linear equations and the solution of the concept shows that students tend to use verbal representations. However, some differences from this research include the process that is not documented along with mathematical representation when the process of forming the system definition of two-variable linear equations and the definition of solving systems of two-variable linear equations. Another difference is the absence of study results that the different mathematical representations of students along with the mistakes they make do not have an impact on the next indicator, which is an indicator of solving everyday problems.

Related to the low student learning outcomes, one of the causes is in learning activities, Students only listen and see their teacher explain the material. Students rarely ask their teacher about the material they do not understand. Students only do the questions as exemplified by the teacher [12].

Students in the activity of defining straight-line concept show the verbal representation with different process of visual thinking. This finding is precisely similar to research by Cahdriyana [4] which suggests that students who become research samples show verbal representation when defining the concept of a two-variable linear equation system. Which the results of this study are different from the results on the activity of defining the concept of a straight line slope. Some causes of this difference are:

1. Students with high ability are able to master the concept of comparative worth, and convert it into a symbolic form of straight-line slope. This is different when the process of defining a straight line equation, where students direct themselves in identifying all the characteristics of an equation which is a straight line equation, but he has difficulty when changing the explicit form ($y = mx$) into an implicit form ($ax + by + c = 0$) so that what appears in the process is only verbal representation.
2. Students with moderate and low abilities tend to have moderate and low visual analysis skills. This has an impact on the process of identifying the characteristics of the equation which are also incomplete. So they tend to go directly to verbal without adequate first visual processing.

Sahendra [16] revealed that students with high self-efficacy tend to use multiple representations of sketches and mathematical models, whereas students with low self-efficacy tend to use single representations of sketches or mathematical models only in mathematical words (verbal). Of course the above findings explain that students with moderate and low abilities, tend to jump over the symbolization and visual process directly to verbal representation.

We suggests that in the process of defining a straight line equation the students' multi-representation process can be seen. This process does not necessarily exist. But through a long and continuous process in a learning design from the teacher that is routine and fun.

4.2 Pattern and Types Of Representation In Determining 4 Condition of Line

In the activity of determining the line equation from several known conditions, the task sheet is divided into 4 conditions. Namely the condition of the line equation known as the slope and one point passed by, the line through two points, the parallel line from the line in which the equation is known, and the line perpendicular of the line which the equation is known.

From the results of the study on these indicators, it can be concluded that students with high abilities and are doing symbolic representations in constructing line equations from a point, and line equations from two specific points. While students with low ability make verbal representations, by making some mistakes in the symbolic process.

The results of this study are in line with Neria, Dorit & Amitt [14], who suggest that from the sample taken, students with high ability to perform or choose symbolic representations in solving the given problems. While other students choose to use verbal representations on the grounds that these types of representations are more easily arranged and interpreted.

4.3 Pattern and Types Of Students' Representation In Real World Problem

We have two different problems that must be solved by subjects. The first problem was population growth over a period of time assuming a constant growth rate. Meanwhile, the second problem was about the unit price of several types of goods.

Students with high abilities represented by AV can consistently represent the two problems presented using visual representations and obtain suitable results. While students with abilities are using symbolic representations on questions about population density, and visual-symbolic representations on questions about the unit price of goods. Whereas MU who represents students with

low ability represents verbally. However, AV and MU students made some algebraic errors in their calculations so that the results were not appropriate.

Akkuş, O. & Çakiroğlu, E. [1] through their research showed that in solving the three algebraic questions given, subjects that are consisting of 21 students in grade 7th were more likely to use symbolic representations. Research results from Neria, Dorit & Amitt [14] show different results. there are a few students who usually used symbolic representation in communicating mathematical ideas in solving problems.

In Sahendra's research [16], students with high self-efficacy abilities use the ability of multi-representation in solving problems related to the concept of geometry. Whereas students with low self-efficacy abilities tend to use one type of representation on the same problem. the results of these studies indicate that the higher the ability of students' self-efficacy, the ability to use more than one type of representation in solving problems will be better. This ability needs to be trained through a good learning process.

His result was confirmed with Utami [6]. She said that students with high representation ability are able to create mathematical ideas in drawings, able to make mathematical equations and write solving steps by words or written text. Students with moderate representation ability are able to make mathematical ideas in drawings, able to make mathematical equations but unable to write solving steps by words/written text. Students with low representation ability are able to make mathematical ideas in drawings but unable to make mathematical equations and write solving steps by words/written text. Based on the results, it is known that most of the students still have low mathematical representation ability. Students find it difficult to solve problems in the form of mathematical representations.

Some of the results of these studies give different results. Depending on the subject matter related to the problem, mastery of the material and prerequisite material, and also with student creativity skill. A good learning process will determine students in practicing their representational abilities, along with the ability to translate between representations well too.

5. Conclusion

Based on the results of the study, we can concluded that: (1) In the activity of defining the concept of slope and straight line equation, students made a visual representation during the process of finding slope and made verbal representation when defining straight-line equation. (2) In the activity of determining or compiling a straight line equation, students made a symbolic representation and carrying out visual representation with among of them doing unique guesses in making an overview of the requested line position. (3) In solving problems related to the concept of the straight line equation, some students chose visual representation to solve the two different problems. Some of the other students chose symbolic representation with some initial guesswork errors, inaccuracy, and errors in the algebraic concept. While students who have been identified in the previous process have low ability tend to choose to use verbal methods and made guesses about the number of patterns. This research has an implication that the teacher must train students' mathematical representation skills by applying multiple representation learning models. In addition, the teacher must familiarize students with questions in the form of visual, verbal, and symbolic representations.

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