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Understanding the concept of percent using the egg rack

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ABSTRACT

This study aimed to produce a learning path that can help students understand the concept of percent using the context of an egg rack. This study used a design research method through the Indonesian Realistic Mathematics Education approach which was carried out at Elementary School No. 2 Gumawang, Indonesia. Data were obtained through observation, photos, video recordings, student activity sheets, and field documentation. The result of the research was a learning trajectory consisting of three activities; first, students explore their knowledge of egg racks which are very close to students' self-life, secondly, students change the problem into a bar form based on students' knowledge of egg racks, then students change the problem into fractions and students change the fraction with the denominator one hundred, third, students solve the percent problem in a more complicated form. The activities that have been produced and tested on percent learning using the context of an egg rack, can help students to better understand the concept of percent.

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1. INTRODUCTION

The concept of percent is material that must be achieved by students, for example solving percent problems related to everyday life [1]. Percent is an important material that is very closely related to everyday life [2] and is valuable in the school curriculum [3]. The percentage is used more broadly in various fields, for example, discounts on sales, bank interest, inflation rates, many statistics in the media use percent, and parking lots offer discounts. The percentage is very important to understand in the financial aspect of everyday life [4]. However, for some people there are still many who do not understand what percent is [5]. This is also experienced by students in elementary schools, the percent material is still an obstacle [6] which makes it difficult for children to solve percent problems even though they know that percent is divided by one hundred [7], [8].

One approach that can overcome these problems is to use the Indonesian realistic mathematics education approach in learning because it can develop students' abilities to think, reason, communicate, and solve problems both in lessons and in everyday life [9]. Indonesian realistic mathematics education can lead students to understand mathematical concepts by constructing their own through prior knowledge related to everyday life such as "real" situations [10]. Learning theory in Indonesian Realistic Mathematics Education is based on real things where the learning process uses context or something that has been experienced by students, emphasizes discussion process skills, and collaborates with classmates so that they can find out on their own and in the end use mathematics to solve problems both individually or in groups [9]. In Indonesian Realistic Mathematics Education based on Realistic Mathematics Educations theory, the context or situation

or real problem in everyday life is the starting point for learning mathematics that plays a role in forming concepts [11], [12].

Percent is a way of representing fractions with a denominator of 100, for example, 15 percent means $\frac{15}{100}$ or written 15%. Problems with percent can be solved using decimal squares [13], and can also be solved using percent bars. To build students' initial knowledge about the percentage of teachers can use the context or situation that is around students as the main characters in the learning process that can provide opportunities for students to explore the context in their way [3], [14]–[16]. One of the real objects that can be used as context in percent learning is an egg rack which is a tangible form of a message bar that is very closely related to students' lives. Through learning activities using an egg rack with a capacity of 10, it is hoped that it can help students understand the concept of percent. Based on the above discussion, this study aims to help students understand the concept of percent by developing a learning trajectory using the context of an egg rack.

2. RESEARCH METHOD

This study uses a design research method of validation studies to develop local instruction theory (LIT) based on existing theories and empirical experiments through collaboration between teachers and researchers [17] with three stages [18]. This research produces a learning trajectory of percent material using the context of an egg rack by developing a hypothetical learning trajectory (HLT) in which there are a series of student learning activities. The three stages of design research are illustrated in the Figure 1.

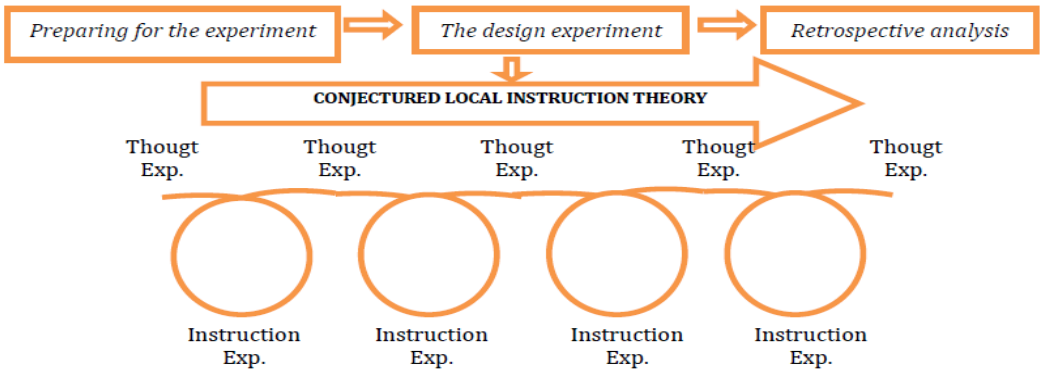

Figure 1. Cyclic design research [17]

