

Multiplication of Fraction With Natural Number by Using Hurdles

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Abstract— Students often have a wrong understanding on multiplication of fractions in which they consider multiplication of numbers, the value definitely will always be higher. It underlies the researchers to design the learning of fractional multiplication operations with natural numbers using hurdles context with real problems. The purpose of this study is to find out the role of hurdles in helping the students' understanding on basic concepts of fractional multiplication operations with natural numbers by the approach of Indonesian Realistic Mathematics Education (PMRI). The method used is research design. This study described how this hurdles made a real contribution to the students of the fifth grade, SDN 179 Palembang, Indonesia to understand the concept of multiplication of fractions with natural numbers. The results showed that the context of hurdles can help students to understand their knowledge about the concept of multiplication of fractions with natural numbers. Strategy in answering, the model found by the students, and discussion in front of the classroom have built constructive ideas and contributions to the students so that it can be used as an initial knowledge of understanding their concept, namely the concept of multiplying fractions with natural numbers. Students' learning process is essential in understanding the multiplication of fractions with natural numbers from informal stage to the formal stage.

Keywords—Design research, Fraction, Hurdles, PMRI

I. INTRODUCTION

One of the basic topics of mathematics is a fraction. Reference [1], the fraction is a difficult topic for students. Reference [2] students get wrong about understanding of multiplication of fractions, they consider if the multiplication of numbers, it definitely will always be higher. Reference [3] state that the difficulties of learning the multiplication of fractions, because they do it in accordance with the rules without understanding.

Students do not understand about conceptual and calculation of fractions becoming a rule without any logic. Therefore, this study uses the approach PMRI (Pendidikan Matematika Realistik Indonesia) or RME (Realistic Mathematics Education). Reference [4] the basic concept PMRI taken out of context that have been identified using a model student and daily life close to the students.

Based on [5] PMRI is an approach in teaching mathematics that is adapted from of Realistic Mathematics Education (RME) approach. Multiplication of fractions with natural numbers is the first indicator on learning plan in fractional multiplication arithmetic operation. Students should understand the concept well in the initial indicators in order to be a bridge to understanding the next level indicator. In finding the concept, it can be implemented in a context. In Reference [1], fraction can be presented by measurements.

This study uses the contextual situation of activities to support students' learning. Using a number line is a long measurement model can be more appropriate than the other tool from [6]. This activity according to Bay-Williams, Martinie (2003) it is a fun way to use a real-world context to engage students in thinking about fractions through the linear model [7]. Context of athletics hurdles which is an Asian Games sport is used as the starting point used as a helpful media to solve the problems associated with fractional multiplication operations with natural numbers.

Asian Games is a multi sports activity participated by Asian countries which will be held in Palembang and Jakarta in 2018 as the host and this would be an interesting thing in order that students are interested in learning mathematics and it becomes a general knowledge of students, which is one of the characteristics of PMRI. Reference [8] describes three principles of PMRI in accordance to the principles of RME, namely guided reinvention and didactical phenomenology, progressive mathematization, self-developed models. This principle can be formed by the interaction of a good student. Reference [9] there are three aspects that are important in the learning process according to the social constructivist perspective, namely, social norms, norms of social mathematics. It is important to establish a good interaction, interaction is one of the principles of PMRI. In this paper, we present three activities that are conducted in a second cycle of an explanatory teaching experiment in learning multiplication of fraction with natural number using hurdles. In this activity, students work on multiplication of fraction with natural number using hurdles. The purpose of this paper is to explore how the hurdles activity helps and gives contribution to learning multiplication of fraction with natural number.

II. METHOD

This study uses a design research which is an appropriate way to answer questions of researchers and achieve the objectives of the study. Reference [10] design research is the systematic study in designing and evaluating educational intervention as a solution to solve complex problems in educational practice and to enhance knowledge of the characteristics of intervention, design and development. This study consists of three phases which are done repeatedly until it discovers a new theory as a revision result of the learning theory which is tested

This research uses PMRI (Pendidikan Matematika Realistik Indonesia) approach. PMRI is a learning which starts from the 'real' things or students' experience, emphasizing the skills process of 'doing mathematics', discussing and collaborating, arguing with classmates so that they can find an invention as opposed to teacher's explanation and ultimately use mathematics to solve the problems either individually or in groups [11].

