Didactical design of cube nets based on Pecle traditional games in primary school

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Abstract. This research is motivated by the results from the analysis of preliminary study that is the existence of learning obstacle experienced by students on the material of cube nets. Learning obstacles cause the process of students' understanding on cube nets material will meet the obstacles. Pecle traditional game-based didactical design on the cube nets material can be used to help students in understanding the cube nets material, so it can overcome the learning obstacle experienced by the students as well as a tool to preserve the local culture. The research problem in this study is how the didactical design of the cube nets material based on pecle traditional games in primary school. The purpose of this research is to describe about: (1) the learning obstacle experienced by students on the cube nets material, (2) the didactical design of cube nets material based on pecle traditional games, (3) the implementation of the didactical design, and (4) the students’ response. The method used is a qualitative study of DDR (Didactical Design Research) model, with three-step procedure: prospective analysis, metadidactic analysis, and retrospective analysis. The research was conducted in two state primary schools in Tasikmalaya City. The result of this research is a didactical design in the form of instructional materials in the form of Student Activity Sheet (SAS) which is developed as an alternative didactical design used in mathematics learning of primary school on the cube nets material to overcome the learning obstacles experienced by students.

1. Introduction
Mathematics is one of the subjects which occupy an important role in education, because the development of mathematical competence is aimed to improve life skills, especially in developing reasoning, communication, and problem solving [1]. Mathematics material taught in primary school is a basic concept which is widely applied in everyday life. Therefore, it is required an adequate mastery toward mathematical concepts. Regarding to the importance of mathematics, it is required to conduct a planning and improvement of learning to enhance students' understanding.

One of the topics in mathematics in Primary School is geometry and measurement. In more detail, there are two kinds of discussion on geometry in Primary School, namely: two-dimensional figure and geometrical figure [2]. One of the materials on the geometry taught in primary school is cube nets. Referring to the Curriculum 2013 revised edition 2017, the material of cube nets is taught in the fifth grade of second semester in Primary School.

In the preliminary study that has been conducted by researchers toward 48 students of sixth grade in Primary School, we found several learning obstacles experienced by students in comprehending cube nets material. In fact, they had learned the material previously. In general, the students of primary school
age have difficulty in understanding abstract concept in mathematics. Accordingly, mathematics is relatively not easy to understand by primary school students. According to the theory of cognitive development by Piaget [3], conveyed that the real period of operation is at the age of 7 years to 14 years. A fundamental feature of cognitive development at this stage is that the student has the capability to think logically, but only toward the concrete objects”, so in this case, the students’ cognitive development stage of primary school age is concrete. Therefore, according to the progressivism theory that the learning should be carried out naturally without having to be artificial because students’ mental development starts from everyday life which basically looked at the objects around them whole [4]. Thus, it is required to arrange the didactical design accommodating in the real world which will give meaning to the students in learning process.

We will make the appropriate didactical design to the students’ real world in everyday life. It is a traditional game-based didactical design based on the elaboration above. Historical background of traditional games together with previous studies indicates that games and sports have always formed an integral part of social life of humankind [5]. Despite the advantages that game playing can contribute to the learning process, there is an important gap between theory and practice for effective integration of games in the educational programs, due to different barriers for implementation [6]. We chose the Pecle traditional game as a traditional game in line with the cube nets material. It is in line [7] that the principle of mathematics in Pecle traditional games namely (1) the concept of geometry by looking at the boxes depicted a cube framework; (2) the features of the cube. Through the instructional design of Pecle traditional game-based on nets cube material, students will be able to draw a pattern of cube nets for the real use in the game every day. This study also confirmed by research entitled “The Development of Teaching Mathematics Based Culture Activities and Traditional Games for Primary Students in Indigenous of Kampung Naga” [8]. The result of this study indicated that Pecle traditional game contained the concept of geometry, symmetry folding, and geometry webs which could be developed into mathematics instructional design for Primary Schools.

We intend to create and develop didactical design of Pecle traditional game-based cube nets material. Pecle traditional game-based can be used as a tool to preserve the culture, we made a study entitled “Didactical design of cube nets based on Pecle traditional games in primary school”. It is applied to create a pleasant learning and to help students in understanding the cube nets material, so students are able to overcome learning obstacle.

2. Methods

This methods of study used qualitative research methods by using Didactical Design Research (DDR) models. DDR is a special form of the research design application refers to either the development of study or validation of study [9]. The use of didactical design only showed that there was an emphasis on didactic aspects in the didactical design refers to more micro learning theory.

This study was conducted to prepare and develop the instructional design on cube nets material based on the learning obstacles experienced by students according to the explanation above. Through reviewing the learning obstacles experienced by students in the cube nets material, it can be the basis for designing an instructional design and teaching materials in order to anticipate the learning difficulties and to develop students’ understanding ability. The Didactical Design Research consists of three stages, namely: (1) Didactic situational analysis before learning (prospective analysis) which is in the form of a Hypothesis Didactical Design including PDA (Pedagogic Didactical Anticipation), (2) Metapedadidactic analysis, and (3) analysis of retrospective, an analysis which links to the result of hypothesis didactical situation analysis with the results of the analysis metapedadidactic [10].

