Advances in Social Science, Education and Humanities Research, volume 174
First Indonesian Communication Forum of Teacher Training and Education Faculty Leaders International Conference on Education 2017 (ICE 2017)

# Didactical Design of Trapezoid Concept for Elementary School Students

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***Abstract*—This study aims to formulate an alternative learning design related to trapezoid concept which is based on the existence of learning obstacle on the concept, such as the definition of the concept that is only procedural and monotonous learning approaches (didactical obstacle), generalization of the concept of trapezoid area (epistemological obstacles), and limitations of thinking (ontogeny obstacle). This research is a qualitative research which used the descriptive method of didactical design research. This research was conducted at SDN 3 Lembang, Lembang district, West Java region in the 5th grade. The data collection technique used was triangulation technique with research subjects that were (1) 6th-grade students for identification of early obstacle learning, and (2) 5th students for implementation of didactic design and identification for final obstacle learning. The results of this study indicate that there is still learning obstacle especially on epistemology. There are two types of learning obstacles, the first one is related to the context of information variation on the problem, the second type is related to problem-solving. Based on the implementation of didactical design and the description of obstacle learning, it can be concluded that this didactical design is one of the trapezoid learning concept design for elementary school students.**

***Keywords— Didactic design, trapezoid, learning obstacles.***

## I. INTRODUCTION

Mathematics plays an important role in daily life due to a number of problems related to mathematics, such as comparing, summing, subtracting, multiplying or dividing. There are also objects in the form of shapes in that we need to know how to find the area, circumference, volume of the shapes and so forth. In addition, by learning mathematics, students can develop their thinking ability. They are able to be more critical in dealing with problems and more creative in solving the problems.

The purpose of mathematics learning is that students are able to understand the concepts of math and the skills as well [1]. The development of mathematics competence is geared to improve life skills, particularly in developing creativity, critical thinking, collaboration or cooperation and communication skills to the demands of the 21st century. In addition, the development of mathematics competence also emphasizes finesse or skill to use technological devices to perform technical calculations (computation) and presentation in the form of pictures and graphics (visualization), which are important to support other cross-disciplinary skills and non-cognitive skills along with the development of values, norms and ethics (soft skills) [2].

Elementary students are students aged 7-12 years. According to Piaget, they are in a concrete operational phase at this stage. In the concrete operational stage, they have to think operationally, using logical reasoning but still in the concrete situation [3]. Knowledge gained by students is merely in the form of knowledge based on the gained direct experience.

All this time, classroom learning has not been centered on students. Students only listen to the teacher then record and memorize all the knowledge transferred then finish exercises. The lessons given do not give students the opportunity to construct their own knowledge. The material and knowledge transferred is merely in a form of memorization and separated from everyday life. This makes learning in the classroom less meaningful.

The lack of meaningful learning in the classroom, especially in the trapezoid concept, is seen from the lack of students' understanding of the trapezoid concept. Students are also seen not mastering the prerequisite materials. They should have mastered the concept of the square, rectangle, triangle and trapezoid shapes. If the prerequisite material has not been fulfilled, it is certain that the student will have difficulty in learning the following material.

In fact, the students' learning results on the trapezoid concept are still less satisfactory. This means that students are still experiencing learning obstacle on trapezoid concept. Ref. [4] in 5th grade of students in SDN Karangnongko, Klaten, showed that the students faced some obstacles in learning because they did not enjoy mathematics lessons due to the conventional learning process. Students also had no experience in group studying so there were not any sharing opportunities with friends. In addition, the use of learning media will greatly help students in learning. Ref. [5] in 5th-grade students of SDN Cijambe, Cibeber, Cianjur regency, showed the occurrence of ontogeny obstacles, didactical obstacles, and epistemological obstacles.

