The rectangle circumference didactical design based on singing, playing, analyzing, discussing, evaluating (SPADE) learning model

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Abstract. This research is motivated by the ability of students on their low results of preliminary studies related to the concept of rectangular circumference and their learning obstacles. The purpose of this study is to describe students’ learning obstacle on the concept of rectangle circumference, didactical design of rectangular circumference based on the SPADE learning model to overcome learning obstacle. The implementation of the rectangular didactical design circumference concept is based on the SPADE learning model, students' responses to the didactical design of rectangular circumference concept based on the SPADE learning model. The method is a qualitative Didactical Design research model; consist of the three stages, namely: prospective analysis, metapedadidactic analysis, and retrospective analysis. This study conducted in Cibogo primary school, grade IV. The data collection uses the description of the concept of the circumference of a rectangle. The results of the study were teaching concepts in the form of Students’ Activity Sheets and lesson plan, then it will be developed as an alternative that can be used in learning in primary schools and used to overcome learning obstacle in mathematics learning grade IV primary schools on the rectangle circumference.

1. Introduction
Geometry is an important aid for communication and application to real-life problems and topics in basic mathematics [1]. Geometry is a branch of mathematics that was born centuries ago and is used to solve everyday problems" [2]. In geometry, students will learn points, lines, planes, shapes, and their properties and measurements. We use geometric terminology to describe the shape of objects like a, point, line, curve, angle, parallel, circle, square, rectangle, or triangle. This is one indication that having knowledge of geometry is critical to daily life, which encourages many researchers to study geometry from many perspectives. [3]

According Kennedy [4] argued that “Experience gained in learning geometry can develop problem-solving skills and reasoning and support many other topics in mathematics”. From the explanation, it is known that geometry has an important role. Thus, it is included in the mathematics concept in the curriculum. One of the geometry concepts in elementary school is the circumference and area of the rectangular area contained in class IV semester II.

Based on the results of interviews with fifth class teachers SDN Cibogo, the data showed that the lack of student understanding the concept of rectangular circumference. Most students have not understood and comprehended the concept of the circumference of the rectangle and the properties of the rectangle as a whole. Thus, when they found the circumference of the rectangle problem, there are
still many students who have difficulty to solve the problem, even though the concept circumference of the rectangle has been studied previously. This is in line with Herawati [5] argued that “there are still many elementary school students who do not understand the basic concepts of geometry, including understanding flat geometry concepts”.

The researcher also conducted a preliminary study to 22 students of class V SDN Cibogo, by giving them a written test in the form of description to find out the extent of students’ in understanding the circumference of rectangle and to find out any learning obstacle (learning obstacle) that experienced by students. The learning obstacles found were 45.5% of students had difficulty in understanding the concept of the circumference of a rectangle, 15.8% of students had difficulty in determining the properties of rectangle, and 98% of students had difficulty in completing task story problems related to the circumference of a rectangle. Learning obstacle that experienced by these students can be caused by various factors.

The contributing factors are "student mental readiness, teacher’s teaching, and student knowledge that has limited context” [6]. Mathematics learning that tends to be abstract often causes difficulties and problems for students. Thus, students need a contextual and interesting learning design to help them understand and solve problems in learning mathematics, such as using traditional games. The Researchers use the traditional game of “gobak sodor” and SPADE model as a medium to bridge the students in learning mathematics.

Elementary school students still enjoy playing. The use of games in math especially geometry instruction is meaningful in terms of turning abstract concepts into concrete for students [7]. Traditional games are chosen to help students in connecting geometry with everyday life, because traditional games are based on cultural values and beliefs [8]. Traditional games can be easily played in wide variety of environments and without need for sophisticated or expensive instruments [9].

Traditional games can be the true example to show number used to support the rule of games in daily life in Indonesia. The games are exciting activities not only for the children, but also adults who need to get refreshing from their busy activities. Indonesia is the rich country from traditional games, but it’s not clearly anymore to make sure many children to do play traditional games. Since many modern games come to Indonesia, many of them are gradually not to play the traditional games. They like to play modern games, such as PlayStation, online game, etc. in which children can do by their self without go outside of home [10].

