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Enhancing Conceptual Knowledge about Shape through Realistic Mathematics Education

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Abstract

This study aims to examine whether there is an increased understanding of the concept of shape using Realistic Mathematics Education. This research was conducted in one primary school class II in the academic year 2016/2017. Design Research was chosen as a basis research which included preparation for the experiment, preliminary teaching experiment class which involved 6 students Class IIA to test early Hypothetical Learning Trajectory (HLT), Teaching Experiment class which involved 37 students of Class IIB, and retrospective analysis (data analysis obtained from the previous stage). HLT plays an important role as a research design and instrument. Learning trajectory that has been designed then was compared with the actual student learning in the teaching experiment. The data of the students' understanding of the concept of shape was obtained by using pre-test, observation, interview, student worksheet and post-test as well as data obtained in the learning process. The results of this study found that there was an increased understanding of the concept of the shape which will be elaborated further in the discussion.

Keywords: Design Research, Shape, Realistic Mathematics Eduation, Elementary School

Peningkatan Pengetahuan Konseptual tentang Bangun Datar melalui Pendidikan Matematika Realtistik

Abstrak

Penelitian ini bertujuan untuk melihat apakah tedapat peningkatan pemahaman konsep bangun datar menggunakan Pendidikan Matematika Realistik. Penelitian ini dilakukan di kelas II sekolah dasar pada tahun akademik 2016/2017. Penelitian desain dipilih sebagai basis penelitian yang meliputi persiapan eksperimen, pre-experiment yang melibatkan 6 siswa kelas IIA untuk menguji awal Hypothetical Learning Trajectory (HLT), teaching experiment yang melibatkan 37 siswa Kelas IIB, dan analisis retrospektif (analisis data diperoleh dari tahap sebelumnya). HLT memainkan peran penting sebagai desain dan instrumen penelitian. HLT yang telah dirancang kemudian dibandingkan dengan pembelajaran siswa yang sebenarnya dalam teaching experiment. Data pemahaman siswa tentang konsep bentuk diperoleh dengan menggunakan pre-test, observasi, wawancara, lembar kerja siswa dan post-test serta data yang diperoleh dalam proses pembelajaran. Hasil penelitian ini menemukan bahwa ada peningkatan pemahaman konsep bangun datar yang akan diuraikan lebih lanjut dalam pembahasan.

***Kata kunci**: Penelitian Desain, Bangun Datar, Pendidikan Matematika Realistik, Sekolah Dasar*

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INTRODUCTION

Along with numbers, geometry is one of the oldest disciplines in mathematics, so the development of mathematics cannot be separated from the development of geometry. In Nur'aeni (2010), Usiskin stated that there are three reasons why geometry needs to be taught. First, geometry is the subject that can relate mathematics to the physical form of the real world. Second, geometry allows ideas from other fields of mathematics to be described. Third, geometry can provide a non-singular example of a mathematical system. It is not only geometry can foster the thinking process of students, but also it strongly supports many other topics in mathematics. Therefore, teaching and learning geometry in school becomes very important.

The importance of geometry position is contrary to lack of amount research that focusing on it, especially research related to students learning geometry in early their study. (Halat & Dağli, 2016; Oberdorf & Taylor-Cox, 1999). Moreover, several empirical studies report that there are still many elementary school students are weak in understanding the basic concepts of geometry, for example, many students of grade 2 assumes that the triangle is just a right triangle and a square is rectangle only. This is because students are not given context-based problems.

Simon (1995) stated that tasks or problems planned for learners should not be limited to situations that are appropriate to problem context, or familiar to the learner. Rather, problem contexts that force learners to carry ideas or knowledge beyond the narrow context to novel or unfamiliar situations should be created to challenge the learner's conception. Providing such challenges lead conceptual growth. He suggested observing students' solving mathematics problems and conceptual difficulties in a challenging and rich set of situations. Based on these statements, students should be equipped with situations that make them to think with problems planned for students should not be limited to situations appropriate to the context of the problem or familiar to students, so that students can think more creative and critical in solving mathematical problems. However, in reality students tend to be equipped by teachers by using students' books and students look at the shape-drawing images contained in the book, then the teacher draws various kinds of shapes on the board. This happens because the lack of media used by teachers in learning shape that only use the book as a source of learning. As stated by Purnomo and Colleagues (Purnomo, Kowiyah, Alyani, & Assiti, 2014; Purnomo, Suryadi, & Darwis, 2016) that students' learning difficulties cannot be separated from the practice of learning that has been going on.

