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Research Article

The Use of Grid 10 x 10 in Learning The Percent

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Abstract

The percent symbol is often used in a variety of media in daily life. Students have difficulty in solving the problems dealing with percentage, even though they know little about percent. Therefore, this research was aimed to obtain learning trajectory percentage using grid 10 x 10 by Pendidikan Matematika Realistik Indonesia (PMRI) approach and find out the role of grid 10 x 10 in helping students to comprehend the percentage problem. The method of this study was design research type validation studies which were aimed to prove the learning theories. Research design consisted of three phases, those are preliminary, experiment design, and retrospective analysis. This research was conducted in SD negeri 3 OKU by involving fifth grade students. The data of this research was collected by using video, documentation, pre-test, the students' activity sheets, post-test, and interview. The data were analyzed qualitatively. The result of this research showed that the learning trajectory which was designed consists of three activities which every activity is divided into two and grid 10 x 10 has a role in percentage learning.

Keywords: *Percent, Percentage, Grid 10 x 10, PMRI*

1. Introduction

The word 'percentage' is very familiar to us as it is used regularly in the media to describe anything from changes in the interest rate, to the number of people taking holidays abroad, to the success rate of the latest medical procedures or exam results. Percentages are useful way of making comparisons, apart from being used to calculate the many taxes that we pay such as VAT, income tax, domestic fuel tax and insurance tax, to name but a few (Mathcentre, 2009).

Learning percent starting from primary school level. in Indonesia, percent began to be studied in the fifth grade. However Van Galen and Van Eerde (2013) stated that at the end of primary school all children more of less know what a percentage is, but yet they often struggle with percentage problems. According to Van den Heuvel-Panhuizen (2003), to make students understand about percentage, began with the introduction where students are faced with the daily life stories in which the percentage has a role. This is stated by De Corte et al (2005), to initiate the teaching of percentages, the teacher can use a lot of everyday situations that are intelligible for students. Moreover, in percentage learning is also needed props and model. Sobel and Maletsky (2004) state that the concrete props, experience manipulates related to the percents often clarify and strengthen the concept, which for most students really seem abstract. According to Fobringer and Fuchs (2014) using a variety of types of representations to model a single concept deepens students' conceptual understanding. One of the models which is used as representation percent is grid 10 x 10 or grid 100-square (Fobringer &

Fuchs, 2014; Walle, 2008). PMRI or Pendidikan Matematika Realistik Indonesia is an adaptation of Realistic Mathematics Education (RME) where mathematics learning is a human activity and mathematics must be related significantly to the context of students' daily life as a source of development and as an area of application through mathematical processes both horizontally and vertically (Zulkardi, 2002). Mathematics learning approach that starts on something real is the purpose of the *Pendidikan Matematika Realistik Indonesia* (PMRI) approach (Zulkardi & Putri, 2006).

Based on the illustration above, the researcher designs the learning percentage using grid 10 x 10 by PMRI approach for the fifth grade students. Then, it is designed by using Hypothetical Learning Trajectory (HLT) which contains a series of activities to help students understand percentages.

The purpose of this research is to obtain the learning trajectory in percentage learning using grid 10 x 10 by PMRI approach and to determine the role of grid 10 x 10 in percentages learning.

2. Literature Review

2.1 Pendidikan Matematika Realistik Indonesia (PMRI)

Realistic Mathematics Education (RME) is a learning theory which is developed in 1971 by Hans Freudenthal in Netherland (Hadi, 2005). Realistic Mathematics Education (RME) is adapted in Indonesia named *Pendidikan Matematika Realistik Indonesia* (PMRI). Realistic Mathematics Education is a learning theory developed specifically by mathematics. RME is rooted in theoretical view of Freudenthal that mathematics as a human activity (Gravemeijer, 1994).

