ANALYSIS OF MATHEMATICAL REPRESENTATION ABILITY ON ASSEMBLAGE MATERIAL FOR JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study aims to provide description of mathematical representation ability of Pekanbaru Junior High School students based on the answers to assemblage questions. The research method Decriptive method in the form of a survey was used in this research. The research subject are 25 students of class VII. The object of research is the ability of students' mathematical representation on the assemblage material. The data analysis technique uses deductive methods by collecting data, processing data, presenting data and also analyzing data with the help of experts and theories from a literature review. Data was collected by measuring written tests about mathematical representation abilities. Consists of 6 assemblage of essay questions with moderate criteria. Through the validity test, valid results were obtained with moderate and high criteria and had moderately correlated reliability with good criteria. The results of the data test and analysis concluded that students' mathematical representation abilities applied to assemblage material had 91% visual representation skills using diagrams, 76% representation skills using mathematical expressions, and 51% mathematical representation skills using words.

Keywords : *Representation Ability, Assemblage*

INTRODUCTION

Material delivery in the field of learning studies has a role in human life, including mathematics. The role of mathematics is to connect science to other fields of study. Seeing the role and urgency is quite large in mathematics studies, there is a reason for this field of study to be designated as a mandatory field of study at all levels of education (Sanjaya et al., 2018) . According to Novitasari (2016) in her research expressed that mathematics is taught to students at all

levels of education in Indonesia from Elementary School (SD) to Higher Education (PT). The learning material contained in the field of mathematics has connection to other fields of study seen from the use of concepts. Various concepts taught in mathematics studies always have a relationship with the concepts possessed by other fields of study. Various concepts taught in mathematics studies always have relationship with the concepts possessed by other fields of study. Brunner gives an opinion that the best method that can be implemented for the development of student's understanding of learning concepts and propositions in mathematics is the use of representations (Afgani. 2011). The existence of representation arises due to the existence of thoughts in the human body to be stimulated to bring out ideas. The development of students' understanding of concepts can be trained through learning in the field of mathematics study. Through mathematics, an understanding of students will be built on the ability to understand and look for relationships between ideas that develop in mathematics and phenomena that occur around students' lives (Fatqurhohman, 2016) .

Sabirin (2014) stated that Representation is an interpretation arises from students' minds on situations or problems that occur around them which are then used in problem solving. Representations that develop in students' mind of will always different. This is shown through the form diversity of representation such as pictures, mathematical symbols, writing, graphs, tables, and others. Representation in mathematical scope has very important properties. These conditions can provide assistance for students to organize their thoughts when solving problem in learning. Mathematical representation which has its own urgency has relevance to the views of National Council of Teachers of Mathematics which stated that representation is the main source in the teaching and learning process, especially in mathematics. The goal is that students can develop and deepen in terms of understanding related to mathematical concepts and the relationships made during learning. In addition, students are expected to be able to make comparisons and implement representations in various activities.

Representation is an ability that is required of students to have it in interpreting and applying various concepts which will later have benefits for providing a solution or problem solving appropriately. Then the representation is a model or form that replaces a situation or problem which will later be useful in determining a solution (Kohl & Noah in Surya & Istiawati, 2016). Skills in performing mathematical representations need to be the main emphasis for students and have relationship with the ability to communicate and solve problem. Activities related to communication require ability to represent the parties concerned. It aims to be able to analyze and read various forms such as graphs, pictures, diagrams, to other forms of representation.

Lestari & Yudhanegara (2017) gives an opinion that the ability to perform representations is the ability to perform restatements relating to mathematical expressions, diagrams, notations, graphs, equations, tables,

symbols, or pictures into other forms of representation. Mathematical representations can include representations in the form of pictures, visuals, pictures, equations, written text, or mathematical expressions. Then Syafri (2017) give a response that the ability to perform mathematical representations is an ability in the field of mathematical studies through the expression of various mathematical (definitions, statements, problems, etc.) using various methods. Representation can be referred to ability to illustrate, symbolize, or represent something in a clearer way. In general, representations divided into two categories, namely external and internal representations (Ashari, 2017).

