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# Design of mathematics learning in the grand mosque of palembang

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# Design of mathematics learning in the grand mosque of palembang

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**Abstract**. This study aims to describe the role of the context of the Grand Mosque of Palembang to support the mathematics learning process and produce learning trajectories to help students in understanding quadrilateral material (square, rectangle, and isosceles trapezoid) with RME approach. The methodology in this research is design research, consisting of preliminary design, design experiment, and retrospective analysis. The subjects are seventh graders of MTSN 1 Palembang. The instruments in this research are videos, documentation, student activity sheets, pre-test, and post-test. The results show that the context of the Grand Mosque of Palembang helps students to compare and connect the perimeter and area of a rectangular plane. All strategies and models that students find, describe and discuss, show how the construction and contribution of students help their initial understanding of the topic. In experience based activity, comparing and connecting the perimeter and area of rectangular plane holds an important role in transitioning from informal to formal levels.

## 1. Introduction

Rectangular plane construction is one form of geometry that is very important and useful in everyday life. Junior High School level students need to understand the surrounding material and the rectangular flat area because this material is related to more abstract topics such as solids, trigonometry, and Pythagorean theorem. During this time, when students are confronted with a rectangular plane and asked to compare and connect the perimeter and area, they often make mistakes [1]. Being able to actively and meaningfully compare and connect the perimeter and area of a rectangular plane will help students develop their level of geometrical thinking [2, 3]. This means to prevent students from merely memorizing the concept as an empty statements without the opportunity to experience meaningful learning [4]. Professional and highly educated teachers effect the quality of curriculum, teaching material, and students [5]. This means every teachers must be able to be creative and innovate in the teaching and learning process in order to contribute in the development of the education world.

The curriculum is one element that can make a significant contribution to realizing the process of developing the quality of the potential and skills of students [6]. Therefore, learning mathematics must also be able to make students actively promote their competencies. One of the efforts is by employing contextual or realistic mathematics learning activities using the RME approach. RME allows students improve their ability to think, reason, communicate and solve problems both in learning and in everyday life [7]. Several studies stated that RME approach promotes students activity, motivation, learning achievements [7 – 14].

Learning is an active process that allows humans to discover new things beyond the information provided to him [15]. For example, a student who studies the perimeter and area of a plane figure will

be able to find important and interesting things that benefits in daily life. One way to make students active in learning is through choosing the right context to help mean the material that being studied.

RME approach emphasizes on the use of context as a starting point in teaching and learning mathematics [7]. The use of context that links the studied concept with daily lives improve students in problem-solving. Using the right real context is more advisable because it will help students to perceive and more easily interpret information [16]. In this study, researchers will employ the Grand Mosque of Palembang as a context to rectangular plane material.

The Grand Mosque of Palembang is one of the historical worship buildings in the city of Palembang, the Grand Mosque of Palembang area is located in the heart of Palembang City, or 1 kilometer of Palembang City. The construction area of the Grand Mosque of Palembang began on 1 Jumadil Late 1151 H (1738 AD) and was inaugurated on 28 Jumadil Early 1161 H (May 26, 1748 AD). The location of the construction of the Grand Mosque is located on an "island" surrounded by rivers, south of the Musi River, west of the Sekanak River, east of the Tengkuruk River and north of the Kapuran River [17]. The Grand Mosque of Palembang as a learning medium arranged according to certain rules. The Grand Mosque of Palembang can be used to help students in completing the perimeter and area of a rectangular structure, one of them is the problem of comparing and connecting rectangular area and the building width.

Based on the description, the researcher will design and develop Local Instructional Theory (LIT) based on the Grand Mosque of Palembang as a starting point in mathematics learning of rectangular planes (square, rectangular, isosceles trapezoid). This study aims to produce a learning trajectory to assist students in understanding the topic with the RME approach. Three principles in RME learning are guided discoveries and progressive mathematical (guided reinvention and progressive mathematically), didactical phenomenology, and self-developed models [18]. Four levels of RME learning are situational level, referential level, general level, and formal level as shown in Figure 1 [18].

