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Representation of Secondary School Students in Solving Fractions

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Abstract **– This article aims to describe the representation of secondary school students in solving fractions. The subjects were students of class VII SMPN 01 Muncar Banyuwangi. Data about the test results in the form of symbolic and illustrated images. Subject shows a symbolic representation when doing computation or manipulation of symbols by changing the problem statement to the form of mathematical symbols to perform the operation procedure and illustrations as an explanation or meaning of the symbolic representation. So, to be able to trigger representation ability of students, need to be introduced to various representations to solve problems, because the representation illustrates that the extent to which a students understands the situation faced or learned.**

Keywords **– Fractions, Representation, Symbolic Representation, Word Problem.**

I. INTRODUCTION

In the education system, students are introduced to various disciplines one of which is mathematics. Mathematics is a science that needs to be understood by everyone, especially students who are at the level of formal education ranging from elementary school to college [5, 7]. Students are sensitive to mathematics if they can understand and interpretation [4]. Interpretation relates to the representation that is interpreted as a result of one's thoughts communicated through explanation orally and in writing to understand and solve a problems [3]. Representation is one of the important components in school mathematics, as it can "*supporting students' understanding of mathematical concepts and relationships; in communicating mathematical ...*" [16]; and in applying mathematics to real objects or situations [15, 19, 20].

Real situations (concrete) can be made through the use of models in the real world into abstract or symbolic concepts by describing the relationship between objects and symbols [11, 17], includes manipulative material (physical objects), images or diagrams (visual static), real situations (concrete), and written symbols [20, 4]. So that representation can be viewed as process and product [16]. Representation as a process of making concrete models to abstract objects or symbols by describing the relationship between objects with symbols and representation as a result of meaning or operating on the form of illustration or symbolic manipulation and representation as a result of meaning or operate on the form of illustration or symbolic manipulation [11, 19, 20]. The results of this representation can be used to describe, represent, symbolize, or organize in meaningful situations in expressing answers in the form of written words, diagrams, tables, equations, or other forms [1, 2].

One of the standard competencies of elementary to secondary schools in Indonesia is fractions, where fraction materials are taught in a coherent and continuous manner ranging from counting, sorting, comparing, simplifying, summing, subtracting, multiplying, dividing, until application in daily life [7]. In the real world, fractions are already known and accustomed to students before they enter school. For example, children often cut the cake or the other into 2 parts or parts of the same to be shared with family members or friends. Therefore, students have a greater opportunity to understand the concept of fractions compared to other mathematical material. However, in reality it is not as expected that students are still having difficulty in interpreting and operating fractional numbers.

Learning mathematics in elementary school is not only aimed at improving students 'ability in numeracy, but also directed to the improvement of students' ability in solving problems [6]. Most elementary school students could use symbolic representation and difficulties in representing image form [24]. For example, students' difficulties making illustrations $\frac{1}{2}$ is greater than $\frac{3}{4}$. This is because the elementary school students are still in concrete operation phase, where the idea of the child is still based on observation real object or concrete [18]. Furthermore, [21] reveals the difficulties students come from understanding the overall value of numbers in fractions and implement procedures whole numbers such as, $\frac{1}{2}+\frac{1}{4}=\frac{2}{6}$ [8]. So that students understand or interpret the fractions based on integer values [22].

The reality in the field shows that not only the students who have difficulty in using the representation, but teachers have gaps using their representational skills in the process of teaching mathematics [9, 10, 23]. Therefore, students need to be taught how to overcome the possible difficulties faced. The school curriculum has been prepared to develop and improve students' ability to overcome difficulties in resolving issues related to representation [9, 13]. Students are expected to understand the problem in the form of a sentence, selecting the information and planning the right solutions and deciding whether the answers obtained make sense or not. Success in solving mathematical problems is supported by ideas that allow students to use their understanding [23, 12]. The achieve this goal, students need to be given the opportunity to illustrate (represent) using their own strategies or ways of solving problems, so that the ability to solve math problems can be achieved effectively [14].