Gravemeijer (1994) states that there are three important principles and five characteristic in the RME approach. PMRI learning principles are in accordance with the principles of RME. Those principles are as follows:

a. Guided reinvention and Progressive mathematization
   This principle emphasizes the rediscovery through certain topics presented, the students in learning mathematics should be given the opportunity to experience themselves about the same process when mathematical concepts are found.
b. Didactical phenomenology
   This principle emphasizes the phenomenon of didactic learning and emphasizes the importance of contextual issues for introducing mathematical topics to students.
c. Self-developed models
   The role of self-developed models is a bridge for students from the real situation to the concrete situation or from informal mathematics to formal mathematics. This means that students create their own models to solve problems.

As for the five characteristics of PMRI approach is as follows: (1) use of context, by using the context, in addition to the student can be involved actively to explore issues (de Lange, 1987) but also can motivate and interest students in learning math and reduce math anxiety (Wijaya, 2012). (2) use of model, The model is directed at increasing concrete models to abstract or model of the real situation on toward the abstract. (3) student contribution, Construction is expected from the students themselves who bridge them from informal methods toward more formal. (4) interactivity, In the learning process, students discuss to resolve the problem. In the discussion, the students interact with other students or with teachers. (5) intertwining, topics of study can be linked and integrated to bring an understanding of a concept or an integrated operation.

In the process of learning, PMRI have learning standards as follows (Putri, 2011):

1. Learning new material, starting with realistic problems so that students can think and work
2. Learning gives students the chance to explore issues and exchange opinions given teachers so that students can learn from each other and improve the understanding of the concept
3. Learning should associate various mathematical concepts to make learning more efficient and provide the opportunity for students to learn mathematics as a whole (concepts in mathematics are interrelated)
4. Learning ends with the confirmation process to conclude a mathematical concept that has been studied and followed by exercises to strengthen the understanding.

2.2 Percent

Percent is a ratio which is stated by a fraction whose denominator is equal to 100 (Sessu, 2014; Bird, J., 2002). Percent is signed by %. The percentage sign means "out of 100". It comes from the "out of" symbol (/) and the two zeros from 100 (Numeracy Professional Development Projects, 2008). For example, 25 percent means 25/100 and written as 25%. The percent problems consist of three amounts. There are three types of the percent problems (McGraw-hill, 2001), those are: 1) find the unknown base in a percent problem, 2) find the unknown rate in a percent problem, 3) find the unknown amount in a percent problem. For example, if a box contains 12 calculators, then the base is 12. If three calculators are placed on the shelves of the store, then 3 is amount. Thus, the percent is 3/12=1/4=25%, that is 25% of the calculator placed on the shelves of the store (Bluman, 2005).

The percentage or the amount can be solved by a basic equation: Percentage = rate x base or p = r x b. To solve the percent problem, Rosenberg, R (1975) argues that before you can add, subtract, multiply, or divide using percents, the percent must be changed to either a decimal or a fraction.

3. Methodology of the Research

The method used was the design research method, the type used was the validation studies type. According to Gravemeijer and Cobb (2006), Design research consists of several stages, namely: (1) Preparing for the experiment/Preliminary Design, (2) Design Experiment, and (3) Retrospective Analysis. Design research is a cyclical process of thought experiment and instruction experiment (Sembiring et al, 2010). That process of cyclic (repeated) is the thought experiment and then to the instruction experiment as shown by the following picture (Gravemeijer and Cobb, 2006):

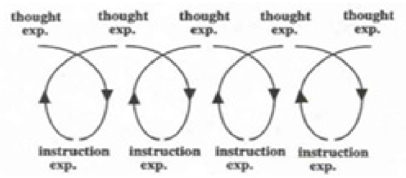

Figure 1. Design Research Cycle

This study involved fifth grade students of SD N 23 OKU with six students in the first cycle and 40 students involved in the second cycle. In the first cycle, the students involved have been selected based on their level of academic ability in mathematics. Data were obtained from video, documentation, activity sheets, pre-test, post-test, and interview. Then the data were analyzed qualitatively.

4. Result and Discussion

This learning was designed to produce learning trajectory using grid 10 x 10 by PMRI approach to help students understand percentages and find out the role of grid 10 x10 in percentages learning. We will discuss the results of experimental learning in the second cycle involving 40 students.