Several researchers have shown that students not only improved their geometry learning and achievement levels, but also their understanding of geometric concepts through measuring objects in traditional game. The SPADE learning model is a learning model that is oriented to the five steps of learning activities with traditional game, such as; singing, playing, analyzing, discussing and evaluating. The SPADE Learning Model is a learning model that is the result of Nur’aeni’s research et all [2]. SPADE is seen as a concrete and fun stage of learning mathematics through singing and playing activities to enhance student understanding. Thus, the purpose of this research is to develop didactic designs and overcome or minimize students’ learning obstacle on the concept circumference of the rectangle.

2. Methods

The research method used was a qualitative research model Didactical Design Research (DDR). This method focused on designing, developing and evaluating a particular design as a solution to solve existing problems in educational practice.

The first step is to determine the focus of research in learning mathematics in elementary school. Then, choose the concept in class IV to develop students’ understanding to the concept of the rectangle circumference. In the preliminary study stage, the instruments used were interview guides, attitude scales, and questions related to the circumference of the rectangle. The preliminary study was carried out in class V SDN Cibogo consists of 22 students. Based on the results of the preliminary study, we found learning obstacles experienced by the students on the concept circumference of rectangle. After analysis, the preparation of teaching concept to implement didactic design is carried out. The
implementation is carried out in two cycles, namely the implementation of initial design and the implementation of the didactic design revision after a review of the initial didactic design if there are still shortages to perfect the initial didactic design. Participants involved in this study were SDN Cibogo, and SDN 1 Karangsambung students. Data collection techniques used were interviews, documentation, and observation.

3. Result and Discussion
The following results and research that has been carried out regarding the didactic design a rectangle circumference based on the SPADE learning model. To uncover the learning obstacles experienced by students, a preliminary study was carried out at SDN Cibogo consists of 22 students by giving them questions that related to the circumference of rectangle concept. Based on the results of preliminary studies, revealed that several barriers to learning including:

3. When gobak sodor area as represented on number 2 is similar to rectangle, then state the circumference?

Answer: The side

![Figure 1. Learning Obstacle Type 1](image)

The results of work on problem number 3 shows that students do not yet know the area intended circumference the rectangle based on the drawing.

4. Study the below rectangle!

State the ABCD characters rectangle!

Answer: The angles corner has sampling

![Figure 2. Learning Obstacle Type 2](image)

Type 2 learning obstacle were found based on students’ responses to the preliminary study questions number 4. The results of students’ answers show correct in writing answers to the properties of rectangular flat shapes, students did not write answers correctly and detailed, students should write that rectangles have four right angles $90^\circ$ and it has two pairs of opposite sides and the same length, and two diagonal lines of the same length.
Based on students' responses to question number 6 shows that the lack of understanding to the concept of rectangular flat figure, so it cannot be distinguished between length and circumference. Most likely because students do not usually face different problems. In solving story problems, students should analyze the questions correctly. After understanding what is asked in the problem, then students determine the right solution to answer the question of the story.

The learning focus of the research is the rectangle circumference. The didactic design arranged was a teaching concept in the form of Student Activity Sheet, which was done in groups. The initial didactic design implementation was held at SDN Cibogo consists of 11 students.

This study began with the findings of learning obstacles or student learning barriers related to the concept of a rectangular circumference. Learning obstacles were found include: (1) Type 1: Learning obstacles related to understanding the concept of a rectangular circumference; (2) Type 2: Learning obstacles related to understanding the properties of rectangular flat shapes; and Type 3: Learning obstacles regarding calculating the circumference of a rectangle based on contextual story problems associated with the gobak sodor traditional game.

The initial didactic design is based on the findings of the learning obstacle found during the preliminary study and is integrated with relevant learning theories. In designing this didactic design, the researcher seeks to design learning that is able to facilitate students learning about the circumference of a rectangle and to adjust the developmental age characteristics of elementary school students who are still happy to play and are at the stage of concrete thinking. Based on the theory of learning according to Dienes is a mathematician who focuses his attention on ways of teaching children, dividing 6 stages in a sequence in presenting mathematical concepts namely, the stage of free play, the stage of play, the stage of studying the similarity of nature, the stage of representation, the symbolic stage, formalization stage. The developed system aims to make learning more interesting for students who study mathematics. Every mathematical concept or principle is presented in a concrete form, so that the objects contained in the game will be very meaningful if processed optimally in mathematics learning.