This research was conducted in two Primary School in Tasikmalaya. Thus, the subjects of this study were divided into two; the subject to identify the learning obstacles, the sixth grade of the first of Primary School and the subject to implement the instructional design, the fifth grade students of the second of Primary School as the implementation of the initial design and the revised design was implemented in fhs first of primary school again. We collected the data with triangulation techniques. Thus, the data
collection techniques used in this study was the test with instrument in the form of question, participant observation, interviews, questionnaires, documentation, and Expert Judgement (assessment experts).

3. Results and discussion

3.1. Learning obstacle on cube nets learning material
The following is a learning obstacle experienced by students in the material of cube nets based on the results of the analysis of each question that researchers conducted on 48 respondents of grades VI A and VI B students. Learning obstacles found are as follows:

3.1.1. Student have not been able to determine the solid geometry of cube and its elements.

![Figure 1](image1.png)

Figure 1. The results of student activities who have not been able to determine the solid geometry of cube and its elements.

Figure 1 shows some students cannot determine which one the picture of the solid geometry of cube is. They assume the picture of an eraser, a pencil case, and milk cans are solid geometries of cube. It should be the picture of an eraser and a pencil case belongs to cuboids. This happens because students do not fully understand the material related to solid geometry of cube.

3.1.2. Students have not been able to determine the solid geometry of cube and its elements.

![Figure 2](image2.png)

Figure 2. The results of student activities who have not been able to determine the solid geometry of cube and its elements.
Figure 2 shows most students cannot determine an arrow indicating which one is the face and which one is the edge of the cube. It happens because students do not fully understand the concept of cube solid geometry, so they do not deeply understand the elements of cube solid geometry.

3.1.3. Students have not been able to determine characteristics of the solid geometry of cube.

Figure 3. The results of student activities who have not been able to determine characteristics of the solid geometry of cube.

Figure 3 shows most students cannot determine the characteristics of cube solid geometry. They mistakenly determine the characteristics of the cube solid geometry. This happens because students do not fully understand the concept of cube solid geometry, so they do not deeply understand the characteristics of cube solid geometry.

3.1.4. Students have not been to determine the cube nets.

Figure 4. The results of student activities who have not been to determine the cube nets.

Figure 4 shows most students cannot determine 4 forms of cube nets. Students make mistakes in determining the forms of cube nets. It happens because students do not understand yet some forms of cube nets.
3.1.5. Students have not been to make the cube nets and cube solid geometry.

Figure 5. The results of student activities who have not been to make the cube nets and cube solid geometry.

Figure 5 shows most students cannot make pictures of cube nets and cube solid geometry. Students still make mistake in creating the pictures of cube nets and cube solid geometry. This happens because students do not understand yet the case in the question, so they cannot create the picture of cube nets and cube solid geometry.

3.2. Didactical design of pecle traditional games-based cube nets in primary school

Didactical design of Pecle Traditional Games-based Cube Nets in Primary School is compiled by researchers based on the results of the preliminary study analysis in the form of learning obstacle experienced by students. We compile the initial design and revised design to get a perfect didactical design, and in accordance with the reality that occurs in the field. The initial design that the researchers arranged is used as a reference in improving the design of the next learning, so that the revised design will be arranged as an improvement design that creates a perfect didactical design.

Moreover, the approach used in compiling didactical design of pecle traditional games-based cube nets relies on the 21st century education concept that uses a 4-C learning approach, which includes Critical Thinking (critical thinking and problem solving), Communication (communication), Collaboration (collaboration), Creativity (creativity and innovation), and applying discovery learning models by directing students to be able to find something through the learning process they do [10]. We compile teaching materials in the form of LAS (Student Activity Sheet) which contains three student activities in Pecle traditional games-based cube nets learning, namely (1) through observation activities, students can determine the cube space and its elements correctly; (2) through Pecle traditional game activities, students can determine the cube nets correctly; and (3) through discussion activities, students can make various forms of cube nets correctly. Thus, through didactical design of pecle traditional games-based cube nets, students will be able to describe the pattern of cube nets to use in everyday games. Following is the preparation of the SAS revised design of pecle traditional games-based cube nets in primary school in primary school.
Figure 6. Layout of students’ activity sheet.
Figure 6 shows about layout of Students’ activity sheet (SAS). SAS (a) has five steps of the activities as follows: 1) Observing objects that resemble the form of the cube solid geometry; 2) Determining objects that resemble the form of the cube solid geometry; 3) Observing the arrow that shows the elements of the cube solid geometry; 4) determining the elements of the cube solid geometry by determining the color of the arrow that shows the face, the edge, and the vertex of the cube; 5) making conclusions about the characteristics of the cube solid geometry. SAS (b) has five steps of the activities as follows: 1) Preparing tools and materials that will be used in Pecle traditional games; 2) Making the Pecle traditional game form using sticks in the similar size; 3) Simulating Pecle traditional game; 4) Exploring three forms of Pecle traditional game arena; 5) Determining the form of Pecle traditional game arena that can be used as cube nets; 6) making conclusions about the form of Pecle traditional game which is a form of cube nets.