2.1. Preparing for the experiment

The first stage is preparing for the experiment, the researcher focuses on the literature review, discussing with the model teacher in designing the hypothetical learning trajectory (HLT) on the percent learning using the egg rack context. HLT is a series of learning activities that contain the assumptions of students' thoughts, strategies, and understandings that develop through a context that contains learning objectives, student learning activities, and conjectures of students' strategies and thoughts during learning [19]. The egg rack was chosen as the context in percent learning because egg racks are often found in students' lives, its advantage is that it can make students more interested and make them more active in understanding concepts because of learning activities while playing which makes learning more meaningful so students do not get bored in its percent learning. If students have understood mathematical concepts correctly, they will be trained and able to develop logical thinking skills so that they can solve problems [20]. The HLT that has been designed can be seen in the Figure 2.

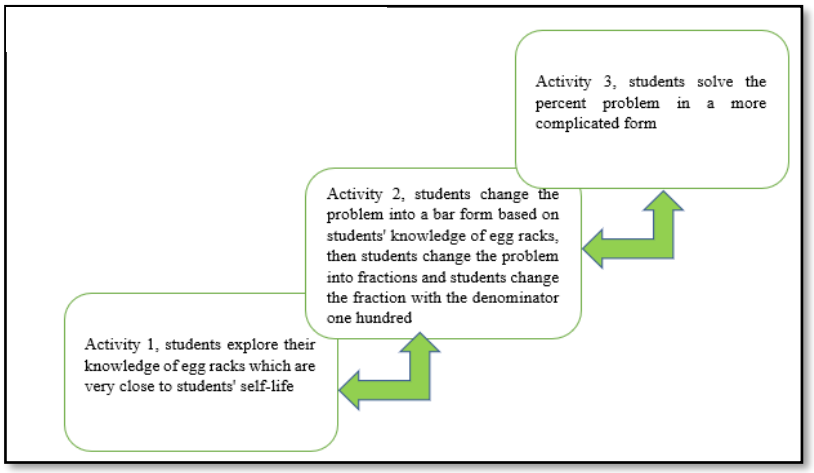

Figure 2. Hypothetical learning trajectory

2.2. The design of experiment

The second stage is the design experiment which consists of a pilot experiment cycle and a teaching experiment cycle. In the pilot experiment cycle, the researcher acts as a teacher to try out the HLT that has been designed for six students who are selected based on ability; two students with low abilities, two students with moderate abilities, and two students with high abilities. Students who are involved in the pilot experiment cycle are students who are not the subject of the teaching experiment cycle. the purpose of the HLT trial in the experimental pilot cycle is to collect data in adjusting and revising the HLT for use in the teaching experiment cycle. In the teaching experiment cycle, the HLT which had been tested and revised in the previous cycle was retested to 30 students of Elementary School No. 2 Gumawang who were the research subjects. In this cycle, the researcher acts as an observer and the class teacher at the elementary school acts as a model teacher.

2.3. Retrospective analysis

The third stage is, the retrospective analysis stage, all data obtained from videos during learning, student photos, interview results, student activity sheets, and student test results were analyzed. The data obtained were analyzed retrospectively with HLT as the guideline, the aim is to develop local instructional theory (LIT) and be able to find out the role of using egg racks as a context to help students understand concepts in percent learning.

3. RESULTS AND DISCUSSION

The teaching experiment was carried out in the fifth grade of Elementary School No. 2 Gumawang, Indonesia with 30 students and mathematics teachers teaching in that class as model teachers. The role of the researcher when carrying out the teaching experiment is as an observer to find out the strategies and creativity of students in solving problems. At the beginning of the activity, the teacher divided students into study groups consisting of six students in each group with high, medium, and low abilities. Before starting the first activity, the teacher reminded again about the fraction material and continued by conveying the learning objectives to be carried out.

3.1. Activity 1: Students explore the knowledge of the context of the egg rack

In the first activity, students were given problems to explore their knowledge of egg racks. From this activity, the researcher hopes that students know and understand that the egg rack is a context in everyday life that can be used as a starting point to understand the concept of percent. Student answers in Figure 3 show that students understand and know eggs and egg racks, and students reveal that eggs and egg racks can be found in markets, supermarkets, and also daily necessities stores.

