Didactical Design Research of Mathematical Communication about Concept of Cuboid Volume in Elementary School

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Abstract- The research based on learning obstacle in preliminary research about mathematical communication for concept of cuboid volume which must be understood student. These concepts are taught in the fifth grade. The research purposes to be achieved is of development of learning design of cuboid volume to mathematical communication of student in problem solving story. Learning obstacles are: students haven’t able to use mathematical concept to mathematical models, to use mathematical concept to life, and haven’t able to use therelationship between mathematical topics in life. To minimize learning obstacles for concept of cuboid volume, then drafted a didactical design. Didactical design organized at SDN Rahayu Kecamatan Mangkubumi, Tasikmalaya as much as 2 (two) cycles, are preliminary didactical design and revised didactical design. Preliminary didactical design implemented to minimize learning obstacle for mathematical communication skills for concept of cuboid volume and revised didactical design to fixing Preliminary didactical design. Didactical Design Research consists of three phases: 1) analysing of didactical situation before learning be in the form of Hypothetic Didactical Design, including ADP; 2) Metapedadidactical Analysis; 3) Restropective analysis between result of hypothetical didactical situation analysis with analysis result of metapedadidactical analysis. This research can increasing mathematical communication understandings and skills for concept of cuboid volume.

Keywords: Learning obstacle, Didactical Design, Cuboid Volume, Mathematical Communication

I. INTRODUCTION

Based on article 31 point 1 of The 1945 Constitution of the Republic of Indonesia “Every citizen has the right to receive education”. Curriculum is a educational foundation in school. In Kurikulum Tingkat Satuan Pendidikan (KTSP), mathematics is one of mandatory subjects in every level of education, include elementary school. Mathematics is used in all fields of science as well as having an important part in solving the problems in life. Therefore, mathematical knowledge should be mastered by the students as early as possible. Understanding the concepts of material in the mathematical learning in elementary school is an implicit prerequisite to continue their education to a higher level.

Education aims to humanize humas, make not knowing to knowing, and can’t be able to able. Aim to improve the quality of human resources in education, refers to act of the republis of indonesia number 20 year 2003 article 3 “The National Education functions to develop the capability, character, and civilization of the nation for enhancing its intellectual capacity, and is aimed at developing learners’potentials so that they become persons imbued with human value who are faithful and pious to one and only God; who possess morals and noble character; who are healthy, knowledgeable, competent, creative, independent; and as citizens, are democratic and responsible.”. In addition, education is also one way of formulation of the human ability to use reason effectively and efficiently as the answer to face with problems that arise in creating a better future. But in reality, education hasn’t reached its intended purpose, both in terms of the learning process and the result of the students’ achievement, not show satisfactory results.

The problem of education has always been an interesting topic, both among teacher, parents, even among the educational expert. This is something that is fair because everyone wants the best education for students as the iron stock for our nation. One of the problems of education is on math, this is stilll due to
low student achievement in that subject. Efforts to improve the quality of mathematics education in Indonesia has long been implemented, but complaints about the difficulty of learning mathematics still continue to be found.

Mathematical learning is identical to drill critical thinking skill of students. Geometry is one of material of mathematics at elementary school. Understand and calculate the cuboid volume is one thing to be achieved student of elementary school in mathematical learning. Questions about cuboid volume usually presented with picture and the students were only instructed to calculate the cuboid volume. Related to that, the students presented only the usual problems or questions, so that when students faced to the unusual problems, student will have difficulty and will not be drill to have critical thinking.

Based on the condition of cuboid volume learning, the research is aimed to developing of learning design collaborate with a variety of learning methods, media, and techniques which is relevant. This research expected to improve mathematical learning process, especially on the material of cuboid volume in elementary school. With the development of learning design expected to facilitate students to think critically is every learning, especially mathematics.

Based on the research background, the formulation of the problem in this study is “How to didactical design in computing and understanding the concept of cuboid volume to improve the mathematical communication in students?”.

