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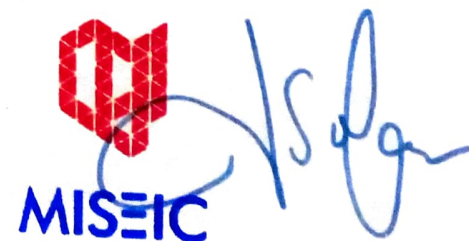
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Mathematical Representation of Middle School Students in Solving Fractional Problems Based on Sex Difference

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Abstract. Mathematics is one of the subjects taught in schools from elementary education to higher education, in which mathematics cannot be separated from the problem-solving activities. This is because the problem-solving activities is one of the most important skills taught to students early, as a preparation to face problems in the future. Fraction is one material that has a relatively difficult and challenging concept for students. This study aims to describe the students' representation of middle school in solving fractional problems based on sex difference used Polya rules. This research is an exploratory research with a qualitative approach that produces descriptive data. This research was conducted on 7th grade students of SMP Negeri 53 Surabaya. Written data was taken from the results of the written test which produced two research subjects. They are one male student and one female student who have a similar mathematical ability. Data collection method used are the test method by giving the task of mathematics and method of interview. The results of the research showed that the mathematical representation of male junior high school students in solving fractions is by presenting the data provided using symbol manipulation and given verbal information with written words or sentences. While the mathematical representation of female junior high school students in solving fraction questions uses more verbal forms or written sentences as explanatory illustrations. So the representation ability of students can be used as a reference to determine the extent to which a student understands a problem at hand.

1. Introduction

Mathematics learning has one general goal, one of which is mathematical representation. Mathematical representation is an ability that is very important for students and is closely related to communication skills and problem solving. So we need an optimal representation in the form of images, graphs, diagrams, and other forms of representation to be able to communicate something. There are five standard processes that describe the objectives to be achieved in mathematics learning related to understanding mathematics and mathematical competencies include: 1). Problem solving, 2). Communication, 3). Reasoning, 4). Connection, 5). Representation [1]. Representation is referred to as the process of making a concrete model to abstract objects or symbols by describing the relationships between objects, as a result of meaning or operation in the form of illustration or symbolic manipulation and as a result of meaning or operation in the form of illustration or symbolic manipulation [2]. One important material in learning mathematics is fractions. Fraction is one of the important materials because fraction is a prerequisite material in mathematics learning which includes basic concepts to understand other types of numbers such as real numbers and complex numbers. Fractional material is also one of the materials in the domain of number content measured in Trend in International



Mathematics and Science Study (TIMSS). Tunç-Pekkan [3] shows that learning related to fractions is difficult in various countries. So it can be said that learning mathematics in fractions is very important. Sex differences not only result in differences in abilities in solving mathematical problems, but also relates to how to obtain mathematical knowledge. This is consistent with the opinion of Keitel in Ferri and Kaiser [1] who argues that gender, social and culture influence mathematics learning. So, it is also possible for a difference in the ability of representation between women and men in solving problems related to fractions [1]. There are four steps used in problem solving, that is understanding the problem, devising a plan, carrying out the plan, and looking back [4].

2. Method

2.1. Subjects

The subjects in this study were 7th grade students of SMP Negeri 53 Surabaya. This is because fraction material is given to students of class VII at the beginning of the odd semester, so it is hoped that students' memories of fraction material are still strong. The number of subjects chosen to be the subjects in this study were one male subject and one female subject. The subject of research was determined by asking for consideration from the teacher, related to the ability of students to express ideas of thinking verbally and in writing. Subjects that have been selected have equivalent mathematical abilities. Acquisition data related to mathematical abilities obtained from the results of tests of mathematical ability. Two subjects are said to have an equivalent ability if the difference between the values of the two is a maximum of 5 from a total score of 100. It is intended that there are no differences caused by a student's ability.