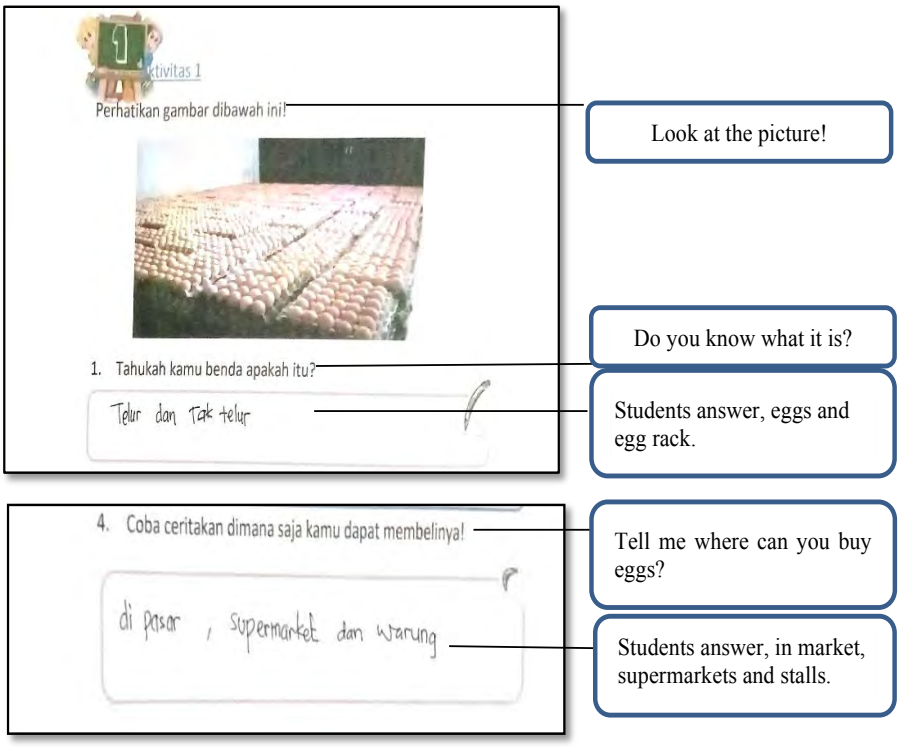

Figure 3. Students know the context of egg racks

3.2. Activity 2: Recognizing the form of percent through the context of the egg rack

The second activity of students was given a percent problem related to daily life, namely comparing the number of eggs they had with 10 egg shelves, to answer this problem with students' understanding of common fractions, then students were asked to change the common fraction to a fraction with a denominator of one hundred. At the end of the second activity, students were asked to conclude the meaning of percent. Figure 4 presents the students' answers in the second activity.

The purpose of the second activity is that students are asked to understand that percent is one hundredth. Based on the results of students' answers in Figure 4, the students' steps are first students make bars consisting of 10 boxes then students shade 4 bars from 10 existing bars, then students explain that 4 is shaded from 10 bars into fractions, namely $\frac{4}{10}$. Next, students are given the problem of how to change the form of the fraction $\frac{4}{10}$ to the denominator of 100, in that problem students answer, first students make 10 bars by assuming each bar is worth 10 and estimating 4 bars from the existing 10 bars to get the conclusion that 4 bars are is estimated at 40 out of 10 bars which is worth 100 and is converted into a fraction of $\frac{40}{100}$. Furthermore, based on the results of these answers, students find that to make $\frac{4}{10}$ into $\frac{40}{100}$ is to multiply the numerator and denominator by the number $\frac{10}{10}$ to get $\frac{40}{100}$. At the end of the activity, students conclude that the percentage is one hundredth [21].