Mathematical representation ability is an important form or component in the development of thinking skills in each student. This is due to the existence of a student learning process in the field of mathematics studies to find the linkage of the material being studied and to make representations in the form of ideas and ideas through various ways. Jones (in Fajriah et al., 2020) expressed his opinion that there are three reasons regarding the development of representations must be carried out in mathematics lessons, these reasons can include (1) the ability at the basic level which is an obligation possessed by students as an effort to build a concept and think systematically, that is, feeling fluent in doing translations when faced with various types of representations available; (2) the level of understanding of students in the field of mathematics studies has a great influence from various mathematical

ideas given by the teacher using media in the form of representations; (3) the ability and way to understand a concept well and flexibly used in solving problems, it is necessary to have an exercise to build the representations possessed by these students. Then Jones' opinion was strengthened by NCTM which determined the importance of ability in mathematical representation through the specified measurement scale.

NCTM (Efendi, 2012) issued a stipulation that the teaching and learning program for Early Childhood Education (PAUD) to Senior High School (SMA) provides a demand to have possibilities in terms of: (1) perform a creation and use of representations in organizing, recording, and manifesting in the communication of mathematical ideas; (2) perform the selection, application, and translation of mathematical representations in solving problems; and (3) the use of representations to form a model and interpretation of social phenomena, physical phenomena, and mathematical phenomena. NCTM (Afgani, 2011) provide an explanation that representation can be in the form of translation of a problem or idea in the form of a new form and can include physical models or pictures into other forms such as mathematical symbols, sentences, or words that can be interpreted. Representations can be used to translate and analyze verbal problems more clearly.

The representation process carried out by students when used adequately and appropriately will have a major influence in the formation of an understanding (understanding or meaning) in the form of concepts in

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mathematics. Representations can be used to explain student discoveries with geometric shapes in a real context. Students can make better concept discoveries on their own when studying mathematics, which can shape their understanding of concepts and improve their thinking (Muhamad, 2016).

Based on the expert's explanation above, it was found that the ability to represent is part of learning mathematics. As we realize that humans have 5 senses, all of which are useful in education. The senses of the eye as vision make humans able to describe something to solve the problems found. The sense of the ear is the entrance to a science which can be processed in the form of visuals and mathematical expressions in the form of words. Other senses are also very instrumental in education where humans are free to express themselves to explain or solve the problems they face. Mathematics that became human life can also be solved through these senses. Representation is the basis of function of five senses of humans or students. Therefore, it is realized that the ability of representation is very important for students and all students have it. However, to find out the extent to which students' mathematical representation abilities are applied to mathematics learning, in this case it is limited to assemblage material, then this is the reason for the author to raise the title of analysis of mathematical representation abilities of Pekanbaru Middle School students on assemblage material. This is surely becomes the basis for teachers in utilizing students' mathematical representation skills based on visuals, expressions or words to make it easier for students to understand mathematics learning in the future.

METHODS

The research method in this study is a descriptive research method in the form of survey. This method provides an overview and explanation related to the results and data that researchers found both from observations and literature reviews which will later be analyzed. This research method is subject to 25 of 7th grade students of SMP Pekanbaru by looking at their mathematical representation abilities in the assemblage material. This research was carried out in the academic year 2020/2021, to be precise, the even semester. In this case, the researcher limits the object to the students' mathematical representation ability on assemblage material. The reason is because in assemblage material there are many mathematical representational abilities of students that can be applied, such as the use of Venn diagrams in solving problems, making conclusions or using mathematical symbols as solving mathematical problems.

Research Procedure

Research with descriptive method in the form of survey begins by looking at the facts on the ground about students' mathematical abilities. Collecting data to measure how the facts on the ground about students' mathematical representation abilities.

Data collection is done by giving a written test to students about assemblage material. Before giving the test the author has carried out validity and reliability on the existing questions to see their feasibility.

