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Ethnomathematical Analysis of Geometry Form in the Great Mosque of Pondok Tinggi at Sungai Penuh City and Relationship to Mathematics Instructional

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ABSTRACT:- Mathematics learning for each individual should be adjusted to local customs and culture. Ethno mathematics is a form of mathematics that is influenced or based on culture that is appropriate to the level of student development that is at a concrete operational stage. This ethnographic-style qualitative research aims to analyze the philosophical meaning, the geometrical shape of the flat field and the ethno mathematics aspects of the Great Mosque structure at Pondok Tinggi, Sungai Penuh City and find out whether the geometry of the flat plane found can be integrated in mathematics learning. Data obtained from direct observations aimed at identifying geometrical shapes of flat shapes, interviews with mosque administrators to find philosophical meaning and interviews with mathematics teachers to find the relationship of flat shapes found with mathematics learning. The results of this study indicate that the philosophical aspects contained in the structure of the Great Mosque of Pondok Tinggi are found in 6 building structures, namely on the roof, walls, pillars, prayer rooms, doors and motives that adorn the Agung Mosque at Pondok Tinggi. There are 6 aspects of the geometry of the plane contained in the structure of the mosque building, namely aspects of square, rectangular, triangle, rhombus, trapezoid and circle. Ethnomathematics aspects found were counting, measuring, locating, designing, and explaining. The flat geometry shapes found in the Great Mosque of Pondok Tinggi structure can be integrated in mathematics learning, namely the geometry material for Education Unit Level Curriculum (in Indonesian, called KTSP) and the triangle and quadrilateral material for the 2013 Curriculum, which were studied in the second semester of Grade VII Junior High School.

Keywords:- Ethnomathematics, Flat Geometry, Mosque Structure

I. INTRODUCTION

Mathematics learning is one of the materials that must be studied by students at every level of the school to equip students to have the ability to think logically, analytically, systematically, critically, creatively and be able to work together [8]. In general, mathematical ideas are abstract forms of activities of daily human life that should be easy to learn and understand. However, there are still many students who have difficulty in learning mathematics and mathematics has become familiar as a frightening lesson for students. One of the reasons is that mathematics taught at school is sometimes found to be not the same as the mathematical problems found in students' daily lives as stated by Rosa & Orey [13] that there is a difference between mathematical knowledge academically obtained and mathematical knowledge obtained informally .

The role of education in preserving culture is very important because in this cultural environment an educational process occurs, where culture is the work of humanity and the educational process occurs in the process of culture. The teaching of mathematics for every individual should be adjusted to their culture [1], [16]. Apart from the diversity of cultures that Indonesia has, the difficulty of students understanding mathematics acquired during learning and when connecting with the real world makes a major factor in the importance of integrating culture-based learning into learning [15]. For that we need something that can connect mathematics outside of school with mathematics inside the school. One of them is by utilizing the ethnomatematics approach. Ethnomatematics is a form of mathematics that is influenced or based on culture that is appropriate to the level of student development that is at a concrete operational stage.

Utilization of culture in a learning process is very important in addition to be a contextual learning source, making it easier for students to understand a material also serves to introduce and preserve local culture [7]. Many benefits can be learned if an educator is able to creatively develop and utilize culture as a source of contextual learning. However, in general teachers still do not apply culture-based learning or ethnomathematics.

In the world of education, especially in Sungai Penuh City there are still many students who do not know or even ignore their own culture. In addition, in learning there is no teacher who integrates mathematics learning based on local culture. Whereas in Sungai Penuh there are many heirlooms, community habits, customs, and culture-based buildings that can be learned as learning resources that make it easier for students to understand the material presented by the teacher and can introduce positive values from the local culture. One interesting form of ethno-mathematics to be explored in Sungai Penuh is the Agung Mosque Pondok Tinggi which is a historical heritage building of Sungai Penuh community.

In general, geometry material is easier for students to understand compared to other branches of mathematics, because basically many objects related to geometry are already known to students in everyday life (D'ambrosio, 1989), for example geometry objects at the Agung Mosque Pondok Tingg. But in reality there are still many students who have difficulty in understanding the concepts in geometry material.

Based on the above problems, a new breakthrough is needed to make it easier for students to understand geometric material by linking geometry material learned at school with geometric shapes known to students in everyday life. In addition, ethnomathematics-based learning is considered important in utilizing existing culture as a source of learning, as a way to preserve and introduce culture to students and as a reference to foster moral values and character of students. Therefore, the geometrical shape of the Great Mosque of Pondok Tinggi is important to analyze in order to be used as a reference for the development of innovative and contextual mathematics learning resources and is expected to foster student character values and students' love for their culture without losing the essence of learning geometry itself.

