Proceeding ICMETA: Volume 1/2017, June 27th 2017 ISBN 978-602-397058-2

Seventh Grade Students' Performance in Dealing with Multiplication of Fractions

[1]Veronika Fitri Rianasari, [2]Hongki Julie
[1,2]Sanata Dharma University, Yogyakarta, Indonesia

[1]veronikafitri@usd.ac.id, [2]hongki_julie@usd.ac.id

Abstract. The aim of this study was to investigate the seventh graders' performance when they solve fractions problems formulated in the contexts of the multiplication calculations, area model, and words problems. This descriptive study was conducted with 44 seventh grade students in Pangudi Luhur Junior High School in Yogyakarta, Indonesia. Data were collected during teaching and learning fractions in the first semester in 2016. Findings showed that the students' performance was high on the computation in multiplying fractions and low on solving words problems and drawing area model to illustrate fraction multiplication.

1. Introduction

Fraction concepts are among the most complex and important ideas for children, the importance can be seen from a practical perspective, fraction understanding improves one's ability to understand and handle situations and problems in the real world [2]. However, many students get difficulty in dealing with fractions and the difficulty might be caused by different interpretations for fraction. The concept of fractions can be interpreted as 1) a part-whole comparison, 2) a measure, 3) an operator, 4) a quotient, and 5) a ratio [1].

There are two different approaches to understanding: instrumental and relational understanding [4]. By having instrumental understanding, students know a mathematical rule and they are able to use and manipulate it. By having relational understanding, students know how to use a mathematical rule and know why it works.

In multiplying fractions, many students are able to use procedural rules for carrying out operations, such as $\frac{3}{4} \times \frac{1}{2}$, but they cannot explain the meaning of multiplying two fractions. Many conventional teaching fractions tend to focus on computation and lack of experiences to promote students 'understanding of the meanings of fractions and operations. Focusing the learning attention on procedural algorithm of fractions has some disadvantages. Memorizing rules do not help students to think about the meaning of operations, students' skill in carrying out those operations is quickly lost, and therefore they get difficulty in solving word problems [2].

Although there are various studies on fractions teaching and learning, studies on fractions multiplication in Indonesia are very rare. Therefore, this study aims to investigate the seventh graders' performance when they solve multiplication of fractions problems.

2. Literature Review

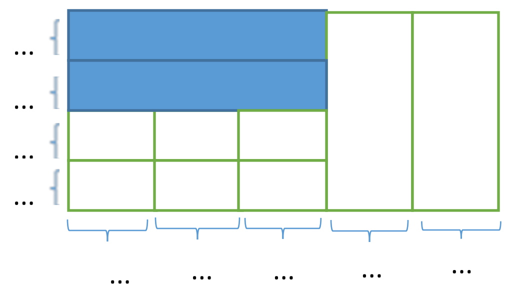
Meanings for multiplication of fractions

The common meaning for multiplication is repeated addition, such as $2 \times 3 = 3 + 3$**.** In this interpretation, one factor play the role as the operator, because it represent the number of times a quantity must be added, so that it is must be a whole number. Therefore this interpretation cannot be extended to the rational numbers [5]. For example, if 2×3 means $3 + 3$, then it is difficult to interpret what $2\frac{1}{2} \times 3$ means. Webel & DeLeeuw explain that fraction multiplication can be interpreted as "part of a part", a conception where one fraction play the role as an operator, specifying a fractional part of the other fraction, the operand [6]. For example, $\frac{2}{3} \times \frac{1}{4}$ means to partition $\frac{1}{4}$ into 3 parts and iterate the result 2 times. Moreover, fraction multiplication can be interpreted the measure of a rectangular area, that is so many units long and so many units wide [6].

3. Methods

This study was a descriptive study investigating the seventh graders' performance when they solve fractions problems formulated in the contexts of the multiplication calculations and words problems. This study was conducted with 44 seventh in Pangudi Luhur Junior High School in Yogyakarta, Indonesia. Data were collected after completion of the fractions lesson and the students were administered a written test. The test consisted of 4 questions and the following are the questions:

1) Find the product of $\frac{2}{3} \times \frac{4}{6}$!
2) Find the value of the shaded area below!



3) Draw a model to show $\frac{2}{3}$ of $\frac{3}{4}$ and determine the product!
4) A tub can accommodate 27 liters of water. However, the tub is only filled two third of the maximum capacity. Dad want to pour some water from bucket with the volume is $\frac{1}{9}$ of the tub's volume.
   a. How many liters of water that is already filled in the container?
   b. How many buckets need to be poured into the container so that the tub filled up with water?

