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Didactic Design Of Material Cubes and Beams Volume Elementary School Students Class V

Asep Kuniawan✉[1], Tatang Herman[2],

[1,2] Departemen Pendidikan Dasar, Sekolah Pasca Sarjana, Universitas Pendidikan Indonesia
✉ [1]kuniawanasep@upi.edu, [2] tatangherman@upi.edu

Abstract. This study aims to create a didactic design of learning based on students' learning obstacles on the material volume of cubes and beams. The participants of this research were conducted in the fifth grade of elementary school in Sumedang Regency with 42 students consisting of 17 male students and 25 female students. The method used is the DDR (Didactical Design Research) method with data collection techniques used through observation, interviews, and documentation. The instrument used is a written test instrument. Data were analyzed qualitatively to determine student Learning obstacle, then make hypothetical learning trajectories and pedagogical didactic anticipation. Learning obstacle are identified, namely obstacles related to multiplication and division in finding volume, understanding the concept of volume, and understanding the story in the concept of cubes and beams. The results of this research are the improvement and development of didactic designs in mathematics that have mathematical connections with cube and beam material in elementary schools. Learning activities are carried out using a variety of methods including lecture, demonstration, practice and training methods, as well as using modified learning media and also using smartboards. From the results of the study it can be concluded that this didactic design can make learning situations more active so as to minimize Learning obstacle and make students easier to understand the subject matter.

Keywords: learning obstacle, didactic design, volume of cubes and beams, Didactical Design Research, a matter of story

INTRODUCTION ~ Geometry is a branch of mathematics that is considered difficult and feared by students (Sulistiowati DL.dkk.2019) Geometry is a topic that is closely related to problems in daily life and problem solving and is also related to mathematical and real-world topics (Haryanti et al, 2019). Spatial material is part of geometry that emphasizes the ability of students to identify properties, elements, and determine the volume in problem solving (Elements, Wahyuni, Ilma, Putri, & Hartono, 2015). The term volume can not only be used to refer to the capacity of the container but also can be used to measure the size of the building (Van de Walle, 2008).

In mathematics, knowing geometry is one of the important things that must be mastered by elementary school students because it allows students to analyze and interpret the world they live in and equip them with tools that they can use in other fields of mathematics. Therefore, students need to develop an understanding of geometric concepts (A. Özerem, 2012).

In line with NCTM (2000) which explains that there are five content standards in mathematics learning, one of which is geometry. In addition, learning geometry is often found in everyday life, for example in the form of objects in the surrounding environment. Therefore learning geometry needs to be learned because geometry can train students to think logically, work systematically, turn on creativity and be able to develop the ability to innovate. (Sari & Aslim, 2015). According to Usiskin one of the reasons why geometry is taught because geometry is the only field of

mathematics that can connect mathematics with real world physics that can allow mathematical ideas to be visualized, and it is also important to support some other material in mathematics. (Anjarsari & Irvan, 2017).

The reality on the ground students have difficulty. Difficulties in mathematics faced by students because students only memorize concepts in learning mathematics and they are less able to use these concepts including geometry material (Abduh, Waluya, & Mariani, 2019). Besides learning is not interesting, the teacher does not provide opportunities for students to actively manipulate objects directly, so that most students find it difficult to understand every concept taught, which ultimately student achievement in geometry material in particular determines the volume of space to be low. The prerequisite concept that students must master is still lacking, so students have difficulty in showing and mentioning the elements or properties of space construction (sides, angles, ribs), thus causing students difficulty in learning the volume of building space. (Rostika, 2008). Furthermore, geometry is usually only taught as memorization and calculation only by teachers learning in class only as a process of transferring knowledge from teacher to student (Hardianti D. et al. (2017). Students are not guided to know the process and discoveries the formula itself and as a whole are not taught the basic geometrical skills that should be possessed, so that the abilities possessed are limited, as a result, students cannot apply them in life and cannot transfer them in the context of new problems (Sulistiawati, 2012). existing in the curriculum is limited to students being able to calculate the surface area and volume of cubes, beams, prisms, and pyramids, but are not related to everyday life in problem solving (Marlina, 2019).