Based on the description above, this study reveal the representation of students in solving fractions. Problems used in the form of word problems, because it can develop

the ability of its representation [3] and the representation itself is used as a means or tool to communicate ideas or ideas owned [25]. This research refer to [7] reveal that representation aspect include the student's interpretation in understand of information on the problems, showing the relationship to the mathematical context (changing symbolic-picture or picture-symbolic), using of procedures to find the right solution. The authors assume that the use of fractional questions allows students to illustrate/ represent their ideas in solving the problem can be images, symbolic or otherwise. So this study aims to describe the representation of students in solving fractions.

II. Research Method

Subjects

Subject of this study is the students of grade 7A at SMPN Muncar Banyuwangi which is chosen based on student answer result, that is: interpretation of students in understand of information on the problems, showing the relationship to the mathematical context (changing symbolic-picture or picture-symbolic), using of procedures to find the right solution.

Instrument (Test Question) as Follows:

Mrs. Leni buy 5 cakes medium size (small) and 2 jumbo size (large) to be distributed to 20 guests evenly. Each cake is cut into equal parts, namely medium size (small) into 12 parts and jumbo size (large) into 10 parts. How many pieces of cake are given to each guest to keep no portion of the cake left?

Procedure

The test was given to 20 students grade 7A. Before conducting the test, students were given instructions or rules that are read by researchers, namely: students solve the problem for 35 minutes, students are not allowed to collect the results of the answers before the specified time is over, students are not allowed to ask questions or see the work of his friends. After completion of the test, the researcher examines the results and conducts a structured interview to 3 students who meet the three specified aspects. The purpose of selecting 3 students because they are considered to represent other students who meet the three criteria specified.

Data Analysis

Data obtained from student answers. Data were analyzed quantitatively and qualitatively. Quantitative data to show the percentage of each aspect of student representation. While the qualitative data to describe the student representation used in solving the problems. The student representation criteria are shown in Table 1 as follows.

Table 1. Criteria of Student Representations

No.	Criteria of Representation		Description
1.	Understand of information on the problem	1)	Read and rewrite of information the problems with the language itself.
		2)	Finding the key of problems
2.	Showing the relationship to the mathematical context (changing symbolic-picture or picture-symbolic)	1)	Illustrates the problem symbolic form
		2)	Illustrates the problem to picture form
		3)	Shows the relationship of symbolic expressions with illustrations of picture
3.	Using of procedures the operations	1)	Modify or eliminate symbolic expressions based on illustrations of new picture.
		2)	Modify or eliminate illustrations of picture based on symbolic expressions created.
		3)	Find solutions according to the question.

III. Results

Results of Data Analysis

The results of data obtained include the results of student answers and structured interviews. The results of interview data written to the form of a conversation aims to provide an overview or explanation of students in providing the results of the answer. The results of the data are grouped into the form of quantitative and qualitative.

Quatitative Data: in the form of a percentage of student answers categorized based on each criteria of representation in solving fraction the problems shown in Table 2 below.

Table 2. Percentage of student representation of answer result

Criteria in Code of Representation	Student (n)	Average (%)
(1-1, 1-2), (2-1), (3-3)	6	30
(1-1, 1-2), (2-1, 2-3), (3-2, 3-3)	10	50
(1-1), (2-2, 2-3), (3-1, 3-3)	4	20

(1) Understand of information on the problems
(2) Showing the relationship to the mathematical context
(3) Using of procedures the operations

Table 2. shows the quantitative data the students are 6 students (30%) can understand the information problems by reading and finding the key problem in qoestion then illustrate to the form of symbolic expression, find solution according to question. 10 Students (50%) rewrite and find the key problems, change information the problem from the form of symbolic expression to the illustration of picture, show the relationship between symbolic expression with the illustration of picture, modify or eliminate the illustrations of new picture based on symbolic expression, and find the solution according to the question. 4 Students (20%) can understand the problem question and find the key problems, convert from the illustrations of picture to symbolic expression, show the relationship between the illustration of picture and the symbolic expression made, modify or eliminate the symbolic expression based on the illustration of the new image, and find the solution according to the question.

