Didactic design of circumference and area of square based on Indonesia traditional game in elementary school

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Abstract. This research is based on the students do not have comprehensive understanding on circumference and area of square as the students faced learning obstacles while learning the concept of circumference and area of square. The purpose of this study is to overcome the learning obstacle faced by the students. The research method used in this research is Didactical Design Research (DDR) method which consists of three stages, namely the didactic situation analysis before learning in the form of HLT and ADP; metapedadidactic analysis; retrospective analysis by linking the results of the didactic hypothetical situation analysis with the results of the analysis of the metapedadidactic. Data collection techniques used triangulation techniques (observation, interviews, and documentation studies). This study resulted in a learning design in the form of a circumference didactic and area of square based on Péclé traditional games in grade IV elementary school which can overcome the students learning obstacle.

1. Introduction
At present, geometry is used on a wider scale and reaches all levels of society. The basic concepts of geometry are part of the elementary school curriculum. This is intended to equip students in solving everyday problems by using the basic knowledge of geometry they already have. A simple example of its application is arranging items in the house in the form of geometry so that they can be classified according to their shape.

Some research shows that geometry is one of the mathematical material that is quite difficult for students to understand. Like the research conducted by Nur’aeni on "Development of Geometry Communication Capabilities of Elementary Students through Van Hiele based Learning". The learning is organized into five stages, namely 1) the information stage; 2) directed / integrated orientation stage; 3) exploitation stage; 4) free orientation stage; 5) integration stage. The reality in the field shows that geometry material is not controlled by students [1].

There are many obstacles found after conducting a preliminary study. Students were still unable to understand the circumference and area of square. The students did not answer the question about the formula of circumference and area of square correctly, moreover to be applied in the problem solving. The understanding about circumference was not comprehensive, so when given a combination of several squares to find its circumference, none of the students answered correctly. In the question of area of square, none of them answered correctly. Especially when it came to long question, the students found it very difficult to answer, even to understand the problem, students could not afford it. On the attitude...
scale of many students answering the questions given is difficult, even though the questions given have been learned before in the grade IV. After conducting interviews with grade IV teachers, the delivery of the circumference and area of square was easy to convey. However, when given a question the students have difficulty answering it, moreover the question given is slightly changed even though the end goal is to look for the circumference and area of square. When conveying the circumference and area of square, the teacher used mathematical teaching media in the form of geometry.

Learning obstacle can be caused by several factors, include "otogenesis obstacle (student mental readiness), didactical obstacle (teacher teaching), and epistemological (knowledge of students who have limited application context)". Based on the theory of child development proposed by Piaget in primary school age (around 7 years to 12 years old) children are in the concrete operation stage, where in this stage students are able to understand logical operations with the help of concrete objects.

In essence, elementary school students still enjoy playing. Use of games in math and especially geometry instruction matters tremendously in terms of turning abstract concepts into concrete for students [2]. Therefore, to overcome learning obstacle, a learning design is needed to facilitate students in understanding the circumference and area of square, but adapted to the stages of the developmental age of those who are still thinking concrete and still happy to play. Giving the concept of geometry can be combined with the environment and habits that are often carried out by the students. In this study geometry can be based on traditional games.

Traditional games have more benefits compared to games in the globalization era. Students can recognize, preserve, and increase love for traditional games that contain noble values in them. Traditional games can increase student interest in learning. In addition, through traditional games, students can do learning while playing. So that the learning can be done in the enjoyable atmosphere.

It can then be argued that educator can learn much from the games of children if he is a careful observer. He will note, for example that although the games are spontaneous and unsupervised, there are certain rigid rules, learned from elders or formulated by the children themselves to which they conscientiously adhere [3].

There are many traditional games Indonesia. One of the traditional games that has a connection with the concept of geometry is péclé. In péclé traditional games, there are several geometrical concepts that can be taken. It's very clear, just one traditional game can be associated with some geometry concepts. So, this traditional game fits well with the concept of geometry.

Péclé is one of the traditional games originated from Sunda, West Java. This game is usually played by several children. The péclé traditional game is usually played in the courtyard, by drawing plots and then jumping from one plot to the next with the applicable regulations, using small gentèng (material for rooftop) / gacu media. The use of educational games in Social Studies course for 4th graders in primary education was evaluated in terms of their effect on learning [4].