Then based on the basic competencies students must master in the material of building space, the teacher should create an interesting learning atmosphere so that students are motivated to learn. The teacher must try to make students discover their own formulas or understand the concepts given, work together, and be able to apply the knowledge acquired to real life and transfer it in a new context (Rohati, 2011). In general, most students have memorized the volume formulas for cubes and beams. However, after being given problems relating to the application of concepts or formulas to problem solving in the form of story problems, students have difficulty in solving the story problems. (Zulfikar, Suryana, Abdul, & Lidinillah, 2018). The same thing was expressed by Burger and Shaugh-nessy (1986) which stated that students had difficulty in identifying images and difficulties in proving the problem of a theorem in the wake of learning geometry. Furthermore, a survey from the Program for International Students Assessment (PISA) (2000) revealed that students were still weak in geometry, more specifically in understanding space and form. (Suryadi & Fatimah, 2015). Based on the report of International Mathematical Trends and

Science Studies in 2011 the average value for material geometry is 377. The report shows that the value obtained by Indonesia ranks third from the bottom compared to other countries and this shows that the ability to work on geometry problems is low. (Kristiana, Utami, & Pramudya, 2017). Based on preliminary studies that have been carried out, there are some obstacles to learning experienced by students related to mathematics learning in the material volume of cubes and beams as follows.

Learning obstacle in Figure 1 regarding the obstacles to learning algebra, the nature of multiplication and division in looking for volumes, Figure 2 relating to understanding material is related to understanding the concept of volume and Figure 3 barriers in understanding the question of stories and concepts of cubes and beams with different units. This means that they still do not understand the concept of cube and beam volumes correctly. Lack of understanding of the concept of cube and block volumes is one of the main causes of

students' inability to answer questions correctly. When students are faced with problems that are not commonly exemplified by their teacher, students will find it difficult to use their knowledge. This is commonly called a learning barrier. Brousseau (1997) revealed "there are three factors that cause Learning obstacle, namely ontogeny barriers (mental readiness to learn), didactics (as a result of teacher teaching) and epistemology (student knowledge which has a limited application context (Kurniawan & Suhandi, 2017). To overcome students' learning difficulties regarding the volume of cubes and beams, it is necessary to design a didactic that is prepared to overcome, and involve students in understanding the overall formation, not just limited to one context, basically, the teacher must be able to design so that the course of the learning process is appropriate with the expected learning objectives, the teacher not only conveys the material being taught and completes the learning target, but the teacher must also be able to predict student learning obstacles that will arise and must prepare Pedagogical Didactic Anticipation (ADP) to overcome student Learning obstacle. This study aims to create a didactic design of learning based on students' learning obstacles.

METHOD

The method used in this research is qualitative research in the form of didactic design. The didactic research design basically consists of three stages: an analysis of didactic situations before learning which takes the form of a hypothetical didactic design including ADP (Pedagogical Didactic Anticipation). methadactic analysis, and retrosfective analysis linking the results of the analysis of the didactic situation analysis results of the hypothetical didactic analysis. From the three stages a didactic empirical design will be obtained that it is possible to continue to be refined through the three stages of DDR. (Suryadi, 2010).

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This study was divided into three stages, namely the situation analysis before the learning stage, the methaddactic analysis and retrospective analysis. Analysis of the phase of the situation before learning consists of collecting literature relating to the material under study, analyzing the material, making instruments to determine student Learning obstacle, conducting preliminary studies, analyzing the results of preliminary studies, identifying Learning obstacle, preparing and developing didactic designs based on Learning obstacle, and predict responses. The Metapedadtik analysis phase consists of applying a didactic design, analyzing the results of the design implementation. The retrospective phase consists of connecting prediction of responses that have been made with responses that occur,

The data collection technique used was a preliminary study test instrument to identify student Learning obstacle, interviews, observations, and documentation. In observations, the researcher acts as a teacher to observe how the relationship between teacher and students, and the learning process in the material volume of cubes and beams.

RESULTS AND DISCUSSION

Based on the analysis of the preliminary study, found several barriers to student learning. The results of the analysis show the errors of students in answering questions related to the material volume of cubes and beams. The Learning Constraints identified are of two types, those are Learning obstacle related to the relationship between mathematical topics, and Learning obstacle related to daily life. The obstacles are found as follows:

Question :
Dayu has a beam-shaped pencil case with a length of 25 cm, width 8 cm, and height 4 cm. specify the volume of the Dayu pencil case?