Thus, the researcher uses the traditional game of the Gobak Sodor as a means of students learning about the concept a rectangle circumference. The use of the traditional game of Gobak Sodor also has benefits for students' lives such as improving children's social skills, training student cooperation, especially to preserve Indonesian culture which is increasingly extinct defeated by technological advances. Educational games have the potential to address these challenges and positively impact mathematic learning and attitude [11].

The implementation of didactical design was carried out into two cycles, each cycle consists of one learning meeting. The first cycle was implemented in class IV Cibogo Elementary School with 11 students. The learning activities are carried out in accordance with the learning implementation plan that has been designed with a time allocation of 3 x 35 minutes. Learning consists of three parts, namely preliminary activities, core activities, and closing activities.

The implementation of the second cycle was carried out for the fourth grade students of SDN Cibogo with 15 students. Previous researchers conducted an analysis and study of the results of the initial didactic design implementation, then revised the deficiencies found in the initial design. Revisions were
made to the presentation of teaching concepts as well as pedagogical didactic anticipation. One of the changes made was the improvement in the context of the questions given to students because there was a mistake. The progress of understanding by game, especially gobak sodor, is concrete effort to support rectangle circumference learning in primary school. Using game in learning process, for instance, mathematics learning for primary school can be a mathematics program for young children.

There is no perfect didactic design that is able to meet the needs of students to the fullest, and is able to remove the obstacles of student learning thoroughly and thoroughly. Didactic designs designed in research must always be developed and adjusted again to the needs of students in the field. Therefore, the didactic design designed by the researcher can be developed by the teacher when learning in class in accordance with the situations and conditions needed by students.

Students' responses to the didactical design of the concept a rectangle circumference based on the SPADE learning model seem to make students more enthusiastic when doing learning activities. This didactic design is designed to create learning activities that can create an interesting learning atmosphere and make learning more meaningful with students constructing students' own knowledge. Prediction of student responses that appear in general can be anticipated with the ADP that has been formulated. Whether it's when the initial didactic design implementation or when the didactic design implementation is revised. Age-appropriate educational tools should be considered when developing a disease control program. Children tend to learn best in a more interactive play environment, including the use of games [12]. Play provides opportunities for children to develop their emotional, physical, and social skills. Playing games also provides children with the opportunity to develop their reasoning abilities, including thinking about infection transmission [13]. Empirically tested game-based learning environments which target the development of complex mathematical skills and knowledge in primary school mathematics education are rare [14].

The analysis is based on the initial didactic design implementation; the researcher makes improvements to the presentation of teaching concepts including predictions of student responses along with pedagogical didactic anticipation to prevent barriers to student learning that may arise during the learning process. In designing a didactic design, the teacher performs a personalized approach to the concept the rectangular circumference concept. the thought process by the teacher does not only occur when the process of delivering teaching concept in the learning process, but the ability of the teacher to consider all student responses from every didactic action the teacher makes when learning activities make students better conditioned. Evidenced by an increase in student understanding and student learning outcomes in filling out student activity sheets when compared with the preliminary study or between the implementation of the initial didactic design and the implementation of the didactic revision design.

4. Conclusion
Students’ learning obstacle on the concept the rectangle circumference is divided into three types. Type one, learning barriers regarding understanding the concept of a rectangular circumference. Type two, learning barriers are related to understanding the properties of rectangular flat shapes. Type three, learning barriers related to calculating the circumference of a rectangle based on contextual story problems associated with the traditional game of gobak sodor. Teaching concepts compiled by researchers, namely didactic designs based on SPADE learning models to develop students’ understanding of rectangular concept, can overcome these learning barriers. Learning presented through student activity sheets can reduce or overcome pre-existing learning obstacles. The results of the initial design and revised design that have been implemented show the development of students' abilities. Through gobak sodor, students discover how to learn new things and new patterns, deal with the world, perform their tasks, and use their abilities to overcome problems.

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