The specified question is in the form of an essay, because later it will take measurements and get data in the form of student representations to solve problems in assemblage material. The results of the data obtained will refer to the indicators of mathematical representation ability proposed by Mudzakir in Lestari & Yudhanegara (2017) which are presented in the following table:

Table 1. Mathematical representation ability indicator

No.	Representation Ability Indicator	Operational Student Answer
1	Visual / Picture	Explained by venn diagram
2	Mathematical Expression	Explained by mathematic symbols or operation
3	Words	Explained and conclude the answer

Reference: Mudzakkir (2006)

Before analyzing the data on the ability to perform mathematical representations, it is necessary to have a validation test, reliability, and the level of difficulty possessed by the instrument about the ability to mathematically represent assemblage material first.

1) Item Validity

The results of calculation of instrument validity can be concluded that the instrument about mathematical representation ability that the researcher will use is declared valid, so that the instrument that the researcher has compiled can be used in collecting data in the field. Then the criteria used in the results of instrument validation will be presented in table 2 below:

Table 2. The results of item validity of mathematical representation

Item No	Coeff. Corr. $r_{arithmetic}$	Value $t_{arithmetic}$	Value t_{table}	Decision	Criteria
1	0.59	3.54	1.71387	Valid	Moderate
2	0.66	4.22	1.71387	Valid	High
3	0.41	2.16	1.71387	Valid	Moderate
4	0.42	2.21	1.71387	Valid	Moderate
5	0.60	3.55	1.71387	Valid	High
6	0.46	2.47	1.71387	Valid	Moderate

2) Question Reliability

Calculation of reliability as in the matter of mathematical representation ability is known that the reliability coefficient is 0.478 then $r_{arithmetic} > r_{table}$ or $0,478 > 0,36$. Because the research instrument that has been compiled can be declared reliable with a moderate level of interpretation.

Table 3. The results of question reliability of mathematical representation

Coeff. Corr.	Corr.	Reliability Criteria
0.478	Moderate	Good

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3) Difficulty Level of Question

Based on calculations on the difficulty level of questions with the theme of ability to perform mathematical representations, a conclusion can be drawn that the results of the 6 essay questions have a moderate level of difficulty in each item, which is described in table 4 below:
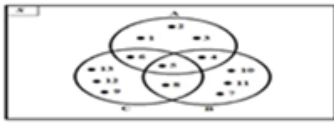
Table 4. The Results of difficulty level of question of mathematical representation

Item No.	TK	Difficulty Index	Criteria
1	0.67	$0.31 \leq TK \leq 0.70$	Moderate
2	0.55	$0.31 \leq TK \leq 0.70$	Moderate
3	0.54	$0.31 \leq TK \leq 0.70$	Moderate
4	0.35	$0.31 \leq TK \leq 0.70$	Moderate
5	0.45	$0.31 \leq TK \leq 0.70$	Moderate
6	0.51	$0.31 \leq TK \leq 0.70$	Moderate

The following is a mathematical representation ability test instrument given and done by students, which can be seen in the following table;

Table 5. Mathematical representation ability question

NO	QUESTION	INDICATOR OF MATHEMATICAL REPRESENTATION ABILITY		
		1	2	3
1.	Lisa's birthday party was attended by 40 of classmate and 15 of neighbors. If 5 of classmate also her neighbors, how many visitor attending in her party?...Then draw the venn diagram.	√	√	
2.	In one class, 25 students like basket, 35 students like volley, and 15 students like both. Determine how many students in that class and draw the venn diagram!	√	√	
3.	Known: $K = (g, i, t, a\,r)$ $M = (s, e, l, o)$ $L = (p, i, a, n, o)$ $N = (t, r, o, m, p, e,)$ From assemblage above, which assemblage is mutually exclusive?		√	√
4.	If H is assemblage of Indonesian President's names which start with P, then make a statement using assemblage notation!		√	√
5.	Known: $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ $A = \{1, 3, 5, 7\}$ $B = \{2, 3, 5, 7, 9\}$ If S is universe assemblage, then draw venn diagram from assemblages and determine member from A and B!	√		√
6.	Pay attention to the following diagram Mention right three statements regarding to venn diagram above by using symbol.		√	
	Total Score 44			
	Final Score = Score obtained / total score X 100			