Reference [12] states that research design is given in anticipation of a thought experiment to imagine learning activities designed in the classroom, and what students can get from learning, because they participate in it.

Reference [13] states that a research design consists of preparing for the experiment / preliminary design. This phase is meant to review literatures, that is to discuss the whole materials. The materials cover the multiplication of fractions with natural numbers, analysis of curriculum in materials, and approaches of PMRI. Then the researchers design the Hypothetical Learning Trajectory (HLT) as a sequence of materials of learning multiplication of fractions by natural numbers using context hurdles with PMRI approach. At this stage HLT researchers examine the first small groups of the fifth graders of SD N 179 Palembang consisting of 6 students with different abilities. There are two students with high ability; two students with middle ability and two students with low ability.

During the lesson, the students are divided into 2 groups, each of which consists of 3 students with different abilities. The observation along with the analysis of anything happened during the Preliminary Teaching Experiment has been conducted. The evaluation on the learning activities is conjectured based on the research findings to improve HLT.

Reference [9] state that the context is a main point for students in developing mathematics and the context it self should be meaningful for them and real for their' mind. Hurdles is chosen because it represents a fraction, in which one track consists of 10 jumps with the same size. So that the students can estimate the fraction later and present to the form of multiplication by leaps and distance traveled by the running participants. In addition, a running hurdle is one sport that will be included in the 2018 Asian Games in Palembang; it can attract the students' attention to do any activity designed.

Furthermore, the role of context to face the hurdles will be more visible when the students are given a problem about the number of jumps in running that have been taken from the overall distance by the runners. So the use of hurdles in the

context of this study is to help the students to multiply fractions by natural numbers.

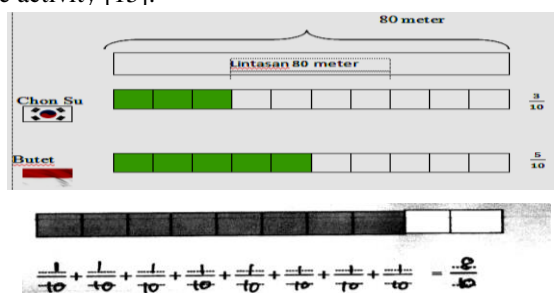
According to Freudenthal in [14], students are given the opportunity to build and develop their ideas and thoughts when constructing mathematics. Teachers can select appropriate learning activities as a basis to stimulate students to think and act when constructing mathematics.

The second phase in the research design is the experimental design, conducting teaching experiments, where the HLT that has been designed and tested in pilot experiments and then revised, retested to the class as the subject of research, namely: class V SDN 179 Palembang consisting of 22 pupils.

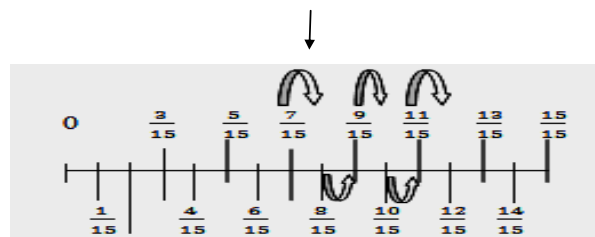
The teacher of the class, as the model teacher and researcher, observe the learning activities. The third phase is a retrospective analysis. The aim of the retrospective analysis generally is to develop the Local Instructional Theory (LIT). At this phase, HLT is compared to the actual student learning, the results are used to answer the problem formulation. All data obtained in the second phase are analyzed to design and develop the activities in the future learning. Here is HLT that has been designed by the researchers.

Data are collected in three meetings of 210 minutes of lesson. According to Van Nes, Van Eerde before conducting the learning activity, researcher discusses the activity with teacher in preparing the lesson. The role of researcher in the learning activity is to stand in the classroom, to ask the students some additional questions, to observe the learning activities, to coordinate the activities, and to make last-minute change to the necessary activity for providing relevant information.

