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Translating The Visual Representations to The Symbolic For Solving Mathematic Problems

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Abstract. This study aims to analyze the ability to translate visual representations into symbolic representations in solving mathematical problems. This research is a descriptive research with a qualitative approach. The subjects in this study were students with high, medium and low mathematical abilities. Data collection techniques were carried out by giving tests and interviews. The results showed that the S-H subject met the Unpacking the Source indicator, while the S-M and M-L subjects did not meet the indicator. In Preliminary coordination, S-H subjects and S-M subjects have met these indicators, while for M-L subjects have not fulfilled them. In Constructing the Target, subjects S-H and subject S-M have met these indicators, for subjects M-L have not been able to fulfill them. In Determining Equivalence, subjects S-H and subject S-M have met these indicators, while for subjects M-L have not fulfilled. So that the conclusion obtained is that the S-H subject has fulfilled all translation indicators between visual representations to symbolic representations, while S-M subjects are only Unpacking the Source indicators that do not meet and for M-L subjects all translation indicators between visual representations to symbolic representations are not fulfilled.

Keywords: translating; visual representations; symbolic representations; mathematic problems.

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INTRODUCTION

The targets of learning mathematics at every level of education include developing the ability of students to think mathematically (Sa’diyah et al., 2020). The development of this ability is very necessary, so that students better understand the mathematical concepts that are learned and can apply in various situations. The active involvement of students in the teaching and learning process will strengthen understanding of mathematical concepts (Konsep et al., 2019). So that each student has a different way to construct their knowledge.

The ability to represent mathematics is one of the general goals of learning at school. This ability is very important and closely related to communication and problem solving skills. In learning mathematics, The National Council of Teachers of Mathematics (NCTM, 2000) states that students need to have a standard process in learning mathematics, namely: (1) problem solving (problem solving); (2) reasoning and proof (reasoning and proof); (3) ability mathematical communication (communication); (4) mathematical connection capability (connection); and (5) the ability of mathematical representation (representation). One of those abilities has an important aspect is the ability to represent. With the representation can help students understand mathematics. As McCoy put it, Baker & Little (Hutagaol, 2013) that the best way to help students understand mathematics through representation is to encourage them to find or make a representation as a tool or way of thinking in communicating mathematical ideas.

Students must have good mathematical representation skills, namely knowing how a mathematical idea can be represented to facilitate students to better understand the idea (Astuti, 2017). The teacher must be able to translate difficult mathematical ideas into a representation that can be understood by students (Sabirin, 2014). To be able to do that, prospective teachers must be facilitated with representational skills that are useful in teaching mathematics, such as problems in the form of stories, pictures, situations and real material.

Representation is an ability that students must have because of representation are expressions of mathematical ideas raised by students in an effort to find a solution to the problem at hand (Absorin & Sugiman, 2018). So that to get communicating and solving problems, someone needs a good representation of the form pictures, graphs, diagrams, and other forms of representation. Variety of representations often used to express mathematical ideas, among others: tables, pictures, symbols, graphics, math statements, written text, or any combination of these. The use of multiple representations in solving a problem is called multi representation (Aulia et al., 2016).

In learning mathematics, students must be able to present a variety form of representation (Simbolon, 2019). So that diverse representation capabilities need to be instilled from an early age in order to help deepen concept understanding, communicate mathematical ideas, recognize the relationship between mathematical concepts and assist in solve the problem. It is further emphasized that the capability of multiple representations mathematics is very important for students because it can develop mathematical concepts, relationship between concepts, using multiple representations can be helpful in communicating the thinking of students (NCTM, 2000).

Multiple mathematical representation is the ability to use various mathematical forms to explain mathematical ideas, to translate between mathematical forms, namely visuals (graphs, tables, diagrams and pictures); symbolic (mathematical statement / mathematical notation, numeric or algebraic symbols); verbal (words or written text) (Afandi et al., 2013). In using a variety of mathematical representations to express a certain mathematical idea in solving a problem, it is possible for students to change a form of representation to another form of representation called translation (Rahmawati et al., 2017).

The translational ability of mathematical representations is the ability of students to change a given mathematical representation (source representation) to the form of the requested mathematical representation (target representation) (Zulianto & Budiarto, 2020). "In solving the problem, students analyze the information from the source representation and then the students solve the problem by using the requested target representation according to their mathematical representation translation skills" (Marliyanti, D. and Amin, 2016). The ability of students in carrying out the translation process can vary because it depends on their translational representation skills (M. Bossé et al., 2014). The translation process that needs to be considered (M. J. Bossé et al., 2011) is (1) the unpacking the source stage is to reveal the information contained in the source representation, (2) the initial coordination stage (preliminary coordination) is to determine the initial step to form the desired target representation. , (3) the stage of constructing the target is to produce or form a representation of the desired target, and (4) the stage of determining equality is to consider the suitability of the representation of the given source and the resulting target representation.