Qualitative Data: Students are asked questions in the form of word problems related to real life or daily with the aim to see the interpretation of students in solving fractions. Analysis shows that most students provide interpretations

through the illustrations of picture and change them to symbolic expressions or from symbolic expressions change to illustrations of picture. Data results of student answers are described according to the established criteria are: understand of information on the problems include read and rewrite of information the problems with the language itself, finding the key of problems; Showing the relationship to the mathematical context include illustrates the problem symbolic form, illustrates the problem to picture form, shows the relationship of symbolic expressions with illustrations of picture; using of procedures the operations include modify or eliminate symbolic expressions based on illustrations of new picture, modify or eliminate illustrations of picture based on symbolic expressions created, find solutions according to the question.

Based on the data obtained from the analysis, selected by 3 subjects on the grounds that the subjects are believed to have represented 20 students from each of the criteria that appear. Description of representation the subject as follows:

Subjek 1

Shows information about reading and rewriting information by finding the key problem questions. Then determine the relationship of various mathematical contexts by illustrating the information obtained in symbolic expressions. The symbolic expression represented by subject 1 shows the answer to the question. Hasill the answer of subject 1 can be shown in Figure 1 below.

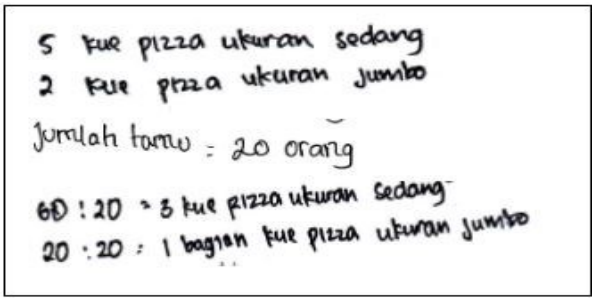

Fig. 1. Representation by Subject 1

Figure 1. shows the criteria of understanding the problem by rewriting the information and key issues. Information written is 5 medium-size cake cut into 12 parts and 2 jumbo-size cake cut into 10 parts. Then the cake was distributed to 20 guests.

Subject 1 can show the relationship to the mathematical context through symbolic expressions using division and multiplication operations. The symbolic expressions is $60 \div 20 = 3$, means medium-size cake cut to 60 parts then distributed to 20 guests and earns 3 parts per guest. While the symbolic expression is $20 \div 20 = 1$, means the jumbo-size cake cut to 20 parts then distributed to 20 guests and earns 1 part per guest. This is stated subject 1 when the interview is as follows. P (*researchers*) and S1 (*subject 1*).

P : How many cakes were obtained every guest?
S1 : Three medium-size cakes and one jumbo-size cake.
P : why that?
S1 : Because the cake was five and each cake is cut into twelve so there are sixty parts. While there were two jumbo sized cakes and every cake cut into tens so there are twenty-parts.

Subjek 2

Shows information about reading and rewriting information by finding the key problem questions. Creating a symbolic expression to the illustrate of picture. After that, giving a description of the symbols in the illustration of the image which then shows the relationship between the illustration of new images and symbolic expression of the question. Results answers subject 2 is shown in Figure 2 below.