The learning activity is recorded by two video recorders. One video recorder captures the whole classroom activity, and the other focuses on the target group. The video is segmented into clips based on sequences of observed interactions, negotiations and activities relating to each didactical episode in the activity [15].



Student can understand the concept multiplication fraction through problem hurdles activity



Multiplication fraction with natural number by using jumping on the Number line of fractions

$$\frac{1}{9} \times 5 = \frac{5}{9}$$
$$\frac{3}{10} \times 3 = \frac{9}{10}$$

Student solve the problems by the multiplication of fraction with the natural number

Fig. 1. Hypotetical Learning Trajectory

During the learning activities, we also make some notes based on some important moments. All the students' works are cross-interpreted to avoid subjectivity in interpretation. Together with the teacher, we discuss on the reason of the students' visualization. To gain more insight on the students' visualization and interpretation, researcher conducts unstructured interview with some students. Reference [16], the interview is also aimed to clarify students' thinking and interpretation.

III. RESULT AND DISCUSSION

Based on the research result, the students are able to understand the concept of multiplication of fraction with natural number from several activities. They can understand the concept multiplication of fraction through problem of hurdles activity, Through Introducing repeated addition by using jumping on the number line of fractions, they solve the problems by the multiplication of fraction with the natural number. Furthermore, the result and discussion can be described as follows.

From activity 1, it can be seen that the students can understand the concept of fraction multiplication through the problem of hurdles activity. It has been done on the teaching experiment stage for solving the existing problems based on the context. In this activity, the students patch an origami paper on the terraced paper. Then, they write down the value of fractions and sum up bracket value one by one. The results of the students' answers can be seen in the picture below.

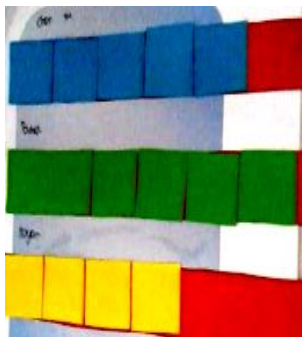


Fig. 2. One of the Students' Answers on the Activity Make a Track from Story of Hurdles Race

Kotak yang berwarna coklat adalah lompatan gawang yang telah dilalui jika dijumlahkan, berapa nilainya pecahan yang dihasilkan?

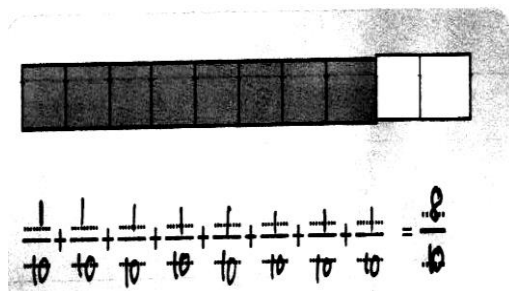


Fig. 3. One of the Students' Answer

From Fig.2, the students create a track using the terraced paper and patch origami paper there on by story of hurdles race. Furthermore, the students link with fractional value. In Fig.3, to determine the concept of multiplication, the students can add up the value of the fractions. Then, the activity 1 is to write conclusions about the relationship between multiplications with addition. The results of the students' answers can be seen in the picture below.

Bisakah kamu menyimpulkan, hasil dari jawabanmu di atas, Adakah hubungan yang dapat kalian lihat dari pertanyaan ke empat dan ke lima? Apa alasanmu?

ada, karena perbandingan sama dengan perbandingan
tambahan yang ditambahkan secara berurutan
dengan bilangan yang sama

Fig. 4. The students' answer of the concept multiplication

From the above figure, the students can write the conclusion between multiplications with addition of simple fractions. At the time of conducting the activities, the students are not told about the concept of multiplication. One of the new students realize it after they completed this activity.

After understanding the relationship between multiplication and addition, the next activity is designed to Introduce multiplication of fraction with natural number by using jumping on the number line of fractions.

On the second activity, students were given the story of hurdles by using the number line. Then, they were asked to describe the leap that has been passed by runners on the number line. The idea of researcher is: students were directed to create a model of the fractional multiplication with their own. After that, the students completed the multiplication of fractions by natural numbers.