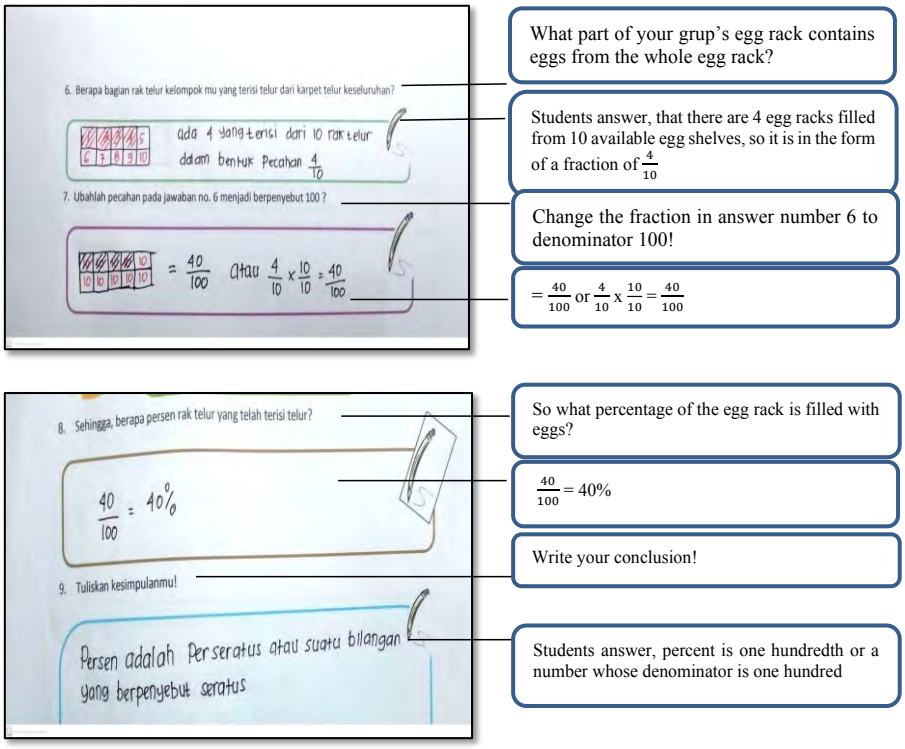

Figure 4. Student answers in activity 2

3.3. Activity 3: Solving the percent problem

In the third activity, students are given more complicated percent problems related to students' real lives. The purpose of the third activity is that students can solve percent problems related to real events that have been experienced by students, to solve these problems students use their experiences when solving problems in the second activity. The problem in this activity, students are asked to determine what percentage of the egg rack is still filled, what percentage of eggs are taken from the number of eggs on the shelf, and students are asked to determine how many eggs are available on the shelf if the shape of the percent is known.

Based on the results of students' answers in Figure 5, shows that students have been able to solve problems correctly. Students can already state that if there are 25 egg racks filled with 25 eggs, it means that the egg racks are 100% filled. Then students are given a problem if the egg rack is 60% filled, students are asked to estimate how many items the shelf is filled with. Students' answers indicate that students can estimate if the egg rack is all filled, it means 100% with 25 eggs, if the rack is filled with 80% it means there are 20 eggs on the egg rack, and if it is filled with 20% then there are five eggs in the egg rack. Egg rack, so based on students' experience in carrying out these activities, students concluded that 60% was obtained from 20%+20%+20%, which means 5 eggs+5 eggs+5 eggs are 15 eggs.