2.2. Instruments

The main instrument in this study is the researchers themselves and supporting instruments is math ability test, fractional mathematical representation test, and interviews.

2.3. Data and data credibility

The data in this study is qualitative data. The data obtained from the work on fractional mathematical representation tests done by two types of students is male and female. Students work results are assessed on the basis of Polya's problem-solving steps. The data in this study also obtained from the interviews that aims to find out in detail chronological workmanship of students on the second and fourth rare that is devising the plan and looking back. And then to assure the obtained data credibility, the researcher made observations continuously/consistently (to improve perseverance), time triangulation and member check [5].

2.4. Data analysis

Data analysis performed after data collection process and data validation process. Based on the credible data, an analysis with three-flow model of activities were made simultaneously: data reduction, data representation and conclusion drawing [6]. Analysis of the representation test results is divided into two, namely the analysis of the representation results of male students and the analysis of the results of the representation of female students. Analysis of the results of male and female representation tests were carried out on each type of item based on the polya step which included: naming fraction number, making fractions item, reconstructing unit from unit fractions items, reconstructing the unit from proper fractions items, improper fractions items, Reconstructing the unit from improper fractions items.

3. Results and Discussion

3.1. Male students

Table 1. Summary of the work male student

Polya's Steps	Case					
	Naming fraction number	Making fractions item	Reconstructing unit from unit fractions items	Reconstructing the unit from proper fractions items	Improper fractions items	Reconstructing the unit from improper fractions items
Understanding Problem	√	√	√	√	×	×
Devising a plan	√	√	√	√	×	×
Carrying out the plan	√	√	×	×	×	×
Looking back	√	×	×	×	×	×

The result of Male student interview for the second and fourth step can be as follows:

Interview 1:

R : What do you do after understanding the problem?

M : I am trying to find the best plan by symbol manipulation and given verbal information with written words or sentences.

R : After your work is over, will you evaluate your reply process again?

M : Yes, I will do.

R : How did you do that ?

M : I will check each step of the answer, then link the answer with a similar problem.

(Note: R= Research; M= Male; √ = doing well × = not doing well)

3.2. Female students

The result of mathematical representation from male students in solving math problems based on Polya's steps can be seen in the following table:

Table 2. Summary of the work male student

Polya's Steps	Case					
	Naming fraction number	Making fractions item	Reconstructing unit from unit fractions items	Reconstructing the unit from proper fractions items	Improper fractions items	Reconstructing the unit from improper fractions items
Understanding Problem	√	√	√	√	×	×
Devising a plan	√	√	√	√	×	×
Carrying out the plan	√	×	√	×	×	×
Looking back	√	×	×	×	×	×

Interview 2:

R : What do you do after understanding the problem?

F : I am trying to find the best plan by verbal forms or written sentences as explanatory illustrations or sentences.

R : After your work is over, will you evaluate your reply process again?

F : Just for the case of measurement only.

Besides, I'm not sure to do it.

(Note: R= Research; F= Female; $\sqrt{}$ = doing well $\times$ = not doing well)

Based on the data obtained from the mathematical representation test results and interviews it was found that the mathematical representation of male and female students is not much different. Both are not successful in using step polya in solving problem cases related to improper fraction items and reconstructing the unit from improper fractions items

The results of the analysis were supported by previous researchers Halpern [7] who stated that in general women remember better than men, whereas in logical thinking men are better than women. In general, male students are the same as female students, but male students have better abstraction power than female student [3].

4. Conclusion

a) Results Table 1 and interview 1 showed that the mathematical representation of male junior high school students in solving fractions is by presenting the data provided using symbol manipulation and given verbal information with written words or sentences.

b) Results Table 2 and interview 2 showed that the mathematical representation of female junior high school students in solving fraction questions uses more verbal forms or written sentences as explanatory illustrations or sentences.

In general, the mathematical representation of male and female middle school students in solving fractions using Polya's theory is not much different, but male students have better abstraction power than female students.

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