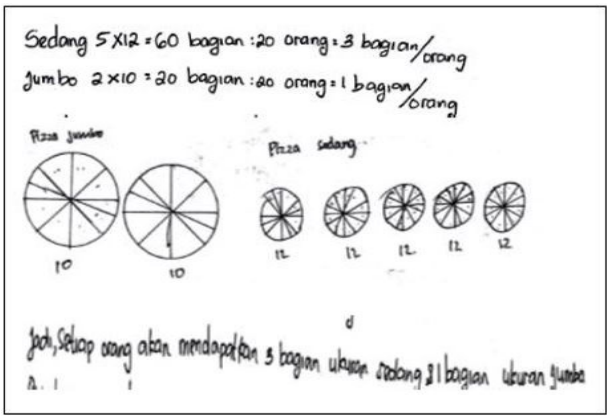

Fig. 2. Representation by Subject 2

Figure 2. shows the rewriting information and key issues. Information written is 5 medium-size cake cut into 12 parts and 2 jumbo-size cake cut into 10 parts. Then the cake was distributed to 20 guests. Information that written is 5 medium-size cake is cut into 12 part and 2 jumbo-size cakes is cut into 10 parts which are distributed to 20 guests. The symbolic expressions is $5 \times 12 = 60$, means medium-size cake cut to 60 parts then distributed to 20 guests and earns 3 parts per guest. While the symbolic expression is $2 \times 10 = 20$, means the jumbo-size cake cut to 20 parts then distributed to 20 guests and earns 1 part per guest.

Subject 2 create illustrations based on symbolic expression to show the relationship between them is to give particulars of the symbols 10 and 12 in each cake. Meaning is a medium-size cake cut into 12 parts and a jumbo cake cut into 10 parts. Then shows the relationship between the answers obtained with the question of each guest get 3 parts medium-size cake and 1 part jumbo-size cake. This is stated subject 2 when the interview is as follows. P (*researchers*) and S2 (*subject 2*).

P: (While pointing out) what information do you know about the problems?
S2: 5 medium-size cake is cut into 12 parts and two jumbo-size cakes are cut into 10 parts.
P: How many cakes obtained by each guest?
S2: Three medium-size cakes and one jumbo-size cake.

Subjek 3

Shows information about reading and rewriting information by finding the key problem questions. Then creating the illustrations of picture and provide information in the form of symbols, transform the illustrations of picture into symbolic expressions, modify and eliminate the symbolic expression based on the illustrations of picture, find solutions appropriate questions. Results answers subject 3 is shown in Figure 3 below.

Figure 3. shows change information the problems to form the ilustration of picturre, then use a symbolic expression. The symbolic expressions is $12 \times 5 = 60$, means medium-size cake cut to 60 parts and $2 \times 10 = 20$, means the jumbo-size cake cut to 20 parts then distributed to 20 guests. Then The symbolic expressions $\frac{60}{20} = 3$ part and $\frac{20}{20} = 1$ part, means each guest get 3 parts medium-size cake and 1 part jumbo-size cake. This is stated subject 3 when the interview is as follows. P (*researchers*) and S3 (*subject 3*).

P : How many types of size of the pie that you can share with guests?
S3 : There are two, medium and jumbo.
P : There are how many parts of each cake?
S3 : Medium-size cake there are 60 part and jumbo-size cakes there are 20 parts.
P : Why are there 60 parts and 20 parts?
S3 : Because the medium-size cake is five and every cake is cut into twelve so there are sixty parts. While the jumbo-size cake is two and every cake is cut into tens so there are twenty parts.
P : So, How many cakes obtained by each guest?
S3 : Three medium-size cakes and one jumbo-size cake.

IV. DISCUSSIONS

Based on the data obtained, the representation can affect students' thinking, especially from their own understanding. For example students can develop information the problem by representation in the form of illustration of picture which is then changed to the form of symbolic expression. This is what makes learning meaningful for students that the giving the opportunity to solve problems independently. But most students still have difficulty the illustrating by picture form other than a symbolic expression, because students are still working according to the procedure. In addition, in mathematics learning, the presence of representation can help students build and develop their understanding of mathematical concepts by linking various topics or real situations. In the classroom, teachers do not have to provide complete information to a problem to students, so that students use prior knowledge to supplement information and generate ideas that can build their understanding of the concepts learn.

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3.	Pemahaman Konsep Matematika Siswa Dalam Menyelesaikan Masalah Bangun Datar	Madiun-Indonesia	Jurnal Ilmiah Pendidikan Matematika	2016	2502-1745

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