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Profile of Students' Mathematical Representation in Solving Trigonometric Problems Based on Mathematics Ability

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Abstract: Profile of students' mathematical representation in solving trigonometric problems based on mathematics ability. **Objectives**: This study aims to determine and describe students' mathematical representational abilities in solving trigonometric problems based on mathematical abilities. **Methods**: This research is a qualitative research with a descriptive approach, in this study 3 subjects were selected from 36 students. Data was collected through tests and interviews. **Findings**: Students with high math skills are good at using visual representations and quite good at using equation representations or mathematical expressions. Students with moderate mathematical ability are quite good at using visual representations and representations of mathematical equations or expressions. Students with low mathematical ability are quite good at using visual representations but are still not good at using representations of mathematical equations or expressions. **Conclusion**: The three research subjects only involved visual representations and mathematical equations or expressions, but did not involve representations of words or written text in solving problems.

Keywords: Mathematical representation, problem solving, and mathematical ability.

Abstrak: Profil representasi matematis siswa dalam memecahkan masalah trigonometri berdasarkan kemampuan matematika. ***Tujuan:*** *Penelitian ini bertujuan untuk mengetahui dan mendeskripsikan kemampuan representasi matematis siswa dalam memecahkan masalah trigonometri berdasarkan kemampuan matematika.* ***Metode:*** *Penelitian ini merupakan penelitian kualitatif dengan pendekatan deskriptif, pada penelitian ini dipilih 3 subjek dari 36 siswa. Pengumpulan data dilakukan melalui tes dan wawancara.* ***Temuan:*** *Siswa berkemampuan matematika tinggi baik dalam menggunakan representasi visual dan cukup baik dalam menggunakan representasi persamaan atau ekspresi matematika. Siswa berkemampuan matematika sedang cukup baik dalam menggunakan representasi visual dan representasi persamaan atau ekspresi matematika. Siswa berkemampuan matematika rendah cukup baik dalam menggunakan representasi visual namun masih kurang baik dalam menggunakan representasi persamaan atau ekspresi matematika.* ***Kesimpulan:*** *Ketiga subjek penelitian hanya melibatkan representasi visual dan persamaan atau ekspresi matematika, namun tidak melibatkan representasi kata-kata atau teks tertulis dalam memecahkan masalah.*

Kata kunci: *Representasi matematis, pemecahan masalah, dan kemampuan matematika.*

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INTRODUCTION

Mathematics has an important position in science. As a science, mathematics is needed in various fields, both in mathematics itself and in other fields. This is as stated by Suherman, et al. (2001) who argues that mathematics is the queen of science. This implies that as a science, mathematics also functions as a source of other sciences. Many sciences whose discovery and development depend on mathematics. In other words, mathematics grows and develops for itself as a science, and is also useful to serve the needs of other sciences in its development.

The National Research Council (NRC, 1989) states that mathematics is the key to success. For a student, the success of studying it will open the door to a brilliant career. For citizens, mathematics will support the right decision making, and for a country mathematics provides useful knowledge to prepare its citizens to be able to compete and compete in the economic and technological fields. From this explanation, it is clear that mathematics has an important role in human life. Therefore, a strong understanding and mastery of mathematics needs to be given from an early age.

According to the National Council of Teachers of Mathematics (NCTM, 2000) there are five Process Standards that students need to have and master in learning mathematics, namely: 1) problem solving; 2) reasoning and proof; 3) communication; 4) connections; and 5) representations . Thus, the ability to represent is one of the important things that need to be mastered by students to support their success in learning mathematics. Representation is a form of interpretation of students' thoughts on a problem, which is used as a tool to find a solution to the problem. The form of student interpretation can be in the form of words or verbal, writing, pictures, tables, graphs, concrete objects, mathematical symbols and others (Sabirin, 2014). Mathematical representation is an expression of ideas or ideas used by students in determining mathematical relationships or concepts in an effort to interpret and find solutions to the problems they face (NCTM, 2000). Mathematical representation ability is the ability of students to describe, write, and remodel mathematical ideas using previously known objects on concrete objects (Junita, 2016).

According to Yuniawatika (2012) there are several reasons for the need for representation, namely: to give students fluency in building a concept and mathematical thinking and to have strong conceptual abilities and understanding. The ability of representation is closely related to the ability of students to solve problems (Gagatsis & Shiakalli, 2004; Elia, et al, 2007: Handayani, 2018). Students who have good representation skills usually have no difficulty in solving mathematical problems. In solving existing problems students need to explore all their ideas both in the form of words, in the form of pictures or in the form of symbols.