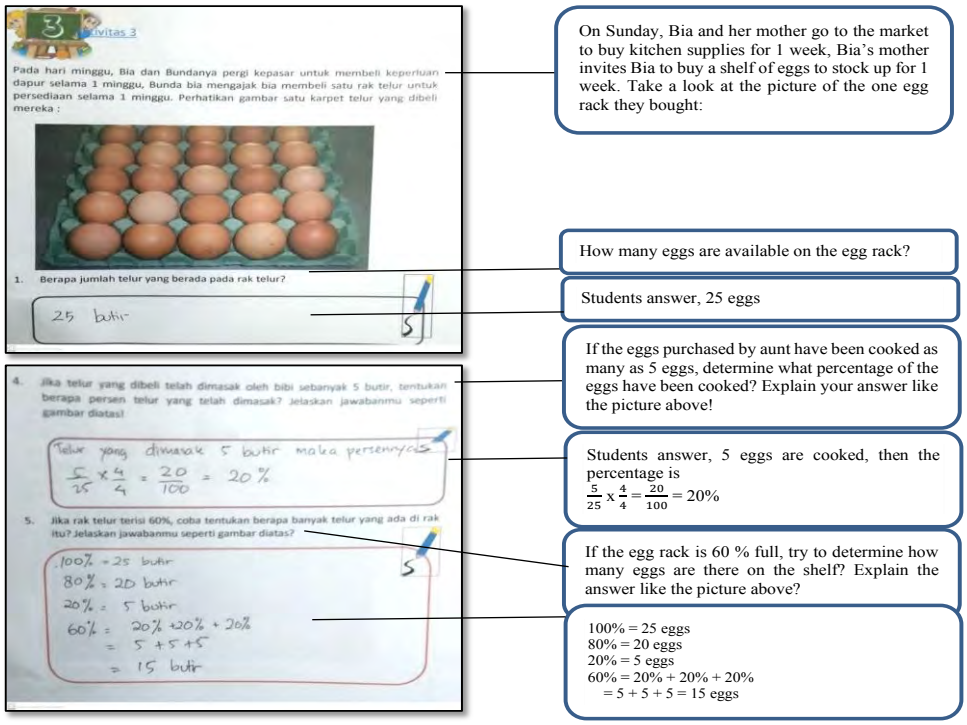

Figure 5. Student answers in activity 3

Based on the results of the study looking at the role of the egg rack context to help students understand the concept of percent that has been designed, the learning trajectory consists of three activities, namely: the first activity of students exploring their knowledge of egg racks; the second activity, students compare the number of toy eggs they have with ten available egg racks so that students can conclude what percent is; In the third activity, students are given more complicated percent problems related to real life. The first activity shows that students explore their initial knowledge through activities to get to know more in the context of an egg shelf, for example, the use of an egg, the benefits of eggs for the body, and where they can buy the eggs. The second activity is a direction towards the formal stage, students are given a problem to compare the number of toy eggs they have with the ten available egg racks then students are directed and guided to present the problem into fractions by changing the egg rack into a bar model, students estimate the fractions which are formed from the bar model and present it in the form of a fraction, then students are guided to change the denominator of the fraction to a denominator of one hundred so that students find that a number with a denominator of one hundred is a percent. This activity shows that the egg rack which is used as a context plays a very important role in helping students understand the concept of percent. Learning to understand the concept of percent carried out by students becomes easier and students are more interested in carrying out learning. It can be concluded that the context related to real life can help students increase interest in learning, students' attention to the material, maintain knowledge, and assist students in solving mathematical problems [22], [23]. In activity 2, students used their knowledge by changing the egg rack to a bar model to make it easier for students to find the concept of percent, this shows that with bars students can estimate the percentage form and can solve percent problems [10]. In activity 3 students were able to solve more complicated percent problems, and students were able to estimate the possibilities that existed to answer and solve problems. This shows that a series of activities that have been carried out by students can bridge students to solve percent problems.

Based on the results of activity 1 and activity 2, it has emerged five characteristics of the Indonesian realistic mathematics education approach adopted from realistic mathematical educations [24], namely: i) The context of the egg rack is the starting point for learning activities which are real situations that are close to students' lives; ii) The use of context is described as a bridge that connects students' knowledge from the informal stage to the formal knowledge stage; iii) Students are free to construct ideas or strategies for solving problems so that they can actively contribute to learning; iv) In the process of learning activities, the occurrence of interactivity between students and teachers in solving problems with various strategies that appear, learning is more meaningful because students communicate their ideas to each other; v) Students are

involved in understanding other mathematical concepts, such as addition, multiplication, subtraction, division, and fractions. Mathematics instructors and researchers must examine more instructional tools and methods to help students obtain a genuine understanding of mathematics [25].

This research has also reflected the three principles of Indonesian realistic mathematics education in the learning process that has been carried out. The three principles are: i) Guided reinvention and progressive mathematizing; ii) Didactical phenomenology; and iii) Self-developed models [9], [26]. Based on the first principle, in the learning process students are allowed to experience the same process when mathematics is discovered through the guidance and direction of the teacher with the use of an egg rack context. The second principle, to find the concept of percent egg rack context is used as a phenomenon in learning percent material. Furthermore, the third principle, the egg rack context acts as a bridge that connects real situations to concrete situations, this can be seen when students solve the percent problem on the student activity sheet, students can find that percent is a fraction with a denominator of one hundred.

4. CONCLUSION

Based on the results of the research and discussion, it was concluded that the learning trajectory consists of three activities, first students explore their knowledge of egg racks which are very close to students' daily lives, second students change the problem to a bar form based on students' knowledge of egg racks, then students change the problem into fractions and students change the fraction with the denominator one hundred, the three students solve the percent problem in a more complicated form, the results show that egg rack context assistance can help students understand the concept of percent and students can solve the problem. The results showed that the context of the egg rack can help students understand the concept of a percent from informal to formal forms. The limitations in this study are that in taking videos, noise is still often heard from outside the classroom because when conducting research, it does not use a special room but uses a classroom that students usually use for learning. Students who are research subjects when conducting teaching experiments are only given post-test questions to be analyzed retrospectively to see the understanding of the students' percent concept and no further statistical tests are carried out. It is recommended for teachers as facilitators and mentors to be able to present mathematics learning that is fun, and meaningful for students, increases interest, and maintains knowledge. In learning the percent material, the learning design can use the Indonesian Realistic Mathematics Education approach by using an egg rack context that is very close to the students' real lives.

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