2. Method
The focus of this study is to overcome the learning obstacle experienced by students in the circumference and area of square material in elementary schools. Based on the learning obstacle experienced by students, a research design was compiled. The research design used in this study was qualitative research method in the form of Didactical Design Research (DDR). Based on the stages of development didactic design research consists of three stages, namely before learning, during learning, and after learning. Didactic design research consists of three stages, namely didactic situation analysis before learning (prospective analysis) in the form of Didactic Hypothesis Design including ADP, analysis of metapedaddidactic, retrospective analysis, namely an analysis that links the results of a hypothetical didactic situation analysis with the results of the analysis of the metapedaddidactic [5].
3. Results and discussion

3.1. Learning obstacle
Learning obstacle could be found from the results of the instrument test that has been previously compiled. The results of the instrument test showed that students experienced several learning obstacles. Didactic obstacle arose as a result of the way teachers taught, starting from planning the learning process, while learning, and after learning. The teacher must really prepare the learning design to minimize obstacles that would occur so that the learning obstacle will not appear again in the future. The following are learning obstacles experienced by the students:

3.1.1. Learning obstacle 1

Based on the students’ responses to problem number 1a, it showed that one student answered "rectangle" while the other student answered "square". Students were expected to not know specifically that the name of the shape was square. However, students may analyze the shape through the condition that the shape has four rectangles. The results of the analysis, 24 students or 96% answered “square”, only 1 student or 4% answered “four square”.

Whereas for the answer to question number 1b all students have been able to answer correctly even though only the final results are included, without including the process.

3.1.2. Learning obstacle 2

Figure 1. Learning obstacle concerned with identifying square images and finding its circumference.
Based on the response to problem number 2, it showed that students experience obstacles in the formula area of square. Students assumed that the size of each square is not the same. Students did not analyze that the problem only includes one size on one side, which is 84 cm. 3 students or 12% did not answer at all, 12 students or 48% wrote the square formula \( l \times w \times h \) without knowing what is meant by length, width, and height in the square image listed, students wrote the formula they knew without being able to distinguish that formula used to find square and rectangular areas was different. 10 students or 40% wrote the formula \( l \times l \times l \times l \). Because the area of square formula has been erroneous, then to solve the problem of finding area of square became wrong. Even students did not use the formula they wrote to answer questions number 2b. Students immediately wrote the results without the process included. So, students were not able to link formulas to the problem of the area of square in question. Overall students’ answers to problem number 2 were all wrong.

3.1.3. Learning obstacle 3

Based on the students’ responses to problem number 3a, it shows that 10 students or 40% were able to answer correctly, which was to describe two squares and name them. 15 students or 60% were only able to describe two squares without giving a name. Students were confused in placing names on the square they have made.

In question number 2b showed that 15 students or 60% are able to calculate the side of each square, 10 students or 40% answered incorrectly. Students who answered correctly did not include the process, only included the final results. While students who answered incorrectly did not know how to find the square side.

In question number 3c showed that none of the students answered correctly. Students’ obstacles in learning were because they were not thorough in understanding the problem and lack of understanding of the circumference and area of square.
3.1.4. Learning obstacle 4

Figure 4. Learning obstacle regarding mathematical connections.

Based on the students’ responses to problem number 4, it showed that none of the students answered correctly. Students included answers without knowing what they wrote. The obstacle that occurred was not being able to understand the combination of several squares, so that students were not able to calculate the circumference and area of square in the picture. Seeing the shape of the picture, students have been confused.

3.1.5. Learning obstacle 5

Figure 5. Learning obstacle related to mathematical connections with daily life.

Based on students’ responses to problem number 5, it showed that 2 or 8% of students did not answer at all, 5 or 20% of students only wrote the final results without mentioning the process and the answer was wrong, and 18 or 72% of students were able to describe the question despite the final answers was not right. So, all students could not answer problem number 5. The obstacle experienced by students was not understanding the purpose of the long question.