In studying mathematics, students will not be separated from mathematical problems that must be solved (Krawec, 2014). This is supported by Branca (Sugiman et al., 2009) stating that problem solving is the heart of mathematics. Problems usually contain a situation that encourages someone to solve it but cannot directly determine what solution must be done (Suherman, et al., 2001; Zayyadi, et al, 2018; Halim, et al, 2020). Polya explains that problem solving is an attempt to find a way out of a difficulty in order to achieve a goal that is not so easily achievable (Zahroh, et al, 2020; Zayyadi, et al, 2020).

Mathematical representation ability is closely related to problem solving as stated by Salkind & Hjalmarson (2007 that students use representations to support understanding when they are solving mathematical problems or learning new mathematical concepts . In addition, Fuad (2016) states that choosing the right

representation will make it easier for students to solve problems (Corter & Zahner, 2007; McKendree, et al, 2002; Fitrianna, et al, 2018; Supandi, et al, 2018). When students use representations that match the problem, it will make complex problems simpler. On the other hand, an inaccurate representation will make the problem difficult to solve.

Research related to student mathematical representation has been carried out by several researchers from various countries. Research by Chen, et al. (2015) who came from Taiwan found that (1) using graphical learning materials enhances performance in pattern reasoning; (2) using digital learning materials in teaching can improve attitudes towards learning mathematics; (3) learners with high mathematics self-efficacy display more positive views towards learning mathematics. Researchers from Denmark Pedersen, et al. (2021) reveal a clear connection between the mathematical topics addressed and the types of representation utilized, and further indicate that certain aspects of the representation competency are outsourced when Digital technologies (DT) are used. To activate the representation competency in relation to the use of DT, we offer five suggestions for consideration when designing mathematical tasks. Finally, we raise the question of whether DT create new representations or merely new activities. While research by Kuntze, et al (2018) Results show that teachers' support in using multiple representations was rare, indicating that teachers' mathematical language in these interactions could be improved.

Research related to mathematical representation is also widely carried out by researchers in Indonesia such as Novira, et al (2019); Suliani (2019); and Suningsih & Istiani (2021). Novira, et al (2019) found that a learning model that supports students' opportunities to represent their own thoughts and perform consistently can encourage students' representational abilities. Somatic, auditory, visualization. Intellectually (SAVI) is a learning model that invites students to use their senses. The stages in the learning process are in accordance with activities to help students create their own mathematical representations. The results of Suliani's research (2019) show that the forms of representation found in the form of geometry are visual representations and representations of mathematical expressions. The representation ability possessed by students is classified as lacking, so it requires attention from the teacher to provide opportunities for students to use representational abilities. Meanwhile, Suningsih & Istiani (2021) found that student achievement on visual representation indicators was 65.2%; indicator of expression and equation representation 43.5%; and 41.2% word representation indicator. This shows that students' mathematical representation skills still need to be considered to be improved.

When students are required to solve a mathematical problem, it is possible for students to try various representations as a manifestation of their ideas and strategies (Goldin & Shteingold, 2001; Xin, et al, 2008). The variety of mathematical representations used by students depends on individual abilities because basically every student has different mathematical abilities. In this case, the ability level of students is high, medium, and low. This is similar to the research conducted by Warisi (2016) which can be seen that the level of students' mathematical ability affects the variety of representations used by students in solving problems.

In learning mathematics, trigonometry is a material that is still a scourge for students. Many students find it difficult when faced with problems in trigonometry material. This is in accordance with the observations of researchers during practice field experience at SMAN 1 Pamekasan, there are still many students who tend to have difficulty solving trigonometry problems. This is because students feel confused in using the forms

of mathematical representation. In addition, in solving problems students tend to imitate the teacher's way and are not accustomed to applying their own representations. Even though the concept of abstract studies contained in trigonometry material requires students to be able to use their mathematical representations in order to solve trigonometric problems well.

This is reinforced by the statement of Probondani (2016) which states that in trigonometry material, mathematical representation skills are needed because the characteristics of trigonometry are full of calculations, symbols, pictures, and graphs. In addition, most of the trigonometry material is abstract and some trigonometry questions are in the form of application questions so that students' mathematical representation skills are needed. Based on this description, it is necessary to conduct a study through a study to find out how the profile of students' mathematical representation abilities in solving trigonometric problems based on mathematical abilities is needed.