Fig. 5. The students' answers on the activity making the leap of the run on the number line

Dialog in answering the first question on the second activity

Observer : then what does the story talk about?

Students : Raja stopped on the $\frac{1}{2}$ leap's track because of thirst

Observer : which one is the number line that indicates $\frac{1}{2}$?
That half is equal to?

Students : $\frac{2}{4}$

Observer : then, what is here?

Students : $\frac{4}{8}$

Jika Raja telah berlari pada jarak $\frac{1}{2}$ lintasan, berapa meterkah, jarak yang telah ditempuh Raja?

$$\frac{1}{2} \times 8 = \frac{8 \cdot 2}{2 \cdot 2} = \frac{4}{1} = 4 \text{ m}$$

Fig. 6. The students' answers getting by multiplication of fraction with natural number

Jika Raja telah berlari pada jarak $\frac{1}{2}$ lintasan, berapa meterkah, jarak yang telah ditempuh Raja?

$$\frac{1}{2} = \frac{4}{8} = 4 \text{ meter.}$$

$$\text{Jarak seluruhnya} = 8 \text{ meter.}$$

$$8 : 2 = 4 \text{ meter.}$$

Fig. 7. The students' answers getting by equalizing fractional value and comparing

In Fig.5, students were asked to draw a jump runner position on the number line. It can be seen that students were able to describe the position of the runner. Furthermore, students were asked to solve the problem about measuring the distance which has been through by the runners on the halftrack, the researcher found several students to answer questions with the idea that is made by the students themselves and the students answered correctly.

In Fig.6, the way students in getting answer that is by multiplying directly the halftrack with the natural number that is the value of the overall trajectory is 8 m, producing 4 m, while in the fig.7, the way of the students in getting answer by equalizing fractional value and comparing it with the number line, and then the students could compare the overall distance to halftrack, students got an idea in dividing into from the overall distance so that it got 4 m.

The next students' activity is completing multiplication of fractions by natural numbers, on this activity the students solved existing problems in the student worksheet using multiplication fractions by natural numbers, students were asked to calculate the time that has been taken by runners per wicket and calculate distance that has been through by each runner, this is students' answers.

$$\frac{1}{10} \times 5 = \frac{5 \cdot 5}{10 \cdot 5} = \frac{1}{2} = 0,5 \text{ menit} =$$

30 detik, karena 10 orang saja 5 menit

Fig. 8. The Students' Answers on Activity Calculate The Time of Hurdles Runner

a. India = $\frac{5}{10} \times 10 = \frac{50}{10} = \frac{5}{1} = 5 \text{ km}$

b. Indonesia = $\frac{8}{10} \times 10 = \frac{80}{10} = \frac{8}{1} = 8 \text{ km}$

c. Korea = $\frac{6}{10} \times 10 = \frac{60}{10} = \frac{6}{1} = 6 \text{ km}$

Fig. 9. The Students' Answers on Activity to Calculate The Distance of Hurdles Runner

From Fig.8, students get answers to 30 seconds for each one leap wicket by multiplying the fractional value of the leap with the overall time, in Fig.9, students get the answer by multiplying the fractional value leaps that have been passed runner by multiplying the overall distance. Hurdles can help students on multiplication fractions material by natural numbers. Student difficult to solve the multiplication fraction due to the low understand about the materials. Multiplication of fraction can be solved using the part-whole relation concept [17], [3] such as using the hurdles.

IV. CONCLUSION

Based on the results and discussion that has been described previously, it can be concluded that the role of hurdles can help students on multiplication of fractions material by natural numbers. Here are the things that helped the students are as follows, the first, experience in meaningful and fun learning given, that is the activity of linking sport with math problems and patching an origami paper on the terraced paper to make the run's tracks can help students to link by finding the concept of addition and multiplication of fractions and the second, the process illustrating the number line and runner's leap can help students to equate the value of a fraction.

Thus, this study is one of a positive contribution to the learning multiplication of fractions material by natural numbers in the context of hurdles.

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