   (The problem 4b is not discussed in this article.)

From the written test, students' understanding of fraction multiplication were examined. Descriptive statistics were used to determine students' understanding of fraction multiplication. Students who wrote inappropriate solutions were probed.

4. Findings

4.1. Findings of Students' Performance in Computation of Fraction Multiplication

From students' answer, it can be seen that 80% of 44 students could give the correct answer, 16% could not give the correct answer, and 5% could not able to give any answer. There are two types of strategy used by the students who could not give the correct answer. The first strategy is shown in Figure 1, the students found the common denominator for the fractions, $\frac{2}{3}$ and $\frac{4}{6}$, and then the students multiplied the numerators. From this incorrect strategy, it is clear to see that the students used the strategy in fraction addition, creating a common denominator for the fractions, to find the product of fraction multiplication.

Proceeding ICMETA: Volume 1/2017, June 27th 2017 ISBN 978-602-397058-2

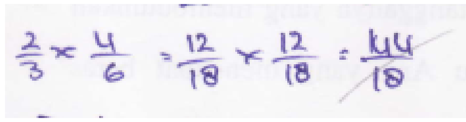


Figure 1

The second strategy is shown in Figure 2, the students multiplied the numerator of the first fraction with the denominator of the second fraction and the result became the numerator of the product. Then, the students multiplied the denominator of the second fraction with the numerator of the second fraction and the result became the numerator of the product. From this incorrect strategy, it shows that the students used cross-multiplication, a common strategy to work with fraction division, in order to solve fraction multiplication.

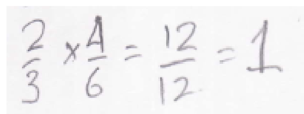


Figure 2

4.2. Findings of Students' Performance in Determining Fraction Multiplication from A Rectangular Area Model

From students' answer, it can be seen that 43% of the students could give the correct answer, 50% could not give the correct answer, and 7% could not able to give any answer. Many students actually were able to determine the fraction from the shaded area model, however they got difficulty in determining the fraction multiplication (see Figure 3).

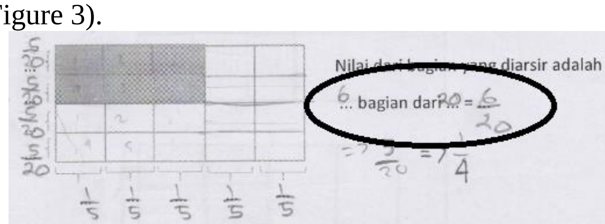


Figure 3

The student's answer shown in Figure 3 shows that the student understood the meaning of fraction as a part-whole relationship.

4.3. Findings of Students' Performance in Modelling Fraction Multiplication

From students' answer, it can be seen that 60% of the students could give the correct answer, 27% could not give the correct answer, and 13% could not able to give any answer. The correct answers given by the students is shown in Figure 4 and Figure 5.

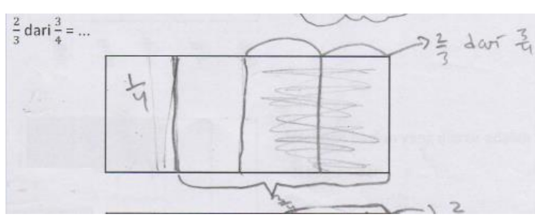


Figure 4

Proceeding ICMETA: Volume 1/2017, June 27th 2017 ISBN 978-602-397058-2

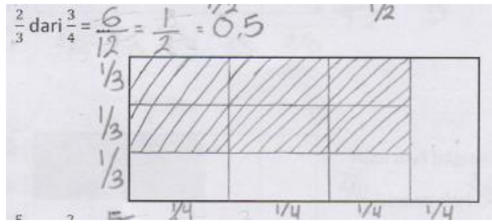


Figure 5

Figure 4 and 5 indicate that the students were able to determine $\frac{3}{4}$ of a rectangle area, that is a rectangle with the length is $\frac{3}{4}$ of the first rectangle's length and the width is the same as the first rectangle's width. Moreover as it is shown in Figure 4, the students drew $\frac{2}{3}$ of $\frac{3}{4}$ as a rectangle with the length is $\frac{2}{3}$ of $\frac{3}{4}$. The other strategy shown in Figure 5, the students drew $\frac{2}{3}$ of $\frac{3}{4}$ as a rectangle with the width is $\frac{2}{3}$ of the first rectangle's width and the length is $\frac{3}{4}$ of the first rectangle's length.