Based on the description above, the researchers will conduct a study entitled: Profile of students' mathematical representation abilities in solving trigonometric problems based on mathematical abilities. This study aims to determine and describe the profile of students' mathematical representation abilities in solving trigonometric problems based on mathematical abilities .

METHODS

This study uses a qualitative research approach with descriptive research type because this study aims to obtain in-depth data so that it can identify and describe students' mathematical representation abilities in solving trigonometric problems based on mathematical abilities. Qualitative research intends to understand the phenomena of what is experienced by research subjects such as behavior, perceptions, motivations, actions, etc., holistically and by means of descriptions in the form of words and language, in a special context that is natural and by utilizing various natural methods (Moleong, 2010). Researchers are the key instrument in qualitative research Gunawan (2015).

This research was carried out at SMA Negeri 1 Pamekasan and was carried out in the even semester of the 2017/2018 academic year. The subjects in this study were 3 students of class X SMA Negeri 1 Pamekasan selected from 36 students. Three subjects were selected based on the results of the initial ability test, which consisted of 1 student with high, medium and low abilities. The subjects used are not to represent the population but to represent information because the retrieval is based on a theoretical study that is used in accordance with the research theme. The collection technique in this research is test and interview. The data analysis technique used in this study was adopted and developed from Miles and Huberman (1994), namely: 1) Data reduction, with the activities carried out are correcting and analyzing the results of the mathematical representation ability tests carried out by students, the results of the student's work are then transformed into notes as material for interviews, the results of interviews with each research subject are simplified into a good language structure and analyzed for later determination students' reasons for using their mathematical representations in solving trigonometric problems; and 2) Data exposure , with the activities carried out are presenting the results of student work, presenting the results of interviews, and draw conclusions. Supporting instruments in this study, namely: 1) Mathematics ability test; 2) Mathematical representation ability test; and 3) Interview guide.

The technique of determining the subject used is purposive sampling. Purposive sampling is a sampling technique of data sources with

certain considerations (Sugiyono, 2010). This study aims to reveal the mathematical representation ability of students in solving trigonometric problems based on mathematical ability. Broadly speaking, the steps for determining the research subject are as follows: 1) Determine the research class, namely high school students in class X; 2) Provide a test of mathematical ability; 3) Analyzing the results of the mathematical ability test, then classifying students into students with high math abilities if 80 the score obtained 100, students with moderate math abilities if 60 scores < 80, and students with low math abilities if 0 scores obtained < 60; 4) Selecting subject candidates for high school students of class X maximum of 3 people consisting of one person who has high mathematical ability, one person who has moderate mathematical ability, and one person who has low mathematical ability. In In addition, the determination of the subject also pays attention to the teacher's considerations relating to the subject's communication skills to express opinions orally. These considerations are carried out so that the disclosure of the description of students' mathematical representation abilities in solving trigonometric problems can be carried out properly; and 5) Asking the selected students' willingness to be given the task of solving trigonometry and being interviewed. If the prospective subject meets the five criteria, then the prospective subject can be used as a research subject. Conversely, if the prospective subject does not meet the criteria, then the prospective subject cannot be used as a research subject and another prospective research subject be selected.

1. Determine the solution set for the following absolute value equations.
$\left|\frac{x^2+2x-8}{x-2}\right| = \left|\frac{(x-1)(x+4)}{x+2}\right|$, with $x \neq 2$and$x \neq -2$
2. Agus, Budi, and Anton have a hobby of reading books. A comparison of the number of books that Agus and Budi have read 6: 5, while a comparison of the number of books that Budi and Anto have read 5: 7. If the number of books that Agus and Anto have read is 65, how many books have Agus, Budi, and Anto read?
3. Known $g(x-2) = 2x + 7$and $(h \circ g)(x) = 4x^2 + 44x + 1$. Value $h(10) = \ldots$
4. From the top of a cliff 50 m high, a climber looks at the harbor with an angle of depression of 30 °, determine the distance between the harbor and the cliff!
5. A ship sails east for 60 km. The ship continued its journey by changing direction 15°to the north for 80 km. Determine the distance of the ship with the position when the ship departs! (ket:cos $105° = -0.26$)

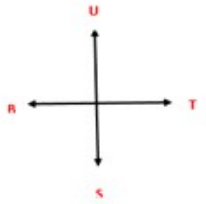

Figure 1. Student ability test questions

■ RESULT AND DISCUSSIONS

Profile of Mathematical Representation Ability of Students with High Mathematics Ability

Based on the data analysis of the research results that have been described, it can be seen that students with high mathematical abilities are good at using visual representations. Students can understand the problem well so that they can state what is known about the problem in the picture correctly, and can determine the solution that will be used in solving the problem correctly, which involves the sine and cosine rules.