4.1 Activity 1: 1.1 Changing simple fraction to the percent form and 1.2 changing percent form to the simple fraction

Learning was started from preliminary activities which were done by teacher. Teacher did apperception by providing some questions for students to explore the prerequisite knowledge of students before starting the percent materials learning. The questions given were about the common fraction and the examples of fractional problems. Next, the teacher asked the students to pay attention to the video concerning to percent which was shown in front of the class. After watching a video about percent, the teacher asked more to the students about the place or the media which often use the percent symbol other than those contained in the video. Then, teacher presented the objectives of learning and the learning will be conducted by a group discussion.

Each group started the discussion by reading the problems in the activity of 1.1. Problems are given, namely: "how many percent of students who attend the class? (Known as the total of seats in class: 25, an empty seat / students who are absent: 3, the seats were filled / students who attended: 22)". Students wrote the seats which were filled in the form of fractions. Then, the students divided square on an activity sheets 1 as much as 25 boxes and shaded 22 parts on the square (as many as seats are filled).

Students stuck plastic on that has been made into grid 10 x 10 on a square that has been shaded. This activity aimed to enable students to know how to change the form of simple fraction to the form of percent to find numbers multiplier for the numerator and denominator. Students got multiplier number is four.

Figure 2. Students used plastic in the form of grid 10 x 10

1. *Observer: "how can you get 4?"*
2. *Students a: "it is shaded…"*
3. *Observer: "it is shaded? Why 4?"*
4. *Student a: (stuck the grid plastic on to the square) "because in this 1 box, there are 4 boxes which were filled on this grid."*
5. *Observer: "oo..the contents are 4 boxes?*
6. *Student a: "mmmm…"*
7. *Observer: "then about 88, where did you get?*
8. *Student a: "many grids which were shaded"*

Conversation 1

Based on the conversation 1, students could follow the steps on the activity sheet properly. By examining each part of square filled by the grid box, students could determine the multiplier numbers and conclude that to change a simple fraction to the form of percent, the numerator and denominator are multiplied by the same number. In this activity, students did not have difficulty in doing all steps given. However, when drawing conclusions, students could not write the conclusion. Students just rewrote the settlement of the problem.

On the activity 1.2, the problem given to the students was to determine a lot of extra water needed to mix the paint after it is given the mixing paint rules. Known as the required water is as much as 10% of the paint used. Students were asked to determine the boundaries of the water on a tube's picture which has the same size as the picture of tube of paint. The aim of this activity is to make students can change the form of percent to the form of simple fraction.

Activity which was done by students after reading problems was to follow the steps given in the activity sheet 1, that is shading the grid as much as 10%. Then, the students were asked to group parts which were not shaded as much as the shaded part and calculate many groups of grid formed. After counting, students could determine the number of groups that have been shaded was 1/10.

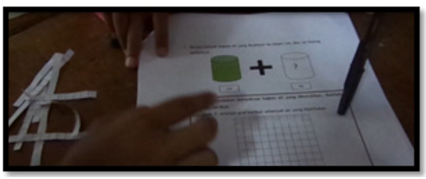

Figure 3. Students divided the grid on the activity 1.2

1. *Observer : "where did you get from 1/10?"*
2. *Student a : "this (grid) is shaded 10 boxes"*
3. *Observer : "yes, then?"*
4. *Student b : "we cut this part (while pointing toward the grid paper), getting 10 groups"*
5. *Observer : "and then?"*
6. *Student b : "Only 1 group which was shaded"*
7. *Student a : "become 1/10"*

Conversation 2

Students divided the picture of tube that represented cans for water container into 10 parts by creating a line. After finish outlining, students shaded 1 part on the picture of tube which showed the limits of wate to mix the paint. Here are the answers of the students:

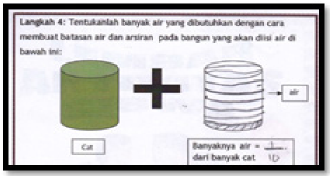

Figure 4. The answers of the students in dividing and shading the picture of the tube.