Start from the formulation of problems, then drafted specific research questions as follows:
1. How a learning obstacle experienced by elementary school student in the material of cuboid volume?
2. How the didactical design to resolve of learning obstacle of student in the material of cuboid volume?
3. How implementation of didactical design on student in the material of cuboid volume?

The research purposes to be achieved is “Development of learning design of cuboid volume to mathematical communication of student in story problem solving in grade V of elementary school”. While specifically, the research purposes to be achieved are:
1. To know and understand a learning obstacle experienced by elementary school student in the material of cuboid volume?
2. To describe the didactical design to resolve of learning obstacle of student in the material of cuboid volume?
3. To describe implementation of didactical design on student in the material of cuboid volume?

Benefits of research are: 1) The theoritical benefits and 2) The practical benefits. The theoritical benefits are: expected to contribute positively in the development of the theory of mathematical learning, especially on the material of cuboid volume to improve the quality of education corresponding national education goals. Then, the practical benefits are:
   a. For the teacher, as an input to develop innovative learning design in order to achieve optimal learning objectives, and to pre-service teacher as a preparation to face the profession.
   b. For the student:
      1) Get a new material about cuboid volume;
      2) Improving the understanding of the concept of cuboid volume;
      3) Drill for critical thinking in the learning process.
   c. For researchers, can obtain direct experience in developing instrument and didactical design of cuboid volume.
   d. For schools, contribution of ideas in written form related learning of cuboid volume.

II. RESEARCH METHOD

Sugiyono (2007, pg.6) suggests that “the research method can be interpreted as a scientific way to get valid data to be found, developed and demonstrated that in turn can be used to understand, solve and anticipate a problem”. Method used by researcher on this study is Didactical Design Research.

Didactical design is a learning plan form of teaching materials which aiming to reduce or eliminate learning obstacle based on the preliminary study. So that students being able to understand a concept or operates whole learning materials. The purpose of this didactical design is to reduce and eliminate learning obstacle on student so they are able to understand a concept as a whole.

Didactical Design Research consists of three stages, namely: (1) situation didactical analysis before learning process in the form of a didactical design hypothesis including ADP; (2) Metapedadidactical analysis, and (3) Retrospective analysis which relating the outcome of situation didactical analysis hypothesis and metapedadidactical analysis.
III. RESEARCH FINDINGS

A cuboid is a three-dimensional space formed by three pairs of square or rectangular, with at least one pair of which sized differently. A cuboid has 6 faces, 12 edges and 8 vertexes. A cuboid is formed by six congruent squares called a cube. The concept of cuboid volumes surely cannot be separated with components of the cuboid. Generally in schools, including elementary schools (SD), it involves the length, width, and height of the cuboid or better known as \( \text{length} \times \text{width} \times \text{height} = \text{volume} \).

The first step of this DDR based research is organising preliminary study instruments. This instrument contained Competency Standard (SK), Basic Competency (KD), Learning Obstacles, Mathematical Communication Indicator, and Learning Indicator. SK and KD adjusted to School-based Curriculum (KTSP) which cuboid concept is one of them. As for Mathematical Communication Indicator which contained on the preliminary study instrument and the goal of this didactic design are:

a. Students are using the concept/ mathematical language to interpret mathematical idea.
b. Students are able to state the mathematical concept into mathematical model.
c. Students are able to pour the mathematical concept on their daily lives.
d. Students are able to understand the relation among mathematical topics to daily life.

Based in the preliminary study which had done on October 23rd 2015, learning obstacles was found. There three types of learning obstacles found, namely:

a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model;
b. Type 2: Learning obstacle related to pour mathematical concept to the daily life;
c. Type 3: Learning obstacle related to pour mathematical topics to the daily life.

The next step after the obstacles obtained is creating learning didactical design. Learning didactical design was made in order to achieve learning goals. This didactical design, which researcher used, is related to the concept of cuboid volume and was done in 2 cycles (2 meetings) at SDN Rahayu Kecamatan Mangkubumi.