Answer:

Figure 1. Learning obstacle in multiplication and division in finding volume

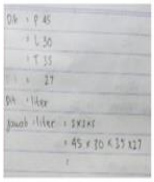
Question :
A bath tub has a volume of 1,800 dm³. If the length and width of the bathtub are 15 dm and 10 dm, what is the height of the tub?

Answer:

Figure 2. Learning obstacle to understand the concept of volume

Question :
At Beni's house there is a beam-shaped aquarium with a length of 45 cm, width of 30 cm, and height of 35 cm. beni has poured 27 liters of water. How many liters of water lack in the aquarium should Beni pour (1 liter = 1.00 cm³)

Answer:



Gambar 3. Learning Obstacles in understanding story problems in the concept of cubes and blocks

2.1 Learning obstacle Type 1

Barriers to student learning regarding aspects of the relationship between the

material by connecting the algebraic concepts of multiplication and division properties in search of the volume of cubes and blocks In these problems students are required to complete calculations with the concept of algebra to solve the problem of beam volume.

Question :
Dayu has a beam-shaped pencil case with a length of 25 cm, width 8 cm, and height 4 cm. specify the volume of the Dayu pencil case?

Answer:

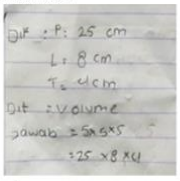


Figure 4. Barriers to type 1 learning

2.2. Learning obstacle Type 2

Learning types of obstacles 2 students do not understand aspects of understanding the concept of volume. In this problem students are required to know and crab one of the elements of the block appropriately.

Based on these responses, students are not familiar with the form of questions contained in the problem so that students have difficulties and mistakenly answer questions. Most students answer the question multiplying all the numbers in the problem. Without seeing what was asked about the problem.

Question :
A bath tub has a volume of 1,800 dm3. If the length and width of the bathtub are 15 dm and 10 dm, what is the height of the tub?

Answer:

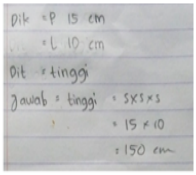


Figure 5. Barriers to type 2 learning

2.3. Learning obstacle Type 3

In the learning type of constraint 3 students' Learning obstacle regarding aspects of the mistake of understanding the story problems and concepts of cubes and blocks with different units. In these questions students are required to write and count story problems related to the use of the formula for surface area and volume of cubes and beams. From the questions given by the researchers, students had difficulty in deciphering what was known and what was asked and changed the units that were asked.

Question :
At Beni's house there is a beam-shaped aquarium with a length of 45 cm, width of 30 cm, and height of 35 cm. beni has poured 27 liters of water. How many liters of water lack in the aquarium should Beni pour (1 liter = 1.00 cm^3)

Answer:

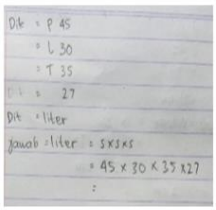


Figure 6. Barriers to type 3 learning

To overcome some of the barriers to learning above, the design of didactic design to minimize Learning obstacle in the material volume of cubes and beams. This designed design is the development of learning activities that are usually done by teachers in the classroom with students by developing the ability to solve mathematical problems. activities with learning connections in mathematics, can facilitate students understanding mathematics in the material.

After the indicators and learning objectives are arranged, then design learning activities related to the volume of the cube and beam material. Before designing learning activities, you must first prepare a learning hypothesis or Hypothetical Learning Trajectory (HLT) including prediction of student responses and anticipation of learning activities to be carried out. Responses These predictions may arise during the implementation of didactic designs, and how to anticipate. To facilitate learning activities, students are given a student activity sheet as a guide to carry out the steps of learning.

The steps of learning activities carried out in the implementation of this design can be explained as follows.

2.3.1 Pay attention to the shapes of benthic in the form of a cube in the surrounding environment

Reintroducing the concept of cube and beam volumes based on objects that are often found in everyday life. This is done so students are directly involved in the process

2.3.2. Measuring Content with Nonstandard Units

The unit of volume can be measured with objects that have smaller volumes. Objects with smaller volumes are called measuring units. Measuring unit can be a glass, cup, dipper, spoon, bucket, tub, and others.