At the end of the activity 1.2, students made conclusion to change the form of percent to simple fraction. The conclusions from the answers of some of the groups are as follows:

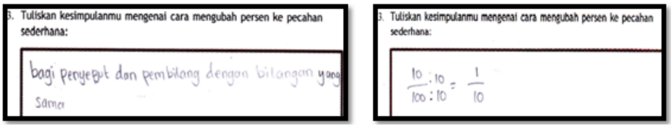

Figure 5. The conclusion of the students on the activity 1.2

Based on the conclusions of the two groups such as figure 5, it can be concluded that the students comprehended about how to change the form of percent to simple fraction. Even though there are some groups, at least two groups have not been able to write the conclusions derived from the activity.

4.2 Activity 2: 2.1 Determine the rate and 2.2 Determine the base

On the activity 2.1, students began the activity by reading problems and writing the necessary description of the problem. Students answered the questions on the activity sheet 2 which guided students to determine the rate. At first, the students observed a lot of grid and the selling price on the problem. Furthermore, the students determined the price for 1% or 1 box grid, here are the following answers given by students:

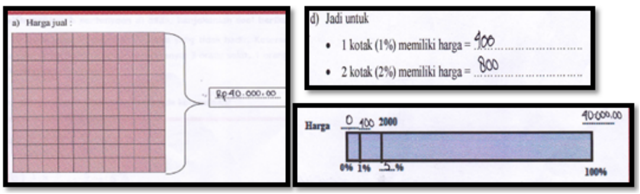

Figure 6. The answers of students determine the rate on the activity 2.1

1. *Teacher : "where did you get from 400?"*
2. *Student a : "from 40.000 divided by 100?"*
3. *Teacher : "what about 800?"*
4. *Student b&c : "400 times 2"*
5. *Teacher : "where is 5% from?"*
6. *Student a : "from 2000 divided 400..it becomes 5"*

Conversation 3

Based on the answers in figure 6 and transcripts 3, it is seen that students can easily determine the price for 1% and determine the rate using bar models. In this activity, it can be said that almost all students understood although there were two groups could not answer correctly.

Activity 2.2 aimed to guide students in determining the base. First, students shaded the grid as much as 15% in order to make students understand the intent of 15%. Then, the students determined the amount for 1% and determined the base using bar models, as follows:

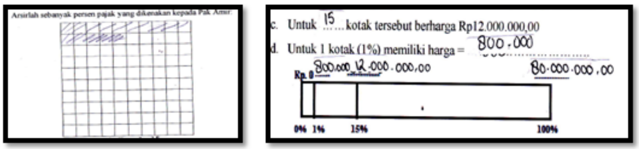

Figure 7. The answers of students determine amount for 1% on the activity 2.2

From Figure 7, it can be seen that students can determine the base by multiplying the amount for 1% by 100. It was also rewritten by the students at the conclusion box at the end of the activity 2.2.

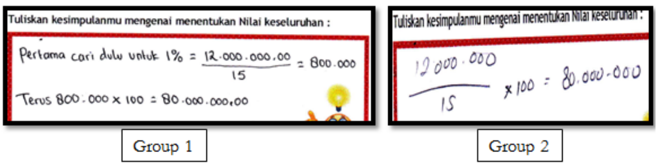

Figure 8. The students' conclusion on the activity 2.2

4.3 Activity 3: 3.1 Determining the amount and 3.2 determine the total amount after the increase in percent

On this activity 3.1, students began to look into the problems. Students shaded the grid as much as 50% and answered the questions sequentially. This activity aimed to lead students to determine the amount for 1 box on the grid in order that students determined the length of time needed to charge the battery as much as 1%.