To overcome the learning obstacles, teachers need to develop a didactic learning design that allows students to achieve learning objectives. The didactic design created by the teacher should be based on the didactic situation occurred in the classroom. The didactic design is made through the process of thinking about concepts to be taught. The thinking process consists of a prospective analysis, a non-tectonic analysis, and a retrospective analysis. Teachers also need to predict what kind of learning obstacles that the students will encounter, how trajectory learning (teacher prediction on the learning process) and it is also important for the teacher to predict how students respond to the learning material that will be provided so that teachers can prepare for pedagogical anticipation. In addition, teachers also need to have a reflection for action, reflection in action, and reflection of action [6].

In learning activities, teachers' role is to create a didactical situation that resulted in the student learning situation. Didactical actions of a teacher in the learning process will create a situation that can be a starting point for the learning process. The didactic situation can be initiated by the teacher to create a situation of that provides large opportunities for students to use, explore, and apply their knowledge to the fullest. Language is very important in a situation of the formulation. Students can express and explain their ideas to be understood by others. Teachers should provide a means of discovering cultural knowledge and passing on what will be taught. In providing learning tasks on the situation of validation, teachers should pay attention to all students to demonstrate their knowledge, ability or understanding entirely. From the series of the didactic situation, students are expected to face a situation of Institutionalization, where students can develop new knowledge to solve given problems.

Through a didactic design that is oriented to the analysis, students are expected to experience zero obstacles and able to understand well the concept of trapezoid so that the learning objectives can be achieved. Students are also expected to apply and develop the concept of the trapezoid in their daily life.

Based on the description, the research on "Development of Didactics Design on Trapezoid Concept in Elementary School Students Mathematics Learning" is necessary. This study focuses on the following problems: (1) what are the learning obstacles related to the concept of a trapezoid?; (2) how is the concept and context of a trapezoid?; (3) how didactic design on trapezoid concepts is capable of overcoming learning obstacle of 5th-grade students?; (4) how does the implementation of the didactic design, especially in the view of the emerging student's responses?; (5) how does the impact of learning obstacle on the implemented didactic design?

## II.METHODS

This study is a qualitative research with Didactical Design Research (DDR). DDR is a study to create instructional designs based on didactic situations that occur in the classroom. The purpose of DDR is to improve the quality of didactic design. The focus of the study in DDR research is concerned with the relationship of three aspects; teachers, students, and teaching materials that form a tripartite teacher-student-teaching material.

In DDR, teacher activity sequences before, during and after learning are analyzed and made into the material to formulate a series of steps that result in a new and more innovative didactic design. The DDR consists essentially of three stages: (1) prospective analysis, i.e didactic situation analysis before the learning which is in the form of Hypothetical Didactic Design including ADP, (2) meta-didactic analysis, and (3) retrospective analysis that is analysis which relates the result of hypothetical didactic analysis with the results of meta-didactic analysis. From the three phases, the empirical didactic design will be obtained which will be likely to continue to be refined through the three stages of the DDR [7].

The focus of this research is to develop the didactic design of trapezoid concept for the students of 5th grade in elementary school. It is expected that by devising this didactic design, it could help teachers to prepare their teaching materials and overcome the learning obstacle students have to face before.

The subjects of this study were students of Class 5-A Year of 2016-2017 in SDN 3 Lembang which is located at Jl. Hotel Lembang no. 30 Lembang District West Bandung Regency West Java Province. The number of students in the class was 40 people. The selection of classes was due to basic concepts of students' necessity in moving to a higher level. In addition, the class was an inclusive one because there are some students who needed special treatments.

Instruments used were non-test instruments, namely interviews, observation sheets, and documentation studies. Interviews conducted early in the study aimed to identify early learning obstacles and interviews were conducted at the end of the study to identify learning obstacles after obtaining the implementation of the didactic design. In conducting interviews, semi-structured and unstructured informal conversation techniques were used. In unstructured interviews, data mining was done informally with the form of questions raised depending on the researcher's spontaneity and informant responses. Whereas in semi-structured interviews, interview guidelines that have been prepared in the form of written questions were used. During the interview, voice recorder and (if possible) a video camera was used also. The recording data was then transcribed in the form of an interview transcript.