Descriptor:
1. Visual / Picture Representation is made picture or venn diagram to clarify problem and facilitate the completion
2. Representation of equations or mathematical expressions, namely solving problems by involving mathematical expressions
3. Representation of written text words to answer questions using written words or text

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RESULTS AND DISCUSSION

The result of the research is the stage that has the goal of knowing the level of distance in the ability to perform mathematical representations on students in the assemblage material.

Based on the analysis using the research instrument that has been given, the researcher can find out the student test results presented in the following table:

Table 6. Percentage of mathematical representation ability

No	Mathematical Representation Ability Indicator	Percentage Correct	Percentage Wrong	Criteria
1	Visual / Picture Representation	91%	9%	Very Good
2	Equation Representation or Mathematical Expression	76%	24%	Good
3	Written Representation / Written text	51%	49%	Not Good

a. Representation in the form of pictures or visuals, by making pictures or Venn diagrams as indicators to clarify the problems in the questions and assist in the completion process.

The ability of visual/picture representation can be seen in the answers to question number 1, 2, and 5. The indicators the researcher uses are students are able to complete or present answers in the form of Venn diagrams.
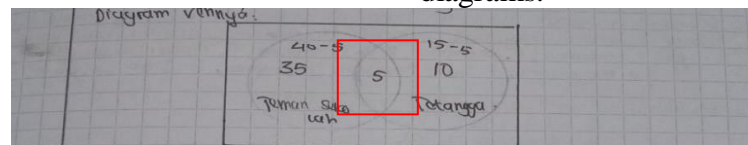

Figure 1. Answer from question number 1

Based on Figure 1, it is one example of student answers. From the result of instrument given in question number 1, some students have been able to answer or provide answers in

the form of Venn diagram. However, there are some students who do not write the letter S as the universe in the answer of drawing venn diagram.
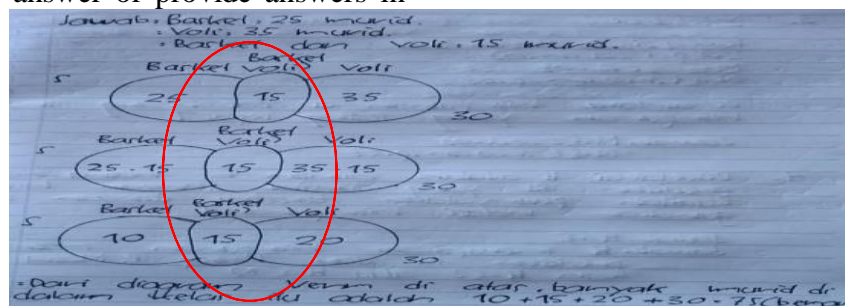

Figure 2. Answer from question number 2

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In Figure 2 for student answers to question number 2, from the results of the study it was found that there were some students who had not been able to present Venn diagrams correctly due to the lack of student understanding of understanding concepts in the use of Venn diagram applications. However, in this case, most students are able to present visual representation or picture in the form of Venn diagram correctly contained in the questions given.
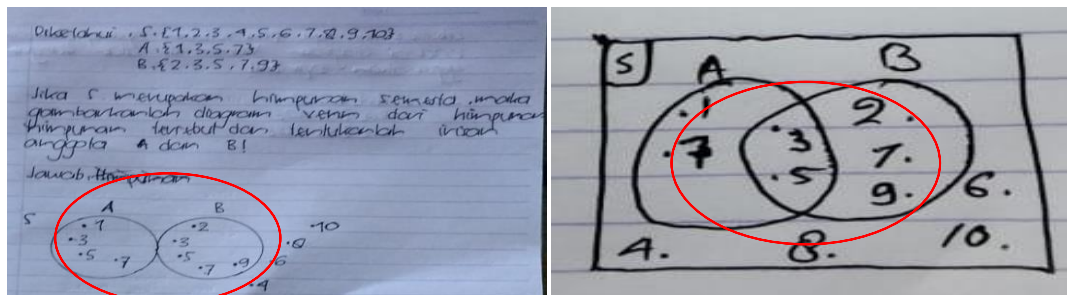