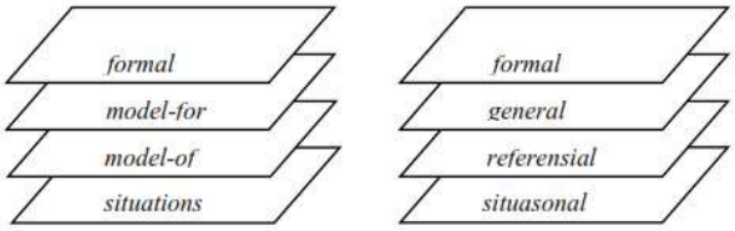


**Figure 1.** Level of RME learning

The activities designed in this study use the RME approach, since RME helps students find the mathematics concepts, express opinions, respond to questions, answers, and provide reasons for each answer to the question. By using the Grand Mosque of Palembang media as a starting point in learning activities, students are expected to be able to compare and connect the perimeter and area of a rectangular planes, such as square, rectangular, and isosceles trapezoid. Therefore, the design of mathematics learning quadrilateral plane in this study will be using the Grand Mosque of Palembang media as the context and RME as the instructional approach.

## 2. Method

The research method uses a design research method that designs quadrilateral plane material (square, rectangle, and isosceles trapezoid) using the context of the Grand Mosque of Palembang. The activities of design research are cyclic processes [19]. When the reality does not follow the design, it is necessary to do a redesign (thought experiment) on the Hypothetical Learning Trajectory (HLT) to then be tested again. The cycle of design research in the form of a cyclic process can be seen in Figure 2.

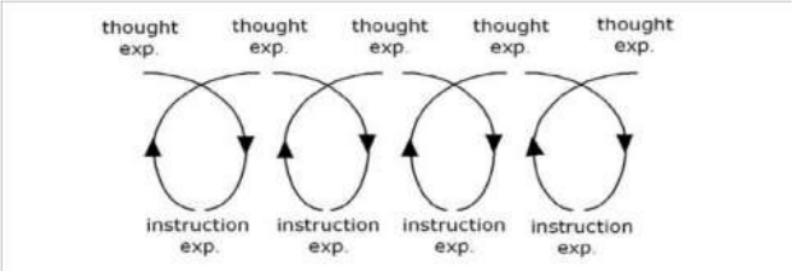


**Figure 2.** Design Research cycle

This design research consists of 3 stages namely preliminary design, with the aim of reviewing the literature to design learning activities, design experiment, which is the stage of carrying out the designed activity, and retrospective analysis, which are analyzing the data obtained to find out whether the activities carried out support or not in accordance with the previously designed conjecture of thought [20].

Subjects involved in the study were teachers and students of grade seven of MTSN 1 Palembang, which was conducted in an odd semester of the academic year 2019/2020. In the pilot experiment stage, 6 $7^{th}$ graders were selected based on their academic abilities. In the Teaching experiment stage, 41 $7^{th}$ graders students were involved.

## 3. Result and Discussion

From the results of the documentation of subject 1, subject 2, and subject 3 it can be concluded that the historical worship building in Palembang is the Grand Mosque of Palembang. The Grand Mosque of Palembang area is dominant with square, quadrilateral, rhombic, and isosceles trapezoid sizes. The mosque's building materials are made of bricks clad in cement without bones. The building has a traditional architecture with a three-tiered pyramid roof [17]. The roof of the Grand Mosque of Palembang in religious figures, worshipers, and the surrounding community is in the form of a trapezoid. The roof of the mosque building has a special meaning. Interpreting overlapping roofs as follows: (1) The lowest roof and the floor symbolize sharia and human deeds; (2) The second level roof symbolizes Tariqat, which is the way to achieve the blessing of Allah SWT; (3) The third level roof symbolizes the Nature, that is the spirit or nature of one's deeds; and (4) the peak (Mustako) symbolizes Ma'rifat, the level of knowing God the Most High. The Grand Mosque of Palembang at its peak (Mustaka/Head roof) from the roof of the mosque has a cymbal group of 50 thorns with 2 x 12 thorns on the two sides and 2 x 13 thorns on the other side. This loose form of Mustaka curves upward at the four ends that resemble the shape of a roof on the roof of a Chinese building [21].

Between the mustaka roof and the separate part separated by a neck decorated with floral motifs. On the signpost is made of metal engraving. The mustaka roof is supported by 4 poles as pillars, with a height of ± 8 meters and a circle line measuring $\pm$ 158 $cm$, in the form of an eight square. In addition to the pillars of the teacher's pillars, there are 12 pillars of the lower part of the mustaka roof, measuring 6 meters high with a circumference of $\pm$ 96 $cm$ and also having an eight square shape. All of these mosque poles are made of ironwood (wood) and not connected. According to reliable information, this pole was imported from Kalimantan. No information can state how old the unglen tree is. The age of the Grand Mosque at this time when calculated with Hijriyah is 274 years old, whereas if calculated by the year AD is 266 years old [17].