3.2. Didactic design of circumference and area of square based on Péclé traditional game in elementary schools

The learning design of the circumference and area of square concept based on the Péclé traditional game in elementary school, compiled by researchers based on the results of the preliminary study analysis in the form of learning obstacle experienced by students. Researchers created learning designs that were appropriate to the children in everyday life, namely didactic design based on traditional games. The design developed in the form of Lesson Plan and Student Activity Sheets. This was applied to create
enjoyable learning and facilitate students in understanding the concept of circumference and area of square, so that learning obstacle could be solved. The researcher compiled the initial design and revised design to get the perfect learning design, and in accordance with the reality that happened in the field. The initial design that the researchers arranged was used as a reference in the improvement of the next learning design, so that a revised design would be arranged as an improvement design that created a similar learning design. Activity steps or activity descriptions on didactic designs can be seen from the following table.

3.2.1. Activity 1
- Students observed on the unmodified arena of péclé traditional games.
- Students created a traditional game arena for modification.
- After conducting observations on the traditional game arena of modification, students wrote them on the Student Activity Sheet and drew conclusions about the square formula.
- Students performed traditional games of modified péclé to calculate the square circumference on each plot of the péclé traditional game arena.
- Students wrote the results of the circumference on the Student Activity Sheet.

3.2.2. Activity 2
- Students understood the formula of area of square.
- Students attached several units of square to prove the formula of circumference and calculate it.
- Students wrote the area of square calculation result on the Student Activity Sheet.

3.2.3. Activity 3. Students solved questions about the circumference and area of square.

3.3. The implementation of circumference didactic design and area of square based on Péclé traditional games in elementary schools
After the researchers performed initial didactic prospective analysis design with regard to learning trajectory (hypothetical learning trajectory) and pedagogical didactic anticipation, the researcher’s implemented didactic design on learning in grade IV elementary school. Students were distributed LAS which contains learning steps to understand the concept of the circumference and area of square.

Students were taken lessons by following the LAS instructions. The final result was to find out the success of students during the learning process, given evaluation questions about the concept of the circumference and area of square.

The learning process results are recapitulated as a whole to find out that there were no more learning obstacle.

Because there were still learning obstacle, a revised design was compiled, overall the learning steps were still the same, only some parts of the LAS were repaired to make it easier for students. Traditional games are a first-rate pedagogical tool available to physical education teacher.

3.4. Student response to learning design
Students’ responses to the learning design of the circumference concept and the area of square based on traditional games at elementary school were seen from the results of the Student Activity Sheet and the results of the data analysis the value of the students’ evaluation of the initial design and revised design based on the value of convection clarification that the students got very good results. In addition, from the results of the analysis of the scale of students’ attitudes towards the initial design and revised design, that students’ understanding was improved by using the didactic design that has been compiled. Based on this, the didactic design in the form of lesson plan and student’s activity sheet could be used in the circumference and area of square learning process in grade IV elementary school. Students in the learning process were very enthusiastic about all activities.

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Based on this, the didactic design in the form of lesson plan and student’s activity sheet could be used
in the circumference and area of square learning process in grade IV elementary school. As has been
pointed out previously, the degree to which spatial skills generic to the life skills and school subjects
can be trained using the various media the now the available, is worthy of urgent further investigation
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4. Conclusion
Research results have pointed that the learning obstacles of students in the circumference and area of
square in the grade IV of elementary school are as follows: a) type 1 Learning obstacles concerned with
identifying square images and finding its circumference; b) type 2 Learning obstacles related to the
formula of area of square; c) type 3 Learning obstacle with respect to the side and area of square; 4) type
4 Learning obstacle regarding mathematical connections; 5) type 5 Learning obstacle related to
mathematical connections with daily life. The response of students to the didactic design of the
circumference and area of square in the fourth grade of the elementary school when the learning process
increases. Students enthusiastically participate in learning, especially when doing traditional games of
pêclé to search the square circumference and attach several units of square to duplex to find the area of
square. The results of learning also increase, from preliminary studies to initial designs, and from initial
designs to revised designs. All students give a positive response to traditional game-based learning. Not
only at the beginning of learning, even to the end of the learning, are students
still enthusiastic about learning.

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