Figure 3. Answer from question number 5

Figure 3 showed student answers to question number 5, on average students are able to answer questions with visual representations / pictures correctly, only a few students are wrong in presenting answers in the form of Venn diagrams (making slices of members A and B) and still there are students who make a mistake in describing the venn diagram.

Based on Figures 1, 2, and 3, the answers written in numbers 1, 2, and 5 from the results of research conducted on visual/picture representational abilities, students have abilities with very good or high criteria with average value of 90% which the average students have been able to present in the form of answers to questions with Venn diagrams according to the questions given in visual representations or pictures and some students who make mistakes in representing pictures/visuals with an average value of 9%. This condition is in line with the results presented by Wijaya (2018) with an explanation that students have been able to describe the objectives of the questions accompanied by stages and the use of symbols and numbers to clarify the pictures that have been made. Through these results, it can be concluded that the visual representation ability of students is in the good category in presenting the circle questions provided. Students have been able to present answers in the form of pictures about the questions provided with an explanation of drawing process. Then Dewi & Sopiany (2017) provide feedback on the drawing ability indicators with the aim of emphasizing the problem and assisting in the resolution process being in the high category.

b. Representation in the form of equations or mathematical expressions is a process of solving problems by involving mathematical expressions

The ability to perform mathematical representation of an equation or expression can be seen in answers to numbers 1, 2, and 6 which

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have indicators that students are able to write assemblage correctly using other representation processes and

students are able to optimize the use of mathematical expressions in solving problems.
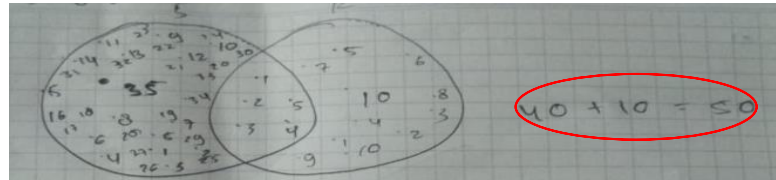

Figure 4. Answer from question number 1

In Figure 4, it is known that the students' answers to question number 1, some students only gave the final answer, while on average students were able to provide answers

equipped with equations and mathematical expressions in solving them by describing the calculated answers.
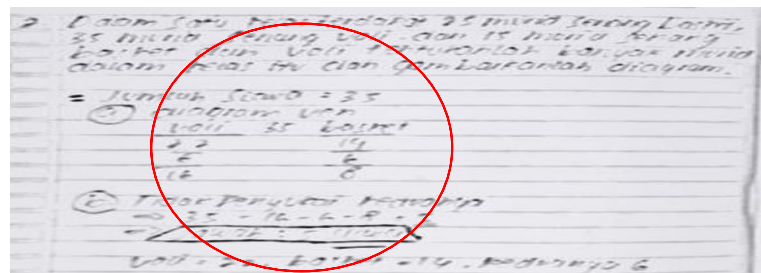

Figure 5. Answer from question number 2

In Figure 5 it is known that the students' answers to question number 2 on average have been able to answer the questions by describing

mathematical expressions correctly, but there are some students when describing or writing the calculations used are still wrong.
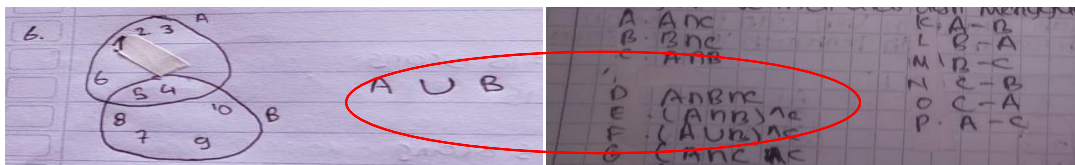

Figure 6. Answer from question number 6

Figure 6 showed students' answers to question number 6. Most of the students have not been able to present the assemblage according to the correct rules, in the student's answers many students are wrong in writing the symbol of the assemblage and students make mistakes in answering questions that are in the

form of stating the conclusion and there are some students who have been able to represent a mathematical equation or expression correctly.