Observation sheets are used to describe observed activities. The observed aspects were teacher preparation, room setting, attendance, and teacher and students activity during the learning process, and learning resources used in the teaching and learning process. The document study was the result of video recording and photographs of activities and the results of student exercise questions. Document study was used to complete the interview result and observation sheet so that it can be used as triangulation material to check the suitability of the data.

The data analysis technique used in the study derived from [8] which suggests that qualitative data analysis is an effort to work with data, organizing data, sort the data so that it can be managed, synthesized, search and find patterns, identify what is important and what is learned, and decide what can be told to others.

## III.RESULTS AND DISCUSSIONS

The results of this study are based on the factors observed and found in the study. These factors include learning obstacle in learning trapezoid concept, early didactic design, the analysis of hypothetical didactic design implementation and empiric didactic design.

### *A. Learning Obstacle*

The didactic design is structured, not only based on the student's obstacle learning but also based on the results of re-personalization, student characteristics, and relevant learning theories. The concept and context of the trapezoid are the results of re-personalization, with a sequence of conceptual development which includes recognizing trapezoid, explaining trapezoid features and types, determining trapezoid formula, and calculating trapezoid area.

The data of early students' learning obstacle on the concept of trapezoid were obtained by through interview with class teachers and some students from sixth grade and by analyzing the students' scores list document owned by the teachers and students exercise books when they were in the fifth grade. From the results of interviews and analysis, learning obstacle on the concept of trapezoid was identified. The learning obstacles consist of an ontogenetical obstacle, epistemological obstacle, and didactical obstacle.

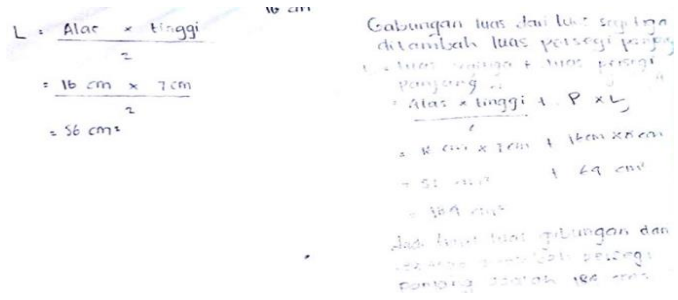


Fig. 1. Learning Obstacle Related to The Prior Knowledge dan Problem Solving

Epistemological obstacles are divided into four types; the first type is related to the prior knowledge that has not been mastered by students, that is, students have not understood how to determine the area of rectangular and triangular builds; the second type of obstacles is related to variations of information; the third type is associated with the concept of trapezoid connected to other mathematical concepts. The fourth type is related to problem-solving. For example, students have difficulty in determining the trapezoid that is made of several triangles. This proves that students experience the third type of learning obstacle. This happens because students have difficulty in finding the relationship between the triangle and trapezoid. Learning obstacles experienced by students because the learning approach given in the form of data. They recommend a clarification approach [9].

### *B. Didactical Design*

Instructional design can serve as an important channel for learning what supports teacher learning over time [10]. The following interview researchers and teachers in preparing the teaching materials.

Researchers: How to set up the didactic design?
Teacher: ...Each didactic design consists of three main stages, namely the initial activity, the core activities and the last activities.
Researcher: What is the usefulness of the initial activity?
Teacher: The first stage is the initial activity. Initial activities are useful for generating motivation and focusing students' attention on the learning process.

High student motivation will help them to understand a concept more easily. Teachers can also direct students' attention by doing apperception, explaining learning objectives, explaining the range of materials to be studied, and describing the activities in accordance with RPP. Apperception is linking the subject matter with the student experience or prior learning. Apperception is important for teachers so that teachers could discover the prerequisites materials that have been mastered by the students. Bruner [11] found that linking a prerequisite learning to the concept will be learned will make learning more effective. In the concept of a trapezoid, the competence that must be mastered by the students is to understand the square, rectangular, triangular, and parallelogram shapes.

