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Development of the Pythagorean Theorem Learning Path with the PMRI Approach using the Context of Tiled Tangram

Delia Septimiranti[1,*], Cecil Hiltrimartin[1]

[1]Master of Mathematics Education Study Program, Universitas Sriwijaya, Palembang, Indonesia
[*]Corresponding author. Email: septimirantidelia09@gmail.com

ABSTRACT

This research uses the research design method or the type of research development type validation study that obtain a product, where the product is the product of the students learning trajectory when learning the Pythagoras theorem with a realistic approach. Are able to develop the context of the squared tangram by connecting in to the Pythagorean theorem material, students better understand and understand how to solve the problem. Students understand more about learning methods related to students real life use Tiled Tangram. The implemented into a formal form of mathematics. The Pythagorean theorem is one of the mathematics material that is always associated with other mathematical materials such as flat and geometric material. By using this PMR approach, the material learned will be displayed and linked to real life. PMR encourages students to be able to bring students to more optimal learning and connect it to real everyday life.

Keywords: *Pythagoras theorem; Design Research; Squared tangram; PMR.*

1. INTRODUCTION

A part of the national education system that makes an important contribution in shaping the character of students is a learning in mathematics. Subjects that must be studied by students are mathematics subjects. What students need to learn in mathematics is that the first is that it is always used in terms of daily life, the second is that all fields of study require appropriate mathematics, make communication tools accurate and strong, can be used to convey information using various ways, then increase students' skills in logical thinking, accuracy and spatial awareness, and the last is to provide opportunities for students to their efforts in solving problems that stimulate adrenaline However, there are still many students who have difficulty and do not like mathematics because for students mathematics lessons are difficult and difficult to understand and understand, because mathematics lessons are always associated with formulas, numbers, and propositions [1]. This states that mathematics becomes a less meaningful lesson for students.

If mathematics learning is tied to students' real life, then mathematics learning will be more meaningful for students by developing mathematical ideas. One of the sub-materials taught at the junior high school level is the Pythagorean theorem. [2] If it leads to the mathematics curriculum at the junior high school level, understanding this material will help students achieve an understanding of the next material such as tangent to circle material, quadrilateral and triangle material and other mathematical material. If students have communication skills that characterize these students have an understanding of mathematics to its roots to the mathematical concepts being studied [3].

The Pythagorean theorem is one of the mathematical materials that is always connected with other mathematical materials such as flat and geometrical materials. In other words, the Pythagorean Theorem is a theorem used when calculating the area of a plane figure. The

Pythagorean theorem is one of the basics in developing students in understanding other mathematical material, flat/flat is one of them. However, the material used can also be used in the fields of daily life, such as the science of architects, one of which is the science of architects. Judging from the important role of studying this material, this material should be more optimized for learning. However, in

fact, students still have difficulty in learning the Pythagorean Theorem. This can be seen from the results of the low preliminary study tests conducted by researchers that only 3 students scored greater than 75 out of 28 students [4]. Students are taught formally, students are not able to develop their reasoning abilities on the concept of the Pythagorean theorem.

This situation was also found when conducting observations and interviews with teachers at SMP Negeri 26 Palembang. When learning takes place, the teaching materials used by the teacher are in the form of textbooks that have been prepared by the school without designing interesting learning for students so that the Pythagorean material can become more optimal and effective learning. The teacher conveys learning in line with the existing plot in the book, not from the results of the teacher's thoughts in designing learning. However, when viewed from the course of learning in the book, it cannot stimulate student knowledge completely. [5] The material in the book is presented directly with concepts without any process of involving students in finding concepts in the material that has been studied.

From the statement above, a new innovation in learning is needed in the form of a learning trajectory or learning trajectory with various approaches that will help students understand the concept of the Pythagorean theorem. By using this approach, it will be able to help students in solving math problems related to Pythagoras and get satisfactory learning outcomes. The learning trajectory is a learning design that sees students' thinking levels actively increase students' knowledge for a long time. The learning trajectory reflects students' thinking with various activities in order to achieve a learning goal. From this activity [6], students will participate in learning and connecting the material with everyday life. According to [7] said that by actively involving students during the learning process will result in cognitive development in students naturally.

In the learning trajectory, the learning objectives are detailed in the sub objectives while the learning process is designed based on the data obtained in the classroom to the school environment. If the learning objectives can be linked to the learning process, this aspect will make it easier for teachers when designing a series of work to design more optimal learning activities. [8] In leading the learning trajectory, various approaches are needed that will make it easier for students to understand the Pythagorean theorem, so students are asked to be able to solve all mathematical problems correctly and get good learning outcomes. Among them, the approach that is always used in developing learning trajectories is a realistic mathematics education approach.