Based on the results of the research analysis carried out in Figures 4, 5, and 6 for students' answers to questions number 1, 2, and 6 in the representation of equations or

mathematical expressions, students have the ability on moderate or good criteria in presenting mathematical expressions with average value of 76 % and students who make mistakes with average value of 24%. The results of this study have conditions that are in line with the research conducted (Huda et al., 2019). In their research, it was stated that the mathematical representation abilities possessed by students in the form of symbolic forms were generally known that students had skills in making equations, mathematical models or doing a representation based on another known form of representation, performing problem solving through the use of mathematical expressions. The questions that the researcher uses in measuring this indicator have relevance to the students' real-life situations. However, referring to the results of the study, it can be seen that many students have a low level of accuracy and are careless in determining the solution to the problem, so that students are less

precise when determining the final result. In addition, students draw conclusions that the ability to represent mathematical equations or expressions symbolically students have been able to determine mathematical equations or forms and solve a problem by using mathematical expressions which have overall results declared to have satisfactory predicates. However, the accuracy of students in doing the problem is still lacking, so it has an inaccurate final result.

c. Representation in the form of written text or words when answering questions using written text or words.

The ability to represent written text or words can be seen by referring to the answers of students number 3, 4, and 5 with the indicator that students are able to provide answers to the questions provided by making representations in the form of written text or words.
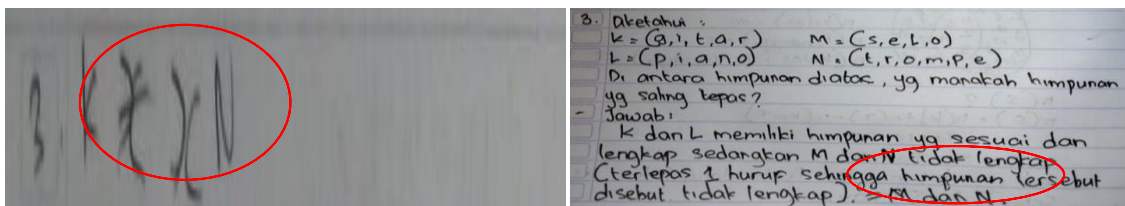

Figure 7. Answer from question number 3

In Figure 7, it is known that the student's answer to question number 3, some students are wrong in answering the question of representation of words or written text where students are less precise in
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answering because of their lack of understanding of the concept of the assemblage and some students have been able to describe the answers to the questions correctly.

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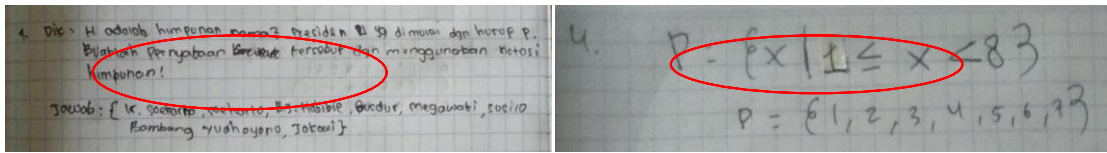
Figure 8. Answer from question number 4

In Figure 8, it is known that the student's answer to question number 4 is that the average student has not been able to present the answer correctly due to a lack of student understanding of the symbols in the empty assemblage and in describing the final conclusions on the representation of written text or words. Many students answer questions by repeating the words or text on the questions without explaining the answers correctly.
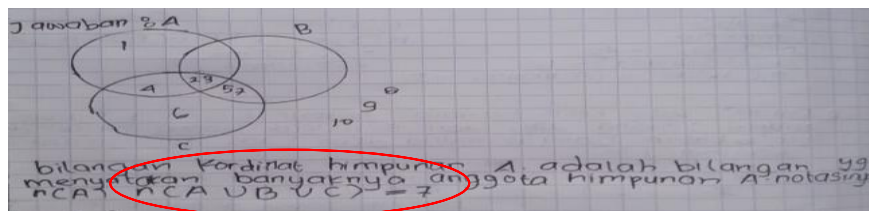