3.3. Implementation of didactical design of Pecle traditional game-based cube nets in primary schools
The implementation of didactical design material on cube nets based on Pecle traditional games in primary schools is a pedagogical action taken to achieve the learning objectives. The initial design implication was implemented in class V. The implementation was performed based on the steps or description of learning activities that had been arranged as follows: students observed objects shown by the researcher in the form of cubical packaging box, students then observed nets from the packaging box shown by the researcher, students discussed doing SAS activity 1, students simulated Pecle traditional game, students made various forms of cube nets, students demonstrated in front of the class the results of discussions about various forms of cube nets, and students simulated the Pecle traditional game using the arena shape of the cube nets. The steps or description of learning activities that had been arranged in the revised design were: students observed dice, students observed dice nets, students discussed doing LAS activity 1, students simulated Pecle traditional game, students discussed doing LAS activity 2, students made various shapes of cube nets, students demonstrated in front of the class the results of discussion about the shape of cube nets patterned 1-4-1, 2-3-1, 2-2 -2, or 3-3, and students simulated a traditional game in the form of cube nets with one of the 1-4-1, 2-3-2, 2-2-2, or 3-3 patterns.

3.4. The response of students to didactical design of cube nets based on Pecle traditional games in primary school
The student’s responses to didactical design of cube nets based on Pecle traditional games in primary school that the researchers have implemented, seen from the results of data analysis of SAS values and the result of data analysis of student’s evaluation values in the initial design and revised design based on the classification of conversion values, indicated that students got very good results. The revised SAS can be used in the learning process regarding the material of cube nets in the fifth grade of primary school. Students were so enthusiast in all activities of learning process that it could facilitate learning mathematics. Consequently, the integration of traditional games in the elementary school classroom was equally accepted among all students, since their personality traits did not influence their experience or learning performance [6].

4. Conclusion
Learning obstacle experienced by students in the material of cube nets, including the following: determining the image of objects in the form of a cube space, the elements of cube space, the properties or characteristics of the cube space, the shape of cube nets and various forms of cube nets and creating cube nets and building cubes.

Didactical design of cube nets based on Pecle traditional games in primary school has activities which is in accordance with activity stages in basic design of Pecle traditional game. The learning approach is based on the 21st century education concept, which uses a 4C (Critical thinking, Communication, Collaboration, Creativity) approach, and applies discovery learning models.

The student’s responses to the didactical design of cube nets based on Pecle traditional games in primary school were that the students were so enthusiast in all learning activities that students enjoyed...
learning mathematics. Based on the data analysis result of SAS values and students’ evaluation values in the initial design and revised design based on the value conversion classification, it was indicated that students got completely good results.

References

[1] Kemendikbud 2017 Model Silabus Mata Pelajaran Sekolah Dasar/Madrasah Ibtidaiyah (SD/MI) (Jakarta: Kementrian Pendidikan dan Kebudayaan)

[2] Nur’aeini E and Muharram M R W 2016 Didactical Design Research of Mathematical Communication about Concept of Cuboid Volume in Elementary School Proceeding of 3rd Internasional Conference on Research 101-104

[3] Mudlofri A and Rusydiyah E F 2017 Desain Pembelajaran Inovatif dari Teori ke Praktik (Jakarta: PT Rajagrafindo Persada)

[4] Susanto A 2016 Teori Belajar dan Pembelajaran di Sekolah Dasar (Jakarta: Prenadamedia Group)

[5] Dehkordi M R 2017 The Educational Impact of Traditional Games: the Role of Zurkhaneh Sport in Educating Children International Journal of Science Culture and Sport 5 3 134-139

[6] Trajkovik V, Malinovski T, Vasileva-Stojanovska T and Vasileva M 2018 Traditional games in elementary school: Relationships of student’s personality traits, motivation and experience with learning outcomes PLoS ONE 13 e0202172

[7] Surahmi E 2016 Permainan Tradisional dalam Pembelajaran Matematika SD sebagai Bentuk Interaksi Sosial Siswa Proceeding of National Seminar of Mathematics Education 132-140

[8] Muzdalipah I and Yulianto E 2015 Development of Teaching Mathematics based Culture Activities and Traditional Games for Elementary Students in Indigenous of Kampung Naga Journal of Siliwangi Education Series 1 1 63-74

[9] Lidinillah D A M 2014 Educational Design Research : a Theori Framework [online] retrieved from http://file.upi.edu/Direktori/KD-TASIKMALAYA/DINDIN_ABDUL_MUIZ_LIDINILLAH_(KD-TASIKMALAYA)-197901132005011003/132313548%20%20dindin%20abdul%20muz%20lidinillah/Educational%20Design%20Research-A%20Theoretical%20Framework%20for%20Action.pdf

[10] Ontario 2016 Phase 1: Définir les Compétences du 21e Siècle pour l’Ontario Édition de l’automne Compétences du 21e Siècle: Document de Réflexion