In connection with that, there is something that needs to be addressed in the practice of learning mathematics in primary school especially in learning of geometry. The practice of mathematical learning that continues until now tends to be oriented towards the achievement of curriculum targets. The learning process still places the teacher as a source of knowledge and still rarely found students involved with the activities and processes of mathematics in the learning process.

Students are not involved in real life with mathematical concepts taught by teachers, whereas many things from real life can be related to the learning of geometry. Due to the lack of interesting learning to build students 'understanding, so that students understanding of shape concept is limited. To bridge the students' real life with mathematical learning, contextual learning is needed. Context in learning mathematics can make abstract mathematical concepts become more meaningful for students, because the context can present abstract mathematical concepts in the form of easy-to-understand representation of students. Contextual mathematical learning is directly related to something that can be imagined by students through his or her real life. This learning involves real-world situations as a source or applied subject matter. Contextual learning can change the above conditions, namely by creating a learning scenario that starts from students' daily life. Thus, context-based learning can facilitate students to understand the

concept of the introduction of a shape through the media. So, it is necessary to find a way out to overcome these problems in order to improve students' understanding of the concept of shape recognition that is transformed through context-based learning. To build the conceptual knowledge, the problems which are given should be meaningful for students. Realistic Mathematics Education (RME) underlies this research in the part of designed context and activities. Zulkardi and Ilma (2006) stated that the context is a main point for students in developing mathematics. Furthermore, they said that the context itself should be meaningful and real for students' mind.

RME is a theory for teaching and learning mathematics that has been developed in the Netherlands since the early 1970's. This approach emphasizes increasing pupils' understanding and motivation in mathematics. In Indonesia, RME is adapted for over last ten years with the support of a group of Dutch math educators to create a new image of mathematics education in primary schools (Sembiring, Hoogland, & Dolk, 2010). As a basis of this research, the RME approach will be defined elaborately through five tenets for Realistic Mathematic Education by Treffers (Bakker, 2004) i.e: 1) Phenomenological exploration; 2) Using models and symbols for progressive mathematization; 3) Using students' own constructions and productions; 4) Interactivity; and 5) Intertwinement. Therefore, the researchers are interested in conducting research on "Enhancing Conceptual Knowledge about Shape through Realistic Mathematics Education In Class II".

METHODS

This research uses design research to reach the purpose of research. This research was conducted in one of the state primary schools located in Kedaung Kaliangke, West Jakarta. This study consists of two cycles. The first cycle involves six students of class 2A, the second cycle involves 37 students of grade 2B and one teacher. We conducted six teaching sections. Two sections were used for Hypothetical Learning Trajectory (HLT) testing which was made, then four sections were conducted teaching experiment to compare between tested HLT and real learning. Pramudiani, Zulkardi, Hartono and Amerom (2014) stated that the teaching experiment aims to collect data to answer research questions. In this teaching experiment, teachers taught in the classroom assisted by the researcher to collect the data obtained from the learning process in class in the form of class observation, student and teacher interview, student worksheet, pre-test and post-test.

The data analyzed included video recording during the learning process and interviews conducted on students and teachers, student work sheets, field notes and video recordings containing the research process from the beginning. According to Bakker (2004), Hypothetical Learning Trajectory (HLT) has been improved in the early experimental stage of teaching compared to actual student learning. The results of this study are the underlying principles, explain how, and why this design works. Hypothetical Learning Trajectory (HLT) as a guide in retrospective analysis to investigate how students learn in understanding the concept of shape recognition.

FINDINGS AND DISCUSSION

First Planning

In this phase, designed teaching and learning of HLT is the most important part in describing the related aspects of mathematical learning in recognizing shape. In addition to HLT, researchers designed learning tools that support HLT in the form of pre-test, student worksheets, lesson plan, and post-test.

Pilot Experiments

The pilot experiment was conducted in class II A consisting of 6 students divided into 3 small groups. This stage has aim to test the initial HLT that has been designed on the previous stage. There were several things that need to be improved from the HLT related to

language, suitability of learning to the condition of students, in terms of language and literature. The results of this stage were used in real teaching and learning experiments.