Figure 9. Answer from question number 5

In Figure 9 it is known that the student's answer to question number 5 is that on average students are able to answer the question correctly in the form of picture but some students do not answer by describing the conclusion or written text at the end of the answer correctly. The lack of understanding of students' basic concepts in the assemblage material makes students make many mistakes in writing assemblage symbols, so that in presenting the answers students make mistakes until the end of the answer.

The results of the research carried out in Figures 7, 8, and 9 of the answers to numbers 4, 5, and 6 regarding the ability to represent words or written texts can be concluded that students have abilities in not good criteria with an average value of 51% correct and students who make mistakes 49%. These results have conditions that are in line with the research of Miladiah et al. (2010) and Sanjaya et al. (2018) which are known that the ability to represent students in the form of words or verbal skills (written text) is categorized at a low or sufficient level and in line with research conducted by Herdiman et al. (2018) the results of his research explain that the ability to perform mathematical representations of students in the discussion of congruence and similarity for text and word indicators has lower qualifications when compared to the average student score of 43%.

Based on the results of the analysis above, it was found that the representation ability of Pekanbaru Junior High School students on the ability of visual representation or pictures of students had a high ability or very good in answering questions with an average value presentation of 91% and 9% who made mistakes in presenting visuals/pictures on the

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given question. given, most of the students were able to describe the Venn diagram correctly. This is in line with the results of the research by Mislul (2019). Students who are categorized as high are able to describe tables completely and correctly but are less systematic because there are no titles and are able to paint bar charts completely, correctly and systematically. Meanwhile, for the representation of equations or mathematical expressions, the average value of 76% of students has the ability with moderate or good criteria and 24% of some students do not do the elaboration in answering the representation of mathematical equations or expressions, students immediately answer in the end. This is in accordance with the results of research by Dwi & Madsuki (2017) he concluded that the students' ability to represent equations or mathematical expressions was quite good or moderate. Students have used mathematical expressions in solving problems by writing down the calculations used. Furthermore, the ability to represent words or written texts, the ability of students to have moderate or good enough criteria with an average value of 51% and 49%, most students make mistakes in answering questions in the form of words or written text, students answer directly to the end of the answer without making conclusions or written text on the answer. This is in line with the research results of Mutiara & Haerudin (2021) who concluded that the indicators of the representation of words or texts students have not been able to write or

explain systematically from existing problems.

The results of this study have conditions that are in line with the research of Saputri & Masduki (2017) with the research title "Analysis of Mathematical Representation Ability in Solving Assemblage Material Problems for Class VII Students of SMP Negeri 2 Baki". The results in the research are (1) students who get scores above the minimum criteria have (a) the ability to perform visual representations with a good category for solving assemblage problems, (b) the ability to process the representation of mathematical equations or expressions categorized as good enough, and (c) the ability to represent written text or words is in the not good category. (2) Students who score below the minimum criteria have (a) the ability to perform visual representation activities in a good category when solving assemblage problems, (b) the ability to represent equations or mathematical expressions categorized as not good, and (c) the ability to in making representations of written texts or words that fall into the not good category.

CONCLUSION AND RECOMMENDATION

Based on the analysis results obtained through the existing presentations, it can be concluded that the students' mathematical representation ability on assemblage material has been applied, visual representation ability is higher than the ability to express mathematically or words.

Thus, educational elements can use this result as evaluation in

learning mathematics with learning that is more visual in nature and students can describe it in tables and diagrams. For this research, it is possible to conduct relevant research and see the percentage of other mathematical representation abilities so that it becomes a common guide in providing the best learning for students.

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