Researcher: How about the core activity?
Teacher: The second stage is the core activity. In the core activity, teachers involve students in learning. first, searching and learning from various sources by applying the natural principles; Second, using various learning approaches, instructional media and other learning resources; Third, facilitating the interaction between students, and between students and teachers, the environment, and other learning resources; Four, involving students actively in various learning activities; five, facilitating students to conduct experiments.

The core activity aims to guide and facilitate students in learning. In this research, the core activity was done through group discussion so that students can share with their friends. Teachers should pay attention to all groups in learning. Teachers sometimes have difficulty in cooperative learning activities [12]. The core activity in understanding the concept of the trapezoid is the process of constructing or finding images of various trapezoid forms around them, forming trapezoids from various flat forms, trapezoid features, and types, trapezoid drawing, determining trapezoid area, so as to train students' skills in solving trapezoid concept problems. The following is the flow or the learning stage of the trapezoid concept.

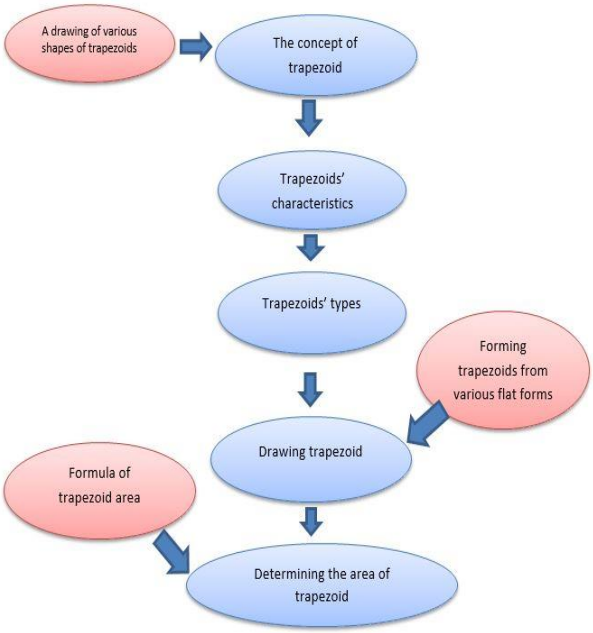


Fig. 2. the flow or the learning stage of the trapezoid concept.

Researcher: How about the last activity?

Teacher:...The third stage is the last activity. The last activity aims to see the students' progress in following the learning process, minimize or reduce learning obstacles experienced by students in learning the concept of the trapezoid and provide reinforcement of understanding to students…

The didactic design for the last activity involves making conclusions about trapezoid concepts, making judgments and/or reflections on the learning of trapezoid concepts, providing feedback and assigning tasks/exercises on trapezoid concepts. In general, this didactic design utilizes three phases to improve students thinking skill in geometry to understand the geometry more easily in accordance with Van Hiele's recommendation [13]. The three phases are visual level, the descriptive level, and the informal deduction level.

After compiling three didactic designs of the trapezoid concept, then the designs were implemented in the 5th-grade students of SDN 3 Lembang and meta-didactic analysis. The new didactic design was a Hypothetical Didactic Design (HDD), a didactic design that is in a form of a prediction or plan that has not been ascertained in accordance with or without the classes' reality. When HHD was implemented in the classroom, students responded differently. There were, therefore, three possibilities, whether the HDD corresponded to the student's response, whether only partial, or whether HDD did not match the response given by the student. This, of course, had already been anticipated by teachers through pedagogic didactic anticipation.

In this research, in general, the implementation of didactic design on trapezoid concept was in accordance with the didactic situation, student response, and anticipation of predicted student response. However, in addition to the predicted responses, there was also a response beyond the prediction so that the teacher anticipates the student's response immediately. Students who were having difficulty, guided by teachers by carrying scaffolding, which provided questions that lead students to think [14].