The ability to represent mathematical equations or expressions of high ability students is still quite good. In solving test questions, students are required to understand several mathematical concepts, including the relationship

of angles, the majors of three numbers, trigonometric comparisons in right triangles, and the rules of sine and cosine. Students have understood the mathematical concept, it seems that students are able to apply the concept appropriately. However, due to inaccuracy, students made errors in calculations in getting the final answer, so they could not solve the whole problem correctly.

Students with high math abilities do not involve the representation of words or written texts in solving problems, so it cannot be ascertained that students are able or not to use written words/texts. Students do not involve words at all, either in providing an explanation of the completion process for the steps that require information or in providing conclusions on the final results that have been obtained.

The explanation of the mathematical representation ability of students with high mathematics abilities is in accordance with the results of Gustina's research (2018) which states that students with high mathematical abilities have good visual representation abilities, this is because students have been able to draw geometric shapes. However, students are still quite good at representing equations or mathematical expressions because there are still errors in using these representations.

This is also supported by the results of research by Munalikatasari and Rosyidi (2016) which states that students with high mathematical abilities can use visual representations in solving problems correctly and can obtain appropriate solutions through these representations. That means, students have good skills in using visual representations. For the representation of mathematical equations or expressions, students are still quite good at using them, because students are less precise in symbolizing the problem because there are constants that are represented as variables. However, students understand the meaning of the symbols used and can get the right solution. However, this study obtained different results on the ability to represent words or written texts. Munalikatasari and Rosyidi's (2016) research shows that the ability to represent words or written texts is still quite good. students involve words in giving conclusions about the final results that have been obtained.

Profile of Mathematical Representation Ability of Students with Medium Mathematics Ability

Based on the data analysis of the research results that have been described, it can be seen that students with mathematical abilities are quite good at using visual representations. In stating what is known in the question on the picture, students make mistakes, due to inaccuracy and confusion. However, students can determine the solution that will be used in solving the problem correctly, which involves the sine and cosine rules.

The ability to represent mathematical equations or expressions of students with moderate mathematical abilities is still quite good. In solving test questions, students are required to understand several mathematical concepts, including the relationship of angles, the majors of three numbers, trigonometric comparisons in right triangles, and the rules of sine and cosine. In this case, students do not understand the concept of the relationship between angles and the direction of three numbers so that they cannot solve the problem as a whole correctly. However, for students' understanding of the sine and cosine rules, it seems that students are able to apply the concept correctly.

Students with moderate math abilities do not involve the representation of words or written texts in solving problems, so it is not certain that students are able or not to use written words/ texts. Students do not involve words at all, either in providing an explanation of the completion

process for the steps that require information or in providing conclusions on the final results that have been obtained.

The explanation of the mathematical representation abilities of students with moderate mathematical abilities is in accordance with the results of Utomo's research (2015) which shows that students with moderate mathematical abilities are quite good at using visual representations. Students show a simpler visual form with a square shape, it shows that the representation that students have is only limited to the abstract form. Likewise for the representation of mathematical equations or expressions. Students are still quite good at involving these representations to solve problems, students tend to manipulate algebraic forms according to what they see without relating the whole thing contained in the problem.

The ability to represent mathematical equations or expressions of moderate mathematical ability in this study is also supported by the results of research by Munalikatasari and Rosyidi (2016) which shows that students with moderate mathematical abilities are still quite good at using representations of mathematical equations or expressions, because the representation of symbols made on The problem is said to be appropriate for the purpose of solving the problem. However, his understanding of the problem as a whole is not appropriate. However, this study obtained different results on the ability of visual representation and representation of words or written text. In Munalikatasari and Rosyidi's (2016) research, it showed that students involved visual representations in solving problems but they were less precise. The representation made cannot represent the problem. That means, students are still not good at using visual representations. While the ability to represent words or written text is quite good. Students involve words in giving conclusions about the final results that have been obtained.