Early didactic design (cycle 1) was done during 2 hour learning time on Saturday, November 7th 2015. Based on the learning indicator and to achieve goal desired, the learning process was also done based on learning steps in lesson plan (RPP) which directed students to achieve learning goal. Learning process on the first cycle, intended to make students understand the concept of cuboid volume, then students were guided to do the student worksheet (LKS), in which students were doing with the their learning group. The groups were formed using colored paper, which let the students who picked the same color in the same group. After the learning groups formed, the students were given a worksheet consists of 3 activities to do with their group. Each group was guided by researchers while doing the activities. In early didactic learning design (cycle 1), students needed an intense guidance because the problems on the worksheet were not usual problems for them. Moreover, to explain about the concept of cuboidvolume in the first cycle Medias are needed, therefore, researchers used a cube and rectangular prism. With those medias, researchers was hoping the students could understand the concept of cuboidvolume, so the students are able to solve problems related to cuboidvolume. Each learning groups were evaluated after finishing the worksheet.

Since on early didactical design revision is needed, a revised didactical design was created. The revised didactical design was organised based on the implementation in the previous cycle. Based on early didactical design, there were things which need revision, and things which were revised are: The learning process is going to be done individually, the evaluation process is going to be done individually, and the duration is to be prolonged; from 2 x 35 minutes to 2 x 40 minutes and problem alteration.

The revised didactical design (cycle 2) was done on Friday, November 13th 2015 at SDN Rahayu. This revised design was intended to improve learning process which had done on earlier cycle (cycle 1). In this revised design, the difference between the earlier cycle and the second cycle was on the worksheet which done individually. This revised design shown different things compared to the early didactic design, in the revised design, researchers were not providing medias, because researchers believed that the students were already understood the concept of cuboid volume. The students were already understood the concept of cuboidvolume, it was proven as the need of guidance from researchers to students was decreased.

IV. RESEARCH DISCUSSION

Based on preliminary study, it was revealed that there are three types of learning obstacle, namely:

a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model
b. Type 2: Learning obstacle related to pour mathematical concept to the daily life
c. Type 3: Learning obstacle related to pour mathematical topics to the daily life

All three types of learning obstacles, was revealed from preliminary study which had done before didactical design. To minimize all three types of learning obstacle, then didactical design was done which consists of early didactical design and revised didactical design. To minimize the learning is through LKS
obstacle to learning in any didactical design. LKS learning in every didactical design was a method to minimize learning obstacle.

Students learning obstacle could be resolved and minimized by didactical design, it was proven with the increased of students mathematical communication understanding in each meeting, one of characteristic is guidance from researchers to students was decreased and final evaluation of this research was increased from a preliminary study.

Implementation of didactical design at SDN Rahayu Kecamatan Mangkubumi, Tasikmalaya, was done in 2 cycles. There was increased of students mathematical communication concepts of cuboid volume from early didactical design to revised didactical design. Teaching method of early didactical design and revised didactical design were same, which was guidance finding method. However, the guidance from researchers was decreased from early didactical design to revised didactical design because the students were already understood and applied their communication skills in problem solving.

V. CONCLUSION

Based on the result of research and discussion, it can be concluded:
1. Based on preliminary study, it was revealed that there are three types of learning obstacle, namely:
   a. Type 1: Learning obstacle related to pour mathematical concept into mathematical model
   b. Type 2: Learning obstacle related to pour mathematical concept to the daily life
   c. Type 3: Learning obstacle related to pour mathematical topics to the daily life.
2. To minimize all three types of learning obstacle, then didactical design was done which consists of early didactical design and revised didactical design.
   a. Didactical design was done at SDN Rahayu Kecamatan Mangkubumi Kota Tasikmalaya in fifth grade with 25 students.
   b. Students learning obstacle could be resolved and minimized by didactical design, it was proven with the increased of students mathematical communication understanding in each meeting, one of characteristic is guidance from researchers to students was decreased and final evaluation of this research was increased from a preliminary study.

VI. SUGGESTION

Based on the result of research and conclusion, then the researcher have some suggestions, as follows:
1. The didactical design has been drafted is one of the learning design of teaching materials that can be used in each lesson can be developed according to the needs.
2. This research is expected to continue to be develop by drafting the didactical design better about mathematical communication in concept of cuboid volume

REFERENCES