After the didactic design was implemented, questions were given to identify student learning progress and to know student learning obstacle after the implementation of the didactic design. This activity was the last activity in devising a didactic design, which is a retrospective analysis, wherein didactic situation analysis is contained in a hypothetical didactic design compared to meta-didactic analysis.

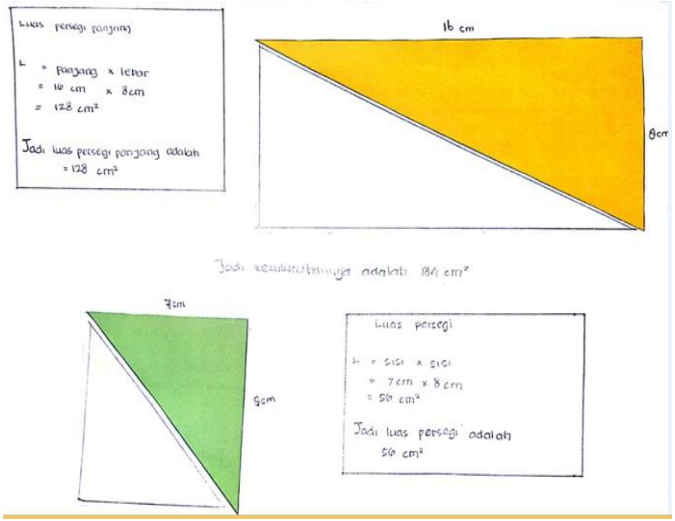


Fig. 3. Students have Mastered The Concept of Trapezoid

Based on the results of the final learning obstacle identification exercise, it is known that there is an increase in student score. Learning obstacle in problem solving, that is 1) Students have difficulty in understanding the keywords that appear in the problem, so cannot interpret it mathematical sentences; 2) Students cannot know what to assume and what information of the problem is required to solve it; 3) Whenever students do not understand the problem, they tend to guess the answer without thinking of any process, 4) Students are impatient and do not like to read math problems; and 5) Students do not like to read long issues. He suggests that designing adaptive environments should take the order of thinking ability, instructional formats, and learner skills are taken into account [15]. Different approaches are combined so as to achieve the development of critical thinking skills anberpikird critical dispositions [16]. The selection of content can encourage and develop the critical thinking of all students, and there should be no limit on the classification of students based on their performance in school [17].

This proves that students have improved in the learning process by using didactic design. It also proves that students who experience obstacle learning are decreasing. Thus, learning by using didactic design can minimize learning obstacle experienced by students. Based on these facts, learning by using

didactic design can be used as an alternative learning for the trapezoid concept.

## IV.CONCLUSION

The discovered learning obstacle is epistemological obstacles that are divided into four types. The first type is related to the prior knowledge that has not been mastered by students i.e students have not understood how to determine the area of rectangular and triangular forms. The second type is related to variations of information. The third type is associated with the concept of trapezoid connected to other mathematical concepts. The last type is related to problem-solving.

The concept and context of the trapezoid are the results of re-personalization, with a sequence of conceptual development which includes recognizing trapezoid, explaining trapezoid characteristics, explaining trapezoid types, determining trapezoid formula, and calculating trapezoid area.

The trapezoid didactic design concept is based on the results of re-personalization, learning obstacle found, student characteristics, and reinforcement by relevant learning theories. The sequence of the trapezoid concept development consists of three main stages, namely the initial activities, core activities, and final activities.

The student's response to the implementation of the didactic design of the trapezoid concept generally corresponds to the initial predictions of the student's response.

Based on the result of the implementation of didactic design, the students learning obstacles have decreased only two type learning obstacle, the first one is related to the context of information variation on the problem, the second type is related to problem-solving. Thus, learning with this didactic design can minimize the increase of learning obstacle related to the trapezoid concept. Therefore, this didactic design can be one of the trapezoid learning design alternatives for elementary school students.

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