The difficulty experienced by students lies in determining the value of the variables in solving story problems because students have to change the problem to a mathematical model (Marliyanti, D. and Amin, 2016). Most students have difficulty when describing the form of the equation into graphical form (Susilo, 2018). Students often have difficulty when determining points on coordinates (Nugraha et al., 2016). In translational understanding related to the ability of students in modeling or presenting, translating sentences in questions or problems into other forms (M. J. Bossé et al., 2011). In this material, mathematical representations that can be used are visual representations and symbol representations. This allows students to use various forms of representation and change a form of representation to another form of representation. In fact, students tend to only use one type of representation. This is also in accordance with research (Nizaruddin et al., 2017) which states that most students tend to use symbolic representations to solve mathematical problems, rather than using other representations. In addition, most teachers only teach similar representations. Whereas in the mathematics learning process the use of representation is not just one type of representation.

This study aims to describe the ability of students to translate visual representations into symbolic representations in solving math problems. Researchers hope that the results of this study can provide insights to students to further improve their mathematical representation skills through experience and practice in solving mathematical problems in order to have good mathematical representation skills and also be able to develop mathematical representation translation skills in solving mathematical problems.

METHOD

This research is a descriptive study with a qualitative approach. This research was conducted on 5th semester Mathematics Education students of Singaperbangsa Karawang University in the odd semester of the 2020/2021 academic year.

Sample and Data Collection

The subjects in this study were students with high, medium and low math abilities. Data collection techniques were carried out by giving tests and interviews.

Analyzing of Data

The data obtained were then analyzed based on indicators of translational ability between representations in solving mathematical problems.

Researchers study the translational abilities of students' mathematical representations by referring to the translation ability indicator representation (Sa'diyah et al., 2020)in the following table.

Table 1. Indicators of Translating The Mathematical Representations

Translating Stage	Indicators
Unpacking the source	Read and investigate the form of source representations (images, graphics, symbols and verbal / text) presented in the problem Determine mathematical ideas or ideas through one form of mathematical representation (images, graphics, symbols and verbal / text) according to the problems presente
Preliminary coordinator	Displaying mathematical ideas or ideas through one form of mathematical representation (pictures, graphics, symbols and verbal / text) to find solutions to problems
Construcing the targets	Implement plans with mathematical ideas or ideas through one form of mathematical representation (images, graphics, symbols and verbal / text) to find the solutions presented
Determining equivalence	Evaluating problem solving with an idea or Mathematical ideas through one form of mathematical representation (images, graphics, symbols and verbal / text), to find solutions to the problems at hand. Are the plans and steps in accordance with their implementation.

Translation test data between representations were analyzed by means of qualitative data analysis, namely data reduction, presentation of data, and draw conclusions based on the written results produced by the subject and indicators that have been made by researchers. Likewise with the analysis of the interview results done by reducing data from interviews, presenting data, and withdrawing conclusion according to the indicator.

RESULTS AND DISCUSSION

In this study, researchers measured students' mathematical abilities using a math ability test so that students could be grouped based on their level of mathematical ability, namely the group of high mathematical ability at intervals of $75 \leq$ test score ≤ 100, group of moderate mathematics ability interval $50 \leq$ test score < 75 and the low math ability group test score < 50 (Istikomah & Jana, 2018).

Mathematics ability tests were given to 30 5th semester Mathematics Education students of Singaperbangsa Karawang University with the results students with high, medium and low math ability categories. Students with the category of high mathematical ability with the subject name are S-H, students with the category of moderate mathematics ability with the subject name are S-M and students with the category of low mathematics ability with the subject name are S-L. The subject was given a translation test between visual to symbolic representations and an interview was conducted.

The following is the result of translational analysis between visual to symbolic representations in solving math problems.

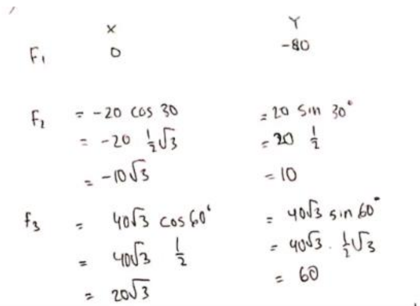

Figure 1. Results of S-H Subject Answers on Unpacking the Source

The S-H subject on Unpacking the Source, changing the problem from an image to a symbol, in revealing information on a given problem, the S-H subject provides information for example as a description of the image which is converted into a mathematical model and based on the answer, S-H subject has been able to investigate or extract the required information in full from the problems given. As the description of the variable in question. This is also in accordance with the results of the interview that the S-H subject was able to mention the required information. Students use a form of symbolic representation by considering things that are known and asked (Hwang et al., 2007).