Profile of Mathematical Representation Ability of Students with Low Mathematics Ability

Based on the data analysis of the research results that have been described, it can be seen that students with low mathematical abilities are quite good at using visual representations. Students use pictures to illustrate problems to make it easier for them to find the right solution. However, students are confused in stating what is known in the picture so that they make mistakes. In addition, students also make mistakes in interpreting the images that have been made. So, students cannot determine the solution that will be used in solving the problem as a whole correctly.

The ability to represent equations or mathematical expressions of students with low mathematical abilities is still not good. In solving test questions, students are required to understand several mathematical concepts, including the relationship of angles, the majors of three numbers, trigonometric comparisons in right triangles, and the rules of sine and cosine. In this case, students with low math abilities do not understand the concept of the relationship between angles and the direction of three numbers so that they cannot solve the problem as a whole correctly. Then, in addition to involving the cosine rule, students also involve the Pythagorean formula in solving test questions. Students' understanding of the cosine rule and the Pythagorean formula is still not good, it looks like students are still not quite right in applying the two concepts.

Students with low math abilities do not involve the representation of words or written text in solving problems, so it cannot be ascertained that students are able or not to use written words/ texts. Students do not involve words at all, either in providing an explanation of the completion process for the steps that require information or

in providing conclusions on the final results that have been obtained.

The description of the visual representation abilities of low-skilled students is in accordance with the results of Gustina's research (2018) which shows that students are still very simple in drawing, such as only drawing triangles. That means, students are still quite good at using visual representations. Then, for the representation of mathematical equations or expressions, according to the results of research by Munalikatasari and Rosyidi (2016), it is known that students with low mathematical abilities are still not good at using these representations. Students only understand the symbols used to obtain problem solving. In addition, the process shows unsystematicity because the solution to the problem obtained has not fully shown a clear sequence. However, this study obtained different results on the ability of visual representation and representation of words or written text. Loc & Phuong (2019) found that students with low abilities face many difficulties and have errors in using visual and symbolic representation.

Similarities and Differences in Students' Mathematical Representation Ability in Solving Trigonometric Problems

Based on the explanation above, it can be seen that students' mathematical representation abilities which include visual representations, mathematical equations or expressions, and written words or texts based on their level of mathematical ability have similarities and differences. However, the tendency of representations used in solving problems is the same, namely visual representations and mathematical equations or expressions. This is in accordance with the results of Saputri and Masduki's (2017) research which showed that of the 6 students who became research students tended to use visual representations and mathematical expressions in solving problems.

From the research results, it is known that the equation of students' mathematical representation ability lies in the representation used, which only involves visual representations and mathematical equations or expressions but does not involve representations of words or written text. Based on the results of interviews, information was obtained that students were not accustomed to involving representations of words or written texts. While the difference lies in the accuracy of the representations made, by which we can find out how well they use mathematical representations (Stylianou & Silver, 2004).

Students with high math abilities are better at using visual representations and mathematical equations or expressions compared to students with moderate and low math abilities. Students with high mathematical abilities are good at using visual representations, but quite good at using representations of mathematical equations or expressions. Then, students with moderate math abilities are still quite good at using visual representations and mathematical equations or expressions. Meanwhile, students with low math abilities are quite good at using visual representations. However, they are still not good at using representations of mathematical equations or expressions.

Differences in mathematical representation abilities among students are influenced by differences in mathematical abilities. This is in accordance with research conducted by Warisi (2016) which can be seen that the level of students' mathematical abilities affects the representations used by students in solving problems. Research conducted by Loc & Phuong (2015) also found the same thing that the ability to assess students' mathematical abilities (Paroqi, et al, 2020).

In this study, it is also known that students with high, medium, and low abilities have not been able to fully use their mathematical representations correctly. It can be seen from the two questions

given that none of the students can use all types of representations perfectly. In fact, the accuracy of the representations made by students can make it easier for them to solve problems. This is in accordance with the opinion of Fuad (2016) which states that the selection of the right representation will make it easier for students to solve problems. When students use representations that match the problem, it will make complex problems simpler. On the other hand, an inaccurate representation will make the problem difficult to solve. Thus, it is necessary to develop students' representational abilities, because students' representational abilities can be developed and developed (Hilton & Nichols, 2011; Mainali, 2021; Dundar, 2015; Popova, & Jones, 2021).