The last pulpit before being replaced with a wooden pulpit now is built of stone, sand, and cement and on the pillars in a prop with iron plates measuring 1 × 5 cm × 2 meters. The pulpit stairs are made of stone with 6 steps. The pulpit is carved with flower and leaf paintings in red and yellow gold. On the roof of the dome-shaped pulpit decorated at the top with an iron flag that reads *Laailahaillallaah* [22]. The front of the stairs is decorated with two poles as the entrance to the pulpit, above the arch-shaped

connecting to the two poles painted red with yellow gold. On the left side of the pulpit is the place where the priest is leading the prayer.

The construction of the Grand Mosque of Palembang began on 1 Jumadil Late 1151 H (1738 AD) and was inaugurated on 28 Jumadil Early 1161 H (May 26, 1748 AD). The location of the construction of the Grand Mosque is located on an "island" surrounded by a river, south of the Musi River, west of the Sekanak River, east of the Tengkuruk River and north of the Kapuran River [17].

In the learning process, several stages are carried out, namely the preparation phase for research (Preparing for the experiment), the design of the experiment (the design experiment). At the time of the preliminary design, a literature review was carried out and then the HLT design was obtained from which the HLT design obtained a Student Activity Sheet which the students would use in the learning process. The initial HLT that was designed by the researcher was discussed with the model teacher. HLT includes learning objectives, mathematical ideas as well as planned activities or suspected student activities that can develop during the learning process. The activities in the research are explained as follows.

*3.1. Activities 1, 2 and 3: Comparing The Perimeter and Area of A Quadrilateral Plane*

The purpose of learning in student activity sheets 1, 2, and 3 is that students can compare the perimeter and area of a quadrilateral plane based on ethnomathematics in the context of the Grand Mosque of. Learning begins with the teacher opening the lesson and beginning with apperception activities, then the teacher divides student activity sheets 1, 2, and 3 to each group. Then the teacher asks students to discuss and conduct experiments and answer the questions contained in the student activity sheets 1, 2, and 3. Students discuss in their respective groups to solve the problems contained in student activity sheets 1, 2, and 3 as seen in Figure 3.

**Figure 3.** Students discuss to solve problems

Based on Figure 3, students can compare the perimeter and area of quadrilateral plane on student activity sheets 1, 2, and 3. Students also carry out activities to solve problem problems comparing the perimeter and area of quadrilateral planes on student activity sheets 1, 2, and 3. The purpose of this activity is for students to compare the perimeter and area of a quadrilateral. The following students' answers on the Student Activity Sheet 1 are given in Figure 4.

Based on Figure 4, it can be seen that students can already compare the perimeter and area of a quadrilateral plane. So that the students' answers to the problem of activity 1 isosceles trapezoid is $ABCD$ the results are $a = 14\ m$, $K_{ABCD} = 40\ m$, $b = 20\ m$, and $c = 3\ m$ and $EFGH$ the results are $b = 20\ m$, $L_{EFGH} = 34\ m^2$, $a = 14\ m$, and $t = 2\ m$. So the $ABCD$ and $EFGH$ isosceles trapezoid has the same size, 2 square $PQRS$ activity results are $s = 20\ m$, $K_{PQRS} = 80\ m$ and $TUVW$ the results are $s = 14\ m$, $L_{TUVW} = 196\ m^2$ and $s = 14\ m$. So the $PQRS$ and $TUVW$ squares are not the same sizes, and the activity of 3 rectangles A results $p = 6\ m$, $K_A = 16\ m$, and $l = 2\ m$ and B results $l = 2\ m$, $L_B = 12\ m^2$ and $p = 6\ m$. So rectangles A and B have the same size.