Teaching Experiment

In this stage the actual student learning was done i.e data collection such as observation, pre-test, interview with teachers and students, student worksheets, student activities during the learning process, and post-test was given after all learning activities were finished. In this teaching experiment, there were 4 learning activities such in the following:

Lesson I: Identifying shape using contextual situation

The teacher asked the students to start learning outside classroom and observe the objects around the school including building and another school environment. Then students actively described the various objects of shape, such as flower vase, cabinets, and whiteboard shaped rectangles, squares, triangles, circles, etc.

Figure 1. Students' activities using Contextual Situation

Lesson 2: Determining Shape Based on Type and Size

After the students identified the school environment, they were divided into 6 groups. In this group, they were asked to create model from what they observe. In this phase, model was primarily used to constitute a situation for developing formal mathematics. Following that, the students started to determine the shape based on the type and size.

Here is the researcher's conversation to Zamziah's answer why Zamziah drew a house and an orange.

Researcher : Let me see what you are doing?
Zamziah : Figure of house.
Researcher : Why are you drawing Zamziah's house? What kind of shape is it?
Zamziah : house shape …..square.
Researcher : You also draw a door. What kind of shape is it?
Zamziah : The door is rectangle…. I also draw orange Bu?
Researcher : Does the orange include the type of shape?

Zamziah : Yes, it is circle...

From Zamziah's answer it is known that the understanding of concept of introducing shape is suitable with HLT. From the activity held, the students could identify and group the shape based on the type and size.

Lesson 3: Grouping Shape Based on Type and Size

In this study, the researcher found that the students could make a grouping shape in accordance with HLT. However, there were some various types of students' answers that can be seen on Figure below. It is noticed that the whole group were able to distinguish the shape based on the type and size. There were only group 1 and 6 that answered the sequence of shape from the largest to the smallest, while group 2, 3, 4, and 5 answered from the smallest to the largest. This proved that their conceptual understanding of the shape is good.

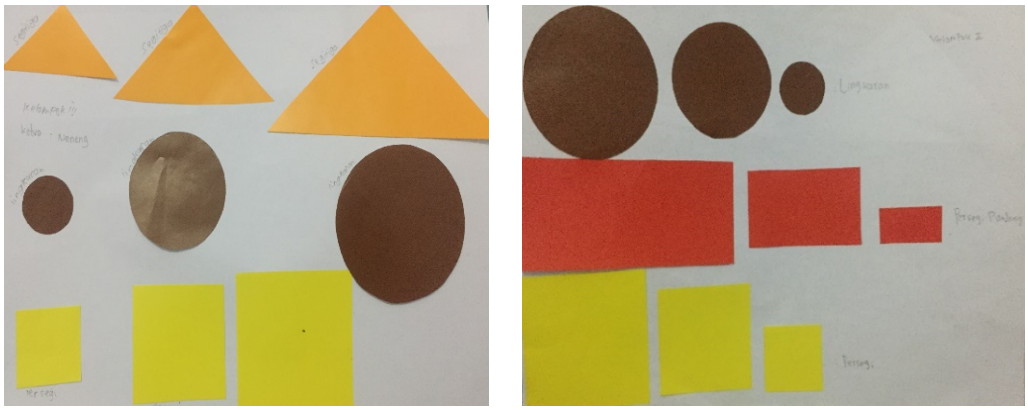

Figure 2. Students' works of Shape Based on Type and Size

Lesson 4: Determining the number of shape sides

In this phase, the students were divided into 6 groups. Teacher explained the shape material using "origami" media that was plugged into a stick in order to help students determining the number of shape sides. The use of media can bridge the students from informal into formal knowledge.

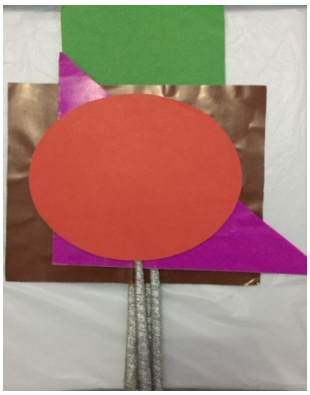

Figure 3. Students' works of determining the number of shape sides using origami

In this phase, the students determined the side and the number of sides on the shapes. However, there were some different answers from HLT with the actual learning. In this learning, the students were given some drawings of shape, then the teacher asked the students in group to determine the location and side of each side of the shape. The detailed answers can be seen on the Figure 4 below.