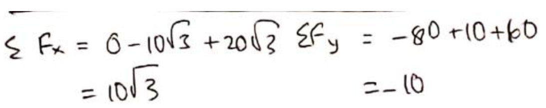

Figure 2. Results of S-H Subject Answers at Preliminary Coordination

Subject S-H on Preliminary Coordination, adding up the information obtained to prove the problem as the initial plan carried out. Based on the answers and interview results, the S-H subject was able to present mathematical ideas as an initial plan to find solutions to problems. Students represent the ideas that they have in mind by writing down things that are known and steps to solve them in the form of equations (Rangkuti, 2014).

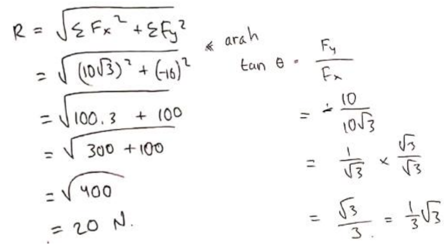

Figure 3. Results of the S-H Subject's Answers on Constructing the Target

The S-H subject in Constructing the Target, constructs the initial plan results with mathematical symbols so as to form a mathematical model, the subject constructs with mathematical symbols well coherently in converting the initial plan results into mathematical symbols. Based on the answers and interview results, the S-H subject was able to construct the initial plan into mathematical symbols as target representations. Students who focus on using the form of algebraic (symbolic) representations are more towards students who have high abilities (Halat & Peker, 2011).

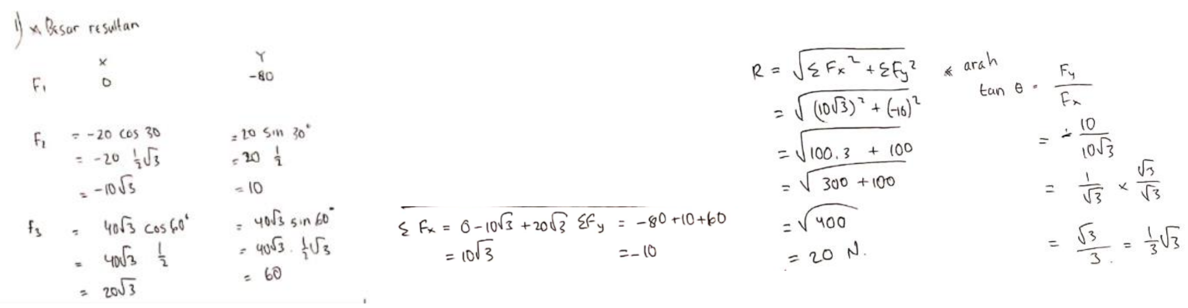

Figure 4. Results of the S-H Subject's Answers on Determening Equeivalenc

The S-H subject on Determening Equeivalence, solves the problem by changing the problem into a mathematical model which is then solved by adding up each equation to prove what is asked until every step taken by the S-H subject is converted into a mathematical symbol as the target representation (symbolic). With high representation skills, students will find it easier to find solutions to solve math problems. Actual representation does not show results or products that are embodied in new and different configurations or constructs, but a process of thinking done to be able to reveal and understand the concepts, operations, and mathematical relationships of a configuration (Bagus, 2018). From these answers and the results of the interviews, the S-H subject was able to solve problems with the appropriate plans and steps. But the drawback is that the final result of the calculation is still not accurate, because the S-H subject has difficulty in determining the angle. But as a whole the process of solving questions, the subject of S-H did it well and correctly.