One solution that can be used to improve students' understanding when learning mathematics is the Realistic Mathematics Education Approach (PMR). The concepts carried out in learning using this approach are broader than other approaches. Students act as active participants during the learning process so that students will develop their mathematical ideas. Meanwhile, the teacher acts as a facilitator in the learning process. By using this PMR approach, the material learned will be displayed and connected to real life. [9] PMR encourages students to be able to bring students to more optimal learning and connect it to real everyday life. Students are given problems related to real life, namely problems related to the conditions experienced by students' daily lives.

This constructs in harmony with the understanding of constructivism theory which believes that knowledge cannot be shared in any way from person to person without activities carried out by the person who will know the science itself. The results of [10] say that a realistic mathematics education approach will result in an increase in learning outcomes, by developing creativity, solving problems, and motivating students in learning. PMR can also improve students' communication skills during the learning process. Suggest that the designed learning trajectory can provide opportunities for students when they get a mathematical understanding concept model and students succeed in finding their own mathematical model with the help provided by the teacher.

Therefore, the learning trajectory using the PMR approach will assist students in connecting the Pythagorean theorem material with everyday life that has been experienced by students. The approach used in this approach is not more than a facilitator, but a moderator or evaluator, while the students are more active and think, express their opinions, focus their respective answers, and practice the nuances of democracy or challenges. on the opinion of others. [11] The research that will be used by the researcher this time relates to the Tangram plot with a triangular shape in each pattern. Tangram is one type of puzzle that is very often found throughout the world. According to [12] tangram is a puzzle that has an arrangement of seven flat pieces known as ' tan'. The use of this method has been studied by several researchers, according [13] in designing flat shapes learning using the “dog catches cat” fable and tangram puzzle Based on this description, the researcher will develop and design a learning trajectory for the Pythagorean Theorem material by using the Tangram with Ticks in the PMR approach and applied to class VIII students. [14] Some of the objectives of this research are to find out the students' conceptual understanding of the Pythagorean theorem material using the context of the squared tangram for class VIII students. Here is a picture of a seven-piece tangram shape. With the puzzle shape in the picture above students can move the seven existing pieces by making a free triangle shape according to the student's wishes. With this, students can present various forms related to triangles so that they can be connected with

the Pythagorean theorem material.[15] The shape of this tangram game is used by designing or assembling pieces of tangram and then affixing the sides of the same length to form the desired geometric shape. The alignment of the tangram game for students is to arrange the seven tangram pieces into a coveted polygon. Consists of 13 shapes including 1 triangle shape, 6 quadrilaterals, 2 pentagons, and 4 hexagons. In this lesson students will use a triangle shape.

2. RESEARCH METHOD

This research uses the method of development or Research and Development (R&D) [16]. Development is a research method that produces a certain product, or can be said to improve an existing product. Graveimeijer and Van Erde said that research design is a research method by developing learning trajectories with teachers and researchers together to design more optimal learning The research design according to Graveimeijer and Cobb has three phases, namely: preliminary design, experiment, and retrospective analysis.

2.1. Preliminary Design

In this phase, the learning trajectory is made. In this case, the learning trajectory made is a prediction that will occur, whether it is in the form of students' thinking processes who will get learning or other things that will happen in the learning process. In making a learning trajectory, the initial step taken is to examine accurate literature, discuss with teachers and experts. The main objective in this phase is to develop an arrangement of learning activities and instrument designers to re-evaluate the learning.

2.2. Design Experiment

The design that has been designed will be tested in the field, namely in the classroom. This trial is useful to see what things that must be seen and observed in the preliminary design phase are appropriate or not in accordance with the design that has been made. This trial also has the aim of exploring and predicting students' strategies and thoughts during the actual learning process.

2.3. Retrospective Analysis

All data that has been obtained will be in experimental analysis. The analysis process is in the form of comparing the anticipated learning trajectory with before the learning takes place, and the activities that have occurred will be continued by analyzing the possible causes and synthesizing what will be done in improving the learning trajectory in the next cycle.

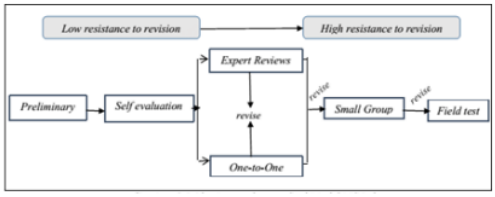

Figure 1 Formative evaluation design.