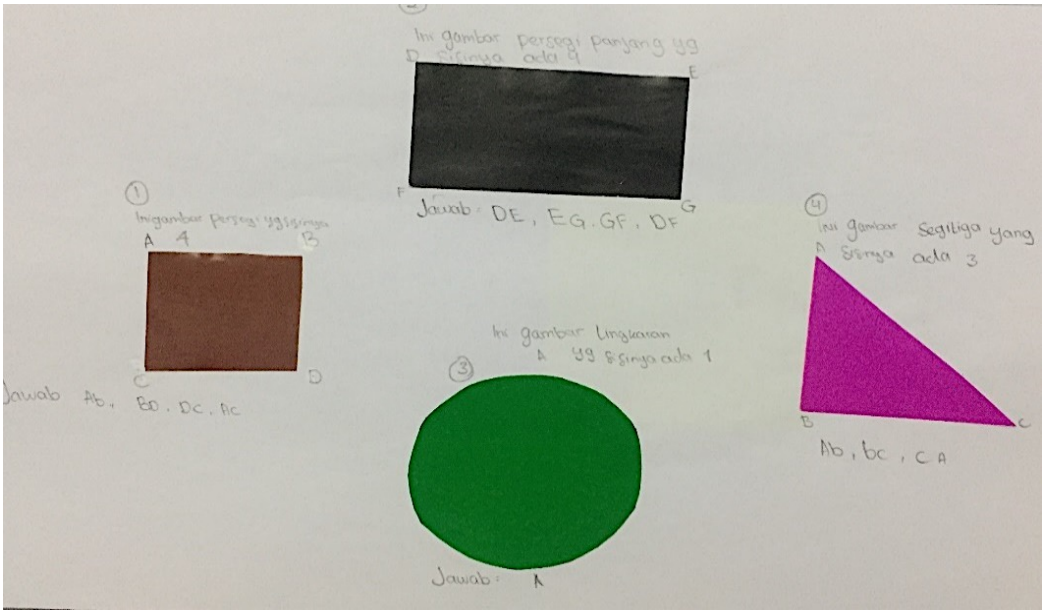

Figure 4. The answer of group 5

From the results of the answer sheet of 5, it can be seen that students have been able to determine the location and the number of sides contained on the shape of square, rectangle, triangle, and circle. They provided letters at each angle of the shape to make it easier to determine where the side and the number of sides. In this case, guided reinvention from teacher plays important role. For square group 5 gave the letters A, B, C, D and answer AB, BD, DC, and AC were 4 sides of it. For triangle that has 3 sides they gave letter A, B, C and answer AB, BC, CA for the side of the triangle. And last, they answered the circle has 1 side.

Lesson 5: Determining the number of shape angles

In this learning the students were divided into 6 groups same as the previous group. They determined the number of angles on the triangular, square, rectangular, and circular shape. There was revised HLT on how students answered the questions given by understanding their concepts of angle recognition. In placing letters on the shapes, students were still experiencing errors. The errors found in determining the side and the vertex.

An example of the correct answer is group 1. They wrote the square has 4 vertices i.e the vertices h, i, j, k. The rectangle has 4 vertices namely D, E, F, G. The triangle has 3 vertices namely A, B, C. and the circle has no vertex. Group 4 who gave the letters A, B, C, D, made different answers but they wrote the angle with AB, BC, CD, AD. The angle they wrote was the side of the rectangle. If they want to write the vertices they should write the vertices A, B, C, and D. Besides that, they answered the circle has 1 angle. However, the circle should have no angle. This happened because when the teacher explained the concept through origami media and wrote it on the board, the students paid less attention to the teacher's explanation, so when they worked on the worksheet the students have difficulties in determining the vertex on the shape.