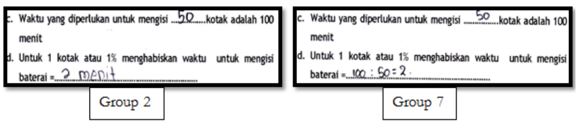

Figure 9. the students' result in determining the amount for 1% on the activity 3.1

Based on the answers of the two groups in Figure 9, it can be seen that students can determine the amount for 1%. Students divided the time by a lot of charged batteries in order to determine the time which is spent to charge 1% of the battery. Furthermore, students used bar models to facilitate students in determining the time required to charge 80% of the battery.

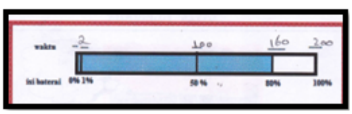

Figure 10. Student used bar model to determine the amount or percentage

At the end of the activity 3,1, students were asked to conclude how to determine the amount and complete one question which has a different theme to the problems given but have the same goal. From some of the conclusions written by students, it can be seen that students wrote the way which was used in the sentences was not in the form of a formula as follows:

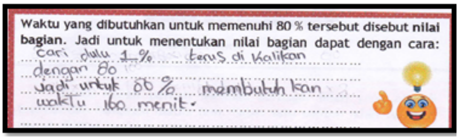

Figure 11. The conclusion of the students on determine the amount or percentage

On the activity 3.2, students were asked to determine a lot of the content on the packaging of the new drink that has got an extra 50% of its original contents, that is 200 ml. At first, students must determine a lot of additions of the drink, as follows:

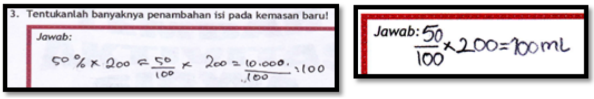

Figure 12. The students' answers in determining a lot of additions

Based on the answers from some groups, it can be seen that students have been able to determine a lot of additions such as determining the amount on the activity 3.1. Group 3 and 4 determined a lot of additions that is multiplying 50% which were changed into fractions by a lot of old packaging contents.

At the end of the activity 3.2, students were asked to givee a conclusion in determining the total amount after an increase in percent. The conclusion of several groups can be seen as follows:

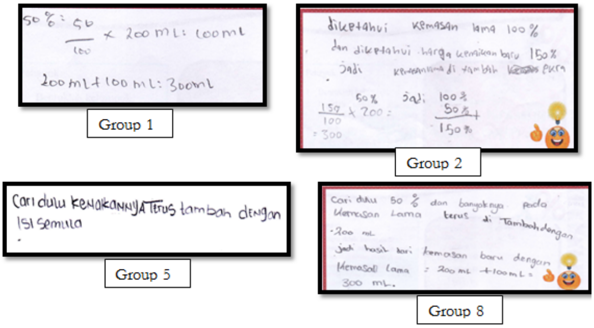

Figure 13. The students' conclusion on the activity 3.2

As Figure 13, it can be seen that students were still not accustomed to write the conclusion. Several groups rewrote the completion that they got at the conclusion box. Group 5 and 8 almost fulfilled the expectations regarding how to determine the total amount after an increase in percent. The strategy of group 2 differed to the other groups, they add up firstly the rate of the beverages, in order to get 150%. Then, 150% multiplied by the original content, that is 200 ml.
Based on the activities that have been described above, it can be seen that grid 10 x 10 can help students in solving problems dealing with percentages. Even though students could not conclude the activity in the form of a formula, but the students can solve the similar problems correctly.

5. Conclusion

Based on the results of research and discussion, it can be concluded that the learning trajectory which was obtained in this study is comprised of three activities with each activity is divided into 2 parts activity. Three of these activities is activity 1.1 students changed the simple fraction to the form of percent, activity 1.2 students changed the form of percent to the simple fraction, activity 2.1 students determined the rate, activity 2.2 students determined the base, activity 3.1 students determined the amount, and activity 3.2 students determined the number of total after an increase in percent. In addition, the results showed that the use of grid 10 x 10 in learning percent materials have a role to help students in comprehening the percentages.

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