2.3.3 Measuring Volume with Unit Cubes and Determining the Number of Unit Cubes on a Transparent Beam

Unit cubes can be used to measure the contents of blocks or cubes. The number of unit cubes that can be loaded into blocks or cubes is the contents of these blocks or cubes with units of unit cubes. The number of other objects in the cube and block can be said as the number of contents of the building space which states the size of the building space. Thus, the amount of content in the building space is also called volume.

2.3.4 Looking for Beam Volumes When Specified Sizes are Available with a Volume Unit

After students understand the measurement using the unit cube (concrete), it is continued by finding the volume with the standard unit (abstract). To facilitate students in remembering given in the form of words or in other terms with "donkey bridge" kucing (km^3), hitam(hm^3), dalam(dam^3), mobil (m^3), Desi (dm^3) Centile Mondar mandir (mm^3). In addition to helping students who are still slow in remembering multiplication, especially multiplication 1 to 10 which is a basic multiplication using the fingerprint method.

2.3.5 Determine the Volume of a Cube

After learning activities concretely and through pictures, the next stage students are trained to be able to solve problems related to everyday life in the form of story problems. In this activity, students are first guided to understand the context contained in the problem by giving clues to what is known and questioned. Through this activity, students are expected to be able to apply mathematics to solve problems related to everyday life.

These activities are carried out in learning mathematics in fifth grade. The implementation of the activities carried out at Neglasari State Elementary School. At the time of the implementation of the didactic design implementation, various student responses that arise have been well anticipated. Students begin to understand the concept of cube and beam volumes. But there are still many students who do not really understand the concept of the volume of cubes and beams, especially in using the formula for the surface area and volume of cubes and beams, so mistakes and errors are still found in students' answers. These events go beyond the prediction that student responses and anticipation of didactics and pedagogies that have been made before need to be modified and developed according to the situation that occurs during the progress of implementation. Therefore, we need a design revision to improve the didactic design.

In the didactic design revision, learning activities are still the same as the initial didactic design, but there are additional media to help students understand the material and revise the student activity sheet. The learning media used are concrete units of wooden cubes and by using "smartboart" learning media. Smart boards are large interactive screens in the form of blackboards. With smart board media that contains video lessons for their students not only enhance their own learning, but also they are more involved in learning and changing the way they learn is more mandatory and enjoyable. (Oktaviyanthi, 2016) In addition, learning using mathematical learning media such as Microsoft Power Point, Macromedia Flash and Augmented Reali makes learning more interactive, which can be used to demonstrate or visualize as well as tools to build basic concepts that stimulate the development of geometrical

mathematical reasoning skills (Cesaria A and Hermawan T. 2019).

Media designed and used to make it easy for students to find the volume of a cube / block and study to make it more interesting, namely the cube of a wooden cube added with smartboard learning media

Figure 7. Media learning units of Wooden Cubes

Figure 8. Learning Media by using Smartboard

The results of the implementation of the design revision most of the students already understand the material of the volume of the cube and the beam. Students have begun to understand concepts, the procedure of defining relationships between lengths and determining the formula for finding the volume of cubes and beams through the media used during the implementation of the revised design. By revising the implementation plan of learning, it can facilitate students who participate in learning activities. In this didactic design, students have improved in response to learning activities.

During the implementation of the revised design, students can see the relationships contained in mathematics, such as the relationship between mathematical topics and their relationship with everyday life. Through this didactic design, it is expected that alternative designs on the volume of cube and beam volumes will be obtained which are more innovative so that they can help the learning process of students more optimally and learning objectives are expected to be achieved.

CONCLUSION

Didactic designs created and developed in this study are alternative didactic designs in mathematics learning in cube and beam volume material. This didactic design was developed based on the Learning obstacle identified by developing students' mathematical connection abilities. Learning obstacle identified in this study, namely Learning obstacle are related to the relationship between mathematical topics and the relationship between mathematics in everyday life. This didactic design can make learning situations more active and fun so that it can minimize learning obstacles and make students easier to understand the subject matter.

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