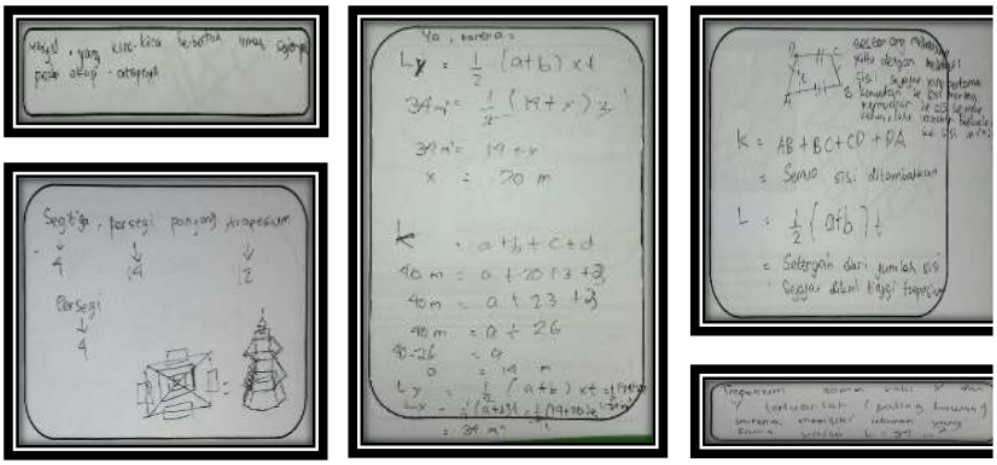

**Figure 4.** Students can compare the perimeter and area of a quadrilateral plane

*3.2. Evaluation: Connecting The Perimeter and Area of A Quadrilateral Plane*

The purpose of learning in this evaluation is so that students can connect the perimeter and area of the quadrilateral flat based on the context of the Grand Mosque of Palembang on the evaluation sheet. Learning begins with the teacher opening the lesson and beginning with apperception activities, then the teacher divides the evaluation sheet into each group. Then the teacher asks students to discuss and conduct experiments and answer the questions contained in the evaluation sheet. Next figure 5. Students discuss in their respective groups to solve the problems contained in the evaluation sheet.

**Figure 5.** Students complete problems on the evaluation sheet

Based on Figure 5 above, students connect the perimeter and area of a quadrilateral plane on the evaluation sheet. Students also carry out activities to solve problems around the area and the quadrilateral flat area on the evaluation sheet. The purpose of this activity is for students to connect the perimeter and area of a quadrilateral plane. The following answers students on the evaluation sheet provided.

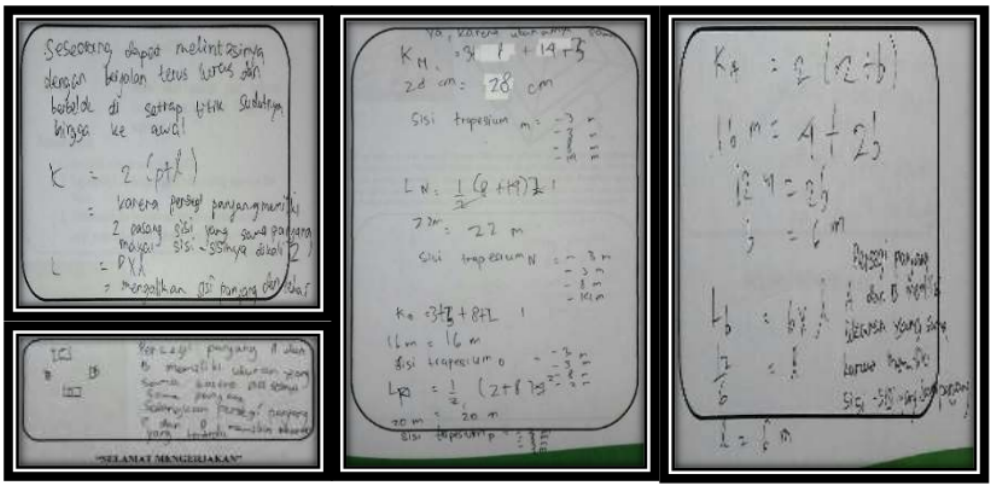

**Figure 6.** Students can solve problems around and the area of the quadrilateral

Based on Figure 6 above, it appears that students can connect the perimeter and area of a quadrilateral plane. So that students' answers to problem 1 can be seen in formula 2. Formula 2 can be used directly to find the area of an isosceles trapezoid if a and b isosceles trapezoid is known, problem 2 can be seen in formula 2. Formula 2 can be used directly to find the area of a rectangle if $p$ and $l$ rectangles are known, and problem 3 can be seen in formula 2. Formula 2 can be used directly to find the area of a square if s square is known.