This study aims to determine: 1) the meaning (philosophy) contained in the structure of the Agung Mosque building Pondok Tinggi , 2) the geometrical elements of the flat area contained in the building structure of the Great Mosque of Pondok Tinggi, 3) the ethnomathematics aspects contained in the structure of the Great Mosque of Pondok Tinggi, 4) and to find out whether the geometrical shape of the plane found in the structure of the Great Mosque of Pondok Tinggi can be integrated in mathematics learning.

II. METHODOLOGY

The research carried out in the form of qualitative research with explorative descriptive methods, using ethnographic design. The things analyzed in this study are the geometrical structure of the flat plane at the Great Mosque of Pondok Tinggi, the ethnomatemic aspects and the philosophy contained therein and the interesting things that were discovered during the study.

The research was conducted at the Great Mosque of Pondok Tinggi, Sungai Penuh City with the Agung Mosque of Pondok Tinggi as the object of research and the caretakers of the Mosque as informants and at Junior High Scholl 9th Sungai Penuh City with mathematics teachers as informants. Data collection was carried out by carrying out observations using the observation sheet instrument, interviews guided by interview guidelines, documentation and reviewing documents and archives relating to the research theme.

Interviews were conducted on two research subjects namely the administrator of Great Mosque of Pondok Tinggi and mathematics teacher. The interview with the administrators of the Great Mosque of Pondok Tinggi was intended to explore the geometrical shape of the flat field and the philosophy contained in the Great Mosque of Pondok Tinggi structure. Meanwhile, interviews with mathematics teachers are intended to see the interrelation and conformity of the geometry of the flat plane in the structure of the Great Mosque of Pondok Tinggi that can be integrated in mathematics learning.

The study was conducted using an ethnographic research design [4] consisting of five stages, namely: 1) identifying the purpose and type of design and linking it to the research problem; 2) carrying out the research licensing process; 3) using appropriate data collection procedures; 4) analyze and interpret the data with an appropriate data analysis design; and 5) writing a report in accordance with the research design.

At the data analysis stage an analysis process is carried out referring to the corresponding data analysis procedure [3] illustrated in Figure 1.

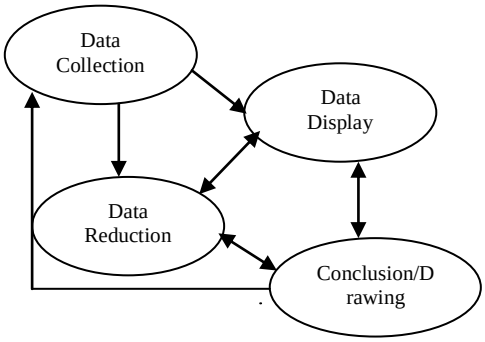

Figure 1. Data processing flowchart

Reduction of data from research results obtained by researchers is done by coding as follows:
Checking the reliability of data is carried out in stages: 1) the researcher checks the results of the transcription again to ensure that no mistakes are made during the transcription process; 2) the researcher makes sure there are no definitions and meanings floating around the codes during the coding process; 3) the researcher cross-checks, by checking repeatedly the sound recordings, observation sheets, and interview transcripts in order to obtain valid results.

There are 3 validity strategies in this research, namely: 1) triangulate different data sources by examining evidence from various sources so that the results of interviews, observations, documentation and audio-visual can be analyzed completely; 2) recheck the interview transcript by transcribing the results of the interview then check its compatibility with the previous interview transcript; and 3) invite an auditor (external auditor) to review the entire research project.

III. RESULTS

This research is a qualitative descriptive study, then the data described are based on research data sources that have been done in the form of words and subject behavior through audio and video recording during interviews with informants namely administrators of the Great Mosque of Pondok Tinggi and a mathematics teacher. Some of the constituent elements of a mosque can be seen as having mathematical content that can be linked to mathematics learning in schools.

3.1 Roof

Figure 2. Flat triangle on the mosque roof

The roof of the Great Mosque of Pondok Tinggi is not in the form of a dome like the roof of a mosque in general, but in the form of a three-tiered "overlapping roof" that rises more sharply upward to form a pyramid. The form of the roof of the Great Mosque of Pondok Tinggi in the traditional proverb is called "Bapucouk Satau", "Barampek Jure", "Batingkat Tigea" which means having one, four jurai, three stories. "Bapucouk satau" (top one), this word is taken from the roof of the Great Mosque of Pondok Tinggi that is pointed upwards with one shoot or one peak. "Bapucouk satau" means symbolizing the almighty God.

"Barampek Jure" (Four jurai), this word is taken from the form of the roof of the Great Mosque of Pondok Tinggi, which at each level has four sides, four corners called four jurai. "Barampek jure" symbolizes the custom found in Pondok Tinggi which has four souls, four "Rio" ("Ninik Mamak"), four priestly officials

whose duties are each governed by “adat and sharak”. “Batingkat tigea” (three storey), this word is taken from the roof of the Great Mosque