So that students can make representations correctly in completing the mathematical representation ability test in this study, there are several things that need to be considered, namely as follows: 1) For question number 1, besides students are required to understand the trigonometry chapter, especially the concept of the sine and cosine rules, students are also required to understand the use of three-digit majors and understanding relating to the relationship of angles, namely opposite and supplementary angles; 2) For question number 2 students are required to understand the concept of trigonometric comparisons in right triangles and the cosine rule. Students seem to have difficulty solving trigonometry problems, this is in line with Gur (2009) which states that students have difficulty solving problems related to trigonometry.

Based on the results of the study, broadly speaking, both students with high, medium, and low math abilities had difficulty in solving problem number 1. Question number 1 was a matter of description. From the results of interviews, it is known that in solving these problems students can understand the problem and determine the right solution when students have tried to illustrate the problem in the picture. In order for students to be able to make visual representations in the form of images well, students must have a good understanding of the three-digit major. But in fact, some students who became research students did not understand about this matter so that they felt confused in stating the angle of direction in the image which caused the image they made to be inaccurate. In addition, in the process of solving problems involving the representation of mathematical equations or expressions, in addition to using the sine or cosine rules, an understanding of the relationship of angles and directions of three numbers is also needed to determine the angles in triangles and angles of unknown directions. Based on the results of interviews, it is known that most students find it difficult to determine this, so they are less precise in calculating and determining the final result.

For question number 2, most students can solve the problem well until they get the final result correctly. This is because for these questions students are not so required to recall the previous material. To make it easier to understand the problem and determine the solution to be used, students are required to involve visual representations, namely by stating the problem on a picture that involves the concept of a triangle's height. Meanwhile, in solving problems involving the representation of mathematical equations or expressions, students are required to have an understanding of the concept of trigonometric comparisons in right triangles and the cosine rule (Napitupulu, 2017; Akrom, et al, 2020; Nu'man & Maula, 2021).

From the explanation of students' difficulties in solving the two questions, it can be concluded that the inaccuracy of the representations used by students is due to students' confusion in finding the combination of concepts and rules that will be used and their lack of understanding of the

material that has been previously studied. This is in accordance with the opinion which states that in representing a problem it is certainly related to students' knowledge and understanding of a previously known concept (Hiebert & Lefevre, 1986). So that when students do not understand a concept, the success of students in representing a problem becomes less precise.

■ CONCLUSIONS

The results showed that the mathematical representation abilities of students in class XD SMA Negeri 1 Pamekasan which included visual representations, mathematical equations or expressions, and words or written texts based on the level of students' abilities contained similarities and differences. The similarity lies in the representation used, which only involves visual representations and mathematical equations or expressions but does not involve representations of words or written text. While the difference lies in the accuracy of the representation made. In addition, in solving trigonometry problems, the sub-material of the rules of sine and cosine shows that students are not yet fully able to use mathematical representations well. It can be seen from the two questions given that none of the students can use all types of representations perfectly.

Students with high mathematical abilities have better visual representation skills than the representation of mathematical equations or expressions. Students are good at using visual representations. However, it is quite good at using representations of mathematical equations or expressions. As for the representation of words or written texts, it is not certain whether they are good or not in using these representations, because students do not involve written words or texts in solving problems. Students with moderate mathematical ability are quite good at using visual representations and representations of mathematical equations or expressions. As for the representation of words or written texts, it is not certain whether they are good or not in using these representations, because students do not involve written words or texts in solving problems. Students with low mathematical abilities have better visual representation skills than the representation of mathematical equations or expressions. For the visual representation ability, students are quite good at using it. However, they are still not good at using representations of mathematical equations or expressions. As for the representation of words or written texts, it is not certain whether they are good or not in using these representations, because students do not involve written words or texts in solving problems.

Suggestions that need to be conveyed by researchers in connection with the results of this study include: 1) In the learning process, teachers should pay attention to students' mathematical representation abilities because good mathematical representation skills can help and facilitate students in understanding mathematical concepts and solving problems; 2) In the learning process, teachers should use appropriate learning methods and familiarize students with solving more varied mathematical problems that make students come up with various forms of representation so that students do not only focus on one form of representation. That way, students' mathematical representation abilities can develop; 3) The results of this study can be used as a basis for further research by other studies in order to dig deeper into the mathematical representation of students in solving mathematical problems; 4) Other researchers are expected to be more careful in selecting or determining the test questions that will be used in research, because basically the representations raised by students also depend on the questions students face. Consider a problem to be given, which allows students to come up with all three

types of representation, namely visuals, mathematical equations or expressions, and written words or texts. So, researchers can find out how well they use the three types of representation in solving problems.

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