3. RESULTS AND DISCUSSION

At the time of conducting research, researchers were able to develop a learning path based on real life. At this research stage there are several stages and development step.

3.1. Preliminary design

The researcher applies the initial idea about the meaning of the Pythagorean theorem, then proves the Pythagorean theorem, then determines the types of triangles by using a squared tangram. Conduct an analysis of student needs. Conducting observations at SMP N 26 Palembang to discuss whether the context used is appropriate or not to be used at the final stage in designing the learning trajectory. All activities in triangle learning are designed in such a way according to the learning trajectory and thinking processes of students who are instructed in 2 meetings for 2 activities. Starting from understanding the concept as well as understanding and knowing how to calculate the length of one side of a right triangle and the types of triangles.

3.2. Design Experiment

Researchers at this stage will try out the design of the learning trajectory by using the context of the plotted tangram, whether it will affect the students. In this case, the aim is to implement and be able to see the assumptions of the students' strategies and thoughts during the actual learning process. At the beginning of this trial, 2 activities were given for 2 meetings. During the trial period, the learning activities were carried out by two observers, namely Arika Sari and Pandu Aditya as colleagues. The observer acts as an observer of the implementation of learning in using the learning trajectory design based on the observation sheet that has been provided.

3.3. Analysis Retrospective

Researchers conducted an analysis at this stage of the learning process taking place. This process is carried out by comparing the results of observations during the learning process with the learning trajectory that has been designed at the preliminary design stage.

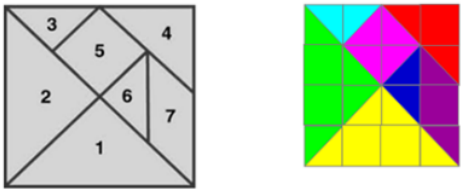

Figure 2 The learning process in the classroom.

Figure 3 Hypothetical Learning Trajectory (HLT).

In learning, it is designed to produce learning activities for the Pythagorean theorem material in order to help students understand the concept of the Pythagorean theorem. In this step, students discuss with their group members to solve the problems contained in the LKPD. The following is the process when students discuss with their group members in solving a given problem.

Figure 4 One to one.

After the questions are given, students are asked to understand, read the questions in the LKPD. Then students construct questions on the LKPD with the abilities of students that have been studied previously.

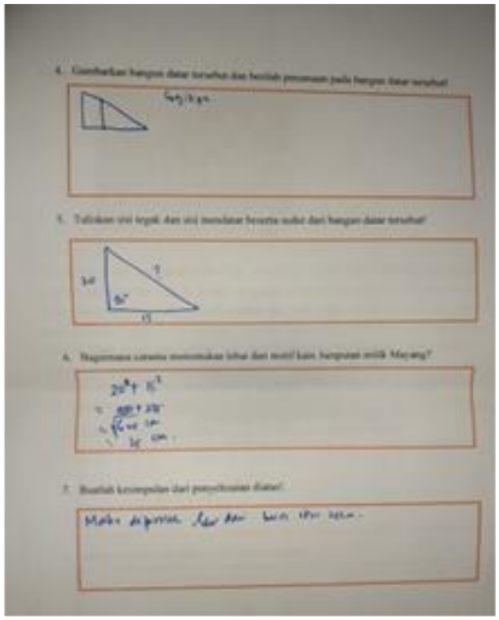

Figure 5 Student solve the problems an question.

At this stage, students discuss in groups to solve problems in the questions. Then each student works on the questions and analyzes the questions that have been given. Figure 3. Students' answers after completing the questions

Based on Figure 3, it can be seen that students are able to solve Pythagorean material problems. These activities have been carried out and can be concluded by helping students understand the number pattern material. All of these things will be in accordance with the results of the retrospective analysis in the activity phase 2 (teaching experiment). The learning will be in accordance with the HLT that has been designed and students can conclude the Pythagorean theorem material by using the context of the squared tangram.

4. CONCLUSION

This study uses a research design method or a type of research development type validation study that obtains a product, where the product is a product of student learning trajectories when learning the Pythagorean theorem with a realistic approach. Students are able to develop the context of the squared tangram by connecting it to the Pythagorean theorem material, students better understand and understand how to solve the problem. Students better understand the learning methods related to students' daily lives, then implemented in the form of formal mathematics.

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