For the students who could not give the correct answer, they got difficulty in understanding the meaning of '$\frac{2}{3}$ of $\frac{3}{4}$'. Most of them drew a model that represents the fractions $\frac{2}{3}$ of $\frac{1}{4}$ (see Figure 6).

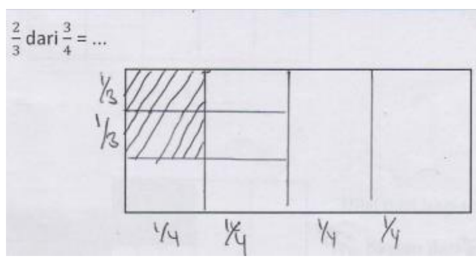


Figure 6

4.4. Findings of Students' Performance in Solving Word Problems

From students' answer, it can be seen that only 45% of 44 students could give correct answer, 48% could not give the correct answer, and 7% could not able to give any answer. There were two common incorrect answers given by the students. First, the students found two third of 27 liters and one ninth of 27 liters and added up the results (see Figure 7). This kind of answer (Figure 7) shows that the students might get difficulties in reading and understanding the language used within a word problem. Moreover, there is a possibility that the students did not able to recognize and image the context in which the word problem is set, although the context chosen in this problem is familiar to the students [3].

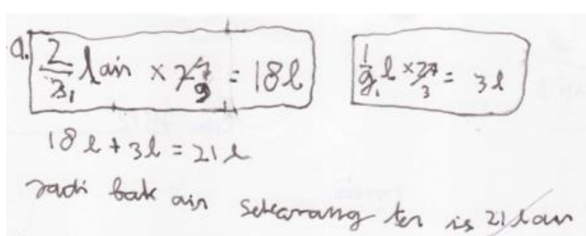
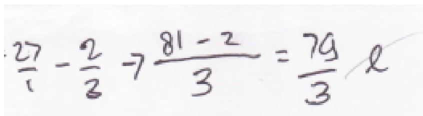


Figure 7

Another strategy is shown in Figure 8, the students did some calculations using the numbers mentioned in the problems. This strategy indicates that the students might get difficulties in understanding the language, imaging the context, and also forming a mathematical sentence from the word problem. As it is shown in Figure 8, the mathematical sentence posed in the students' answer is meaningfulness [3].



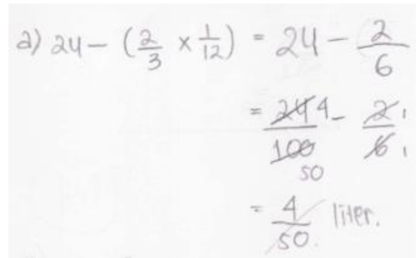


Figure 8

5. Discussion and Conclusion

This findings is consistent with previous studies ([3] and [6]) that have revealed students' low performance in problem solving of fractions.

The result of this study have implications for mathematics teachers and mathematics education researchers. Mathematics teachers and mathematics education researchers should work collaboratively to facilitate students' development of mathematics conceptual knowledge. By having conceptual knowledge, students have integrated mathematical ideas and concepts and this knowledge help them in solving problem. Furthermore, the result also implies that mathematics teaching should emphasis in problem solving skills because it can reinforce mathematical knowledge, enhance logical reasoning, and it encompasses skills which are important in everyday life.

References

[1] Anderson, J., & Wong, M. (2006). Teaching common fractions in primary school: Teachers' Reactions to a New Curriculum. *Proceedings of Australian Association for Research in Education*, 1-13.

[2] Behr, M., Lesh, R., Post, T., & Silver E. (1983). Rational Number Concepts. In R. Lesh & M. Landau (Eds.), Acquisition of Mathematics Concepts and Processes, (pp. 91-125). New York: Academic Press

[3] Gooding, S. (2009). Children's Difficulties with Mathematical Word Problems. *Proceedings of the British Society for Research into Learning Mathematics*, *29*(3), 31-36.

[4] Skemp, R. (1978) . Relational understanding and in strumental understanding. *Arithmetic Teacher*, 26(3), 9-15.

[5] Thompson, P. W., & Saldanha, L. A. (2003). Fractions and multiplicative reasoning. *Research companion to the principles and standards for school mathematics*, 95-113.

[6] Webel, C., & DeLeeuw, W. W. (2016). Meaning for fraction multiplication: Thematic analysis of mathematical talk in three fifth grade classes. *The Journal of Mathematical Behavior*, *41*, 123-140.