Material learning activities around and wide quadrilateral plane as the following description. The first activity invites students to compare and connect the perimeter and area of the quadrilateral flat building context of the Grand Mosque of Palembang on student activity sheets 1, 2, and 3. Students begin the activity by paying attention to the Student Activity Sheet 1, 2, and 3 questions that are given. From these activities, students compare the perimeter and width of the square shape of the context of the Grand Mosque of Palembang. After that student are asked to compare the perimeter and area of a quadrilateral plane what are the answers to activity 1, activity 2, and activity 3. Then the students know how much the results of the activity of 1 isosceles trapezoid is $ABCD$ the results are $a = 14\ m$, $K_{ABCD} = 40\ m$, $b = 20\ m$, and $c = 3\ m$ and $EFGH$ the results are $b = 20\ m$, $L_{EFGH} = 34\ m^2$, $a = 14\ m$, and $t = 2\ m$. So the $ABCD$ and $EFGH$ isosceles trapezoid has the same size, 2 square $PQRS$ activity results are $s = 20\ m$, $K_{PQRS} = 80\ m$ and $TUVW$ the results are $s = 14\ m$, $L_{TUVW} = 196\ m^2$, and $s = 14\ m$. So the $PQRS$ and $TUVW$ squares are not the same sizes, and the activity of 3 rectangles A results $p = 6\ m$, $K_A = 16\ m$, and $l = 2\ m$ and B results $l = 2\ m$, $L_B = 12\ m^2$ and $p = 6\ m$. So rectangles A and B have the same size. After students know the value of comparing the perimeter and area of a quadrilateral plane requested, students can also understand how the writing, pronunciation of the perimeter and area of a quadrilateral flat figure, besides that students can find out ways to compare the perimeter and area of a quadrilateral plane context the Grand Mosque of Palembang on student activity sheets 1, 2 and 3.

The evaluation sheet invites students to connect the perimeter and area of a quadrilateral flat using in the context of the Grand Mosque of Palembang on the evaluation sheet. Students start the activity by paying attention to the evaluation sheet questions given. From these activities, students connect the perimeter and square shape area of the Grand Mosque of Palembang. After that student are asked to determine how many answers to problem 1, problem 2, and problem 3. Then students find out how the results of problem 1 can be seen in the formula 2 relationship. Formula 2 can be used directly to find the area of an isosceles trapezoid if $a$ and $b$ isosceles trapezoid is known, the problem 2 can be seen in formula 2. Formula 2 can be used directly to find the area of a rectangle if $p$ and $l$ rectangles are known, and problem 3 can be seen in formula 2. Formula 2 can be used directly to find the area of a square if s

square is known. After students know how much value connects the perimeter and area of the quadrilateral plane context of the Grand Mosque of Palembang on the evaluation sheet.

During the learning process that lasted as much as 1 meeting, students seemed very enthusiastic when discussing in their respective groups. This is because students are interested in the media used and the problems that are given. Some of the problems in the form of things that are often encountered by students in everyday life and the Grand Mosque of Palembang media that are used is a real example that is always encountered by students when students are in the school environment. This is following mathematics and culture is something that cannot be avoided in everyday life, because the culture is a whole and comprehensive unit, applicable in society while mathematics is the knowledge that humans use in solving everyday problems. This is consistent with previous research using the RME approach, [7 - 14] stated that students like to learn with RME, students are also active and motivate students in learning activities in class and student learning outcomes categorized very well. That learning mathematics is an activity of humans and mathematics must be significantly related to the context in everyday life.

## 4. Conclusion

Based on the results and discussion that has been described, it can be concluded that the context of Grand Mosque of Palembang can help students to compare and connect the perimeter and area of a quadrilateral plane. All of the strategies and models that students find, describe and discuss show how the construction or contribution of students can be used to help their initial understanding of the perimeter and area of a quadrilateral plane. In activities based on student experience for learning quadrilateral, the stages in the learning path of students have an important role in comparing and connecting the perimeter and area of quadrilateral plane from informal to formal levels. HLT carried out in research has become a Learning Trajectory (LT) that can help students compare and connect the perimeter and area of a quadrilateral plane (Square, Rectangle, and Isosceles Trapezoid).

## 5. Acknowledgments

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