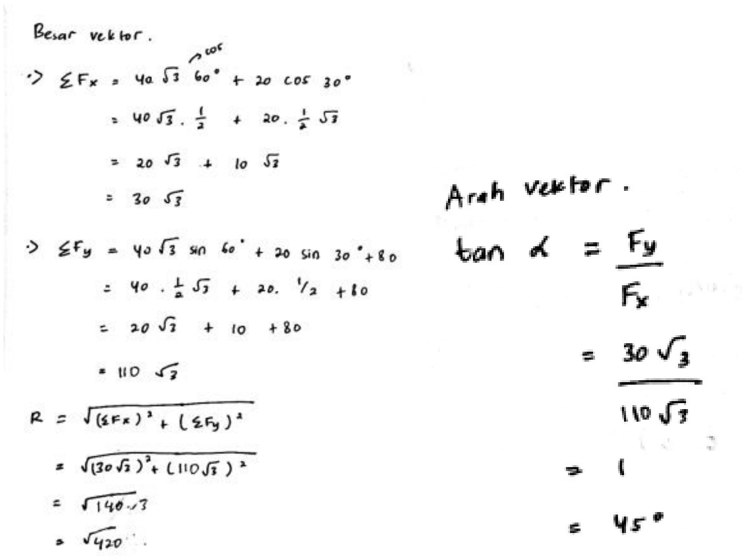

Figure 5. Results of S-M Subject Answers

The S-M subject on Unpacking the Source, changes the problem from an image into a symbol, in revealing information on a given problem, the S-M subject does not provide information for example as a description of the image that is converted into a mathematical model and based on the answer , the MS subject has not been able to fully investigate or dig up the required information from the problems given. As the description of the variable in question. This is also in accordance with the results of the interview that the S-M subject has not been able to mention the required information. In Preliminary Coordination, the subject S-M adds up the information obtained to prove the problem as the initial plan carried out. Based on the answers and interview results, the S-M subject was able to present mathematical ideas as an initial plan to find solutions to problems. Whereas in Constructing the Target, the S-M subject constructs the initial plan results with mathematical symbols so as to form a mathematical model, the subject constructs with mathematical symbols well coherently in converting the results of the initial plan into mathematical symbols. Based on the answers and interview results, the S-M subject was able to construct the initial plan into mathematical symbols as target representations. Then in Determening Equeivalence, the S-M subject solves the problem by changing the problem into a mathematical model which is then solved by adding up each equation to prove what is being asked until every step that the S-M subject takes is converted into the form of a mathematical symbol as the target representation (symbolic). Many students have difficulty solving math problems, especially translating questions (Deswantari et al., 2020). From these answers and the results of the interviews, the S-M subject was able to solve problems with the appropriate plans and steps.

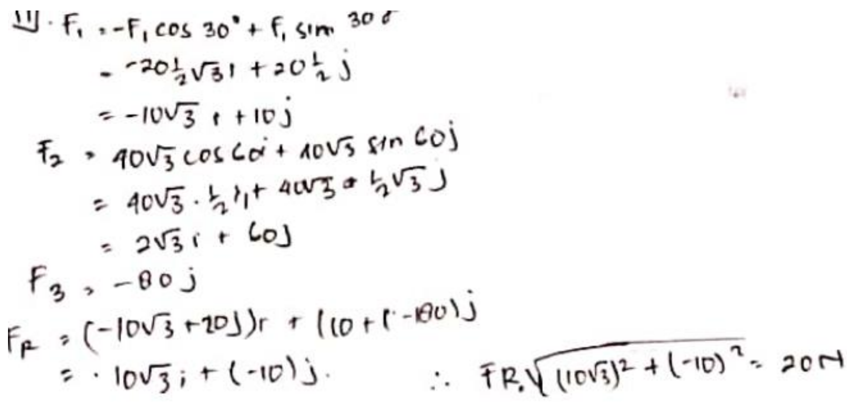

Figure 6. Results of S-L Subject Answers

S-L subjects on Unpacking the Source, change questions from image form into symbol form, in revealing information on a given problem, S-L subject does not provide information for example as a description of the image which is converted into a mathematical model and based on the answer , MR subjects have not been able to fully investigate or dig up the required information from the problems given. In Preliminary Coordination, the subject of S-L does not add up the information obtained to prove the problem as the initial plan carried out. Based on the answers and interview results, the subject of S-L has not been able to present mathematical ideas as an initial plan to find solutions to problems. Whereas in Constructing the Target, the S-L subject does not construct the initial plan results with mathematical symbols. Based on the answers and interview results, the S-M subject has not been able to construct the initial plan into mathematical symbols as target representations. Then in Determening Equeivalence, the S-L subject does not solve the problem by changing the problem into a mathematical model. Only a few students choose to use symbolic representations in communicating or conveying their mathematical ideas (Tyas & Sujadi, 2016). From these answers and the results of the interviews, the subject of S-L has not been able to solve the problem with the appropriate plans and steps.

CONCLUSION

Based on the results of the research data analysis discussed previously, it is concluded that at Unpacking the Source, the S-H subject has been able to dig up information from the problems given to the questions, while the S-M and S-L subjects have not been able to do it. In preliminary coordination, the S-H subject and the S-M subject have been able to determine the initial representation of the given problem, while the S-L subject has not been able to determine it. In Constructing the Target, the S-H subject and S-M subject have been able to construct the initial representation to determine the target representation, for the S-L subject has not been able to determine it. In Determening Equeivalence, the S-H subject and the S-M subject have been able to explain the completion plan with the appropriate steps in determining the target representation, while the S-L subject has not been able to explain it well.

Based on the above analysis, the S-H subject has fulfilled all translation indicators between visual representations to symbolic representations, while the S-M subject is only the Unpacking the Source indicator which does not meet and for S-L subjects all translation indicators between visual representations to symbolic representations are not fulfilled.

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