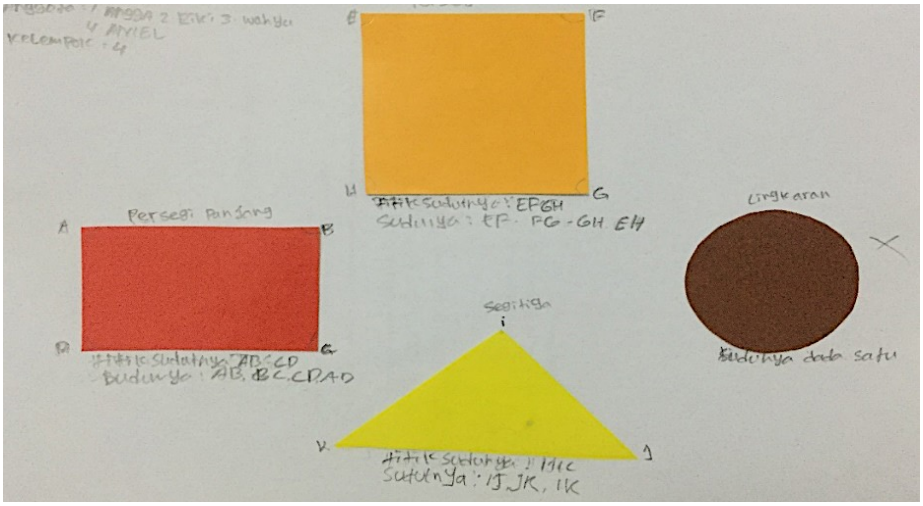

Figure 5. The answer of group 4

Through a series of learning activities from 1 to 5, it can be known that the understanding of students' concept of shape is good. It can be shown from the improvement from pre-test results with an average of 6 students is 85.6 and the average value of 88.3 for post- test. This research was conducted to 6 students who became the focus of research in class II B in the teaching experiment stage are as follows:

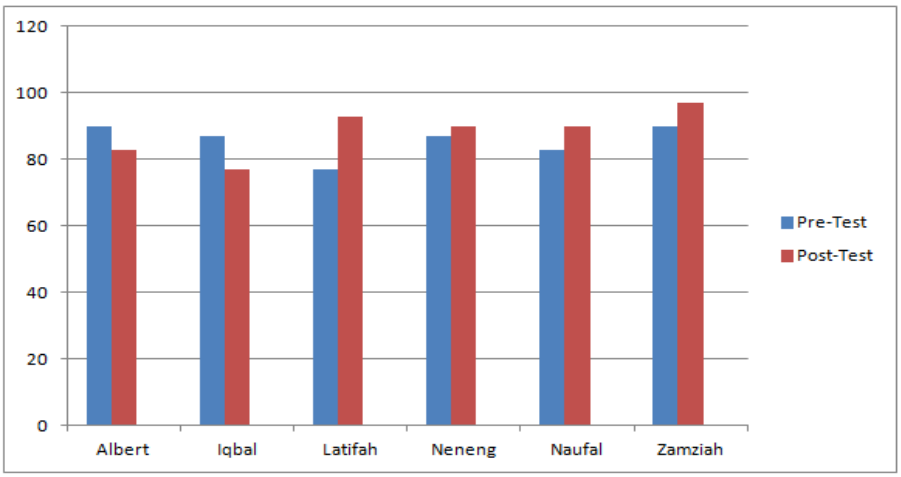

Figure 6. Pre-Test and Post-Test Result

From the Figure 6 above it can be known that 4 students namely Latifah, Neneng, Naufal, and Zamziah had made improvement in understanding the concept of introduction of shape, while 2 students Albert and Iqbal' understanding had decreased. This happened because they were less careful in doing the problem of pre-test and want to go home so they seem in a rush to solve the given problem.

At that stage, according to Van Hiele (1999) that the learning activity in the intention is to improve the thinking stage of students from 0 (visualization) to stage 1 (analysis). In other words, students have been able to identify, name, compare, operate geometric images such as triangles, sides, angles, and line pieces based on their appearance. Students are also capable of analyzing shape based on characteristics, arranging the properties of a real shape, and using those characteristics to solve mathematical problems.

CONCLUSION

The results of this study indicate that there is an increased understanding of the concept of the introduction of a shape. The improvement is how students understand the concept of shape recognition using a context-based realistic mathematical approach. Students are better to understand the application of a context-based realistic mathematical approach than book-centered learning as well as examples presented only by the book. Students can more easily understand the application of mathematical learning with contextual or real learning so that it can generate new experiences and knowledge of shape through the learning. Based on the explanation of the application of context-based realistic mathematical approach is one of the good methods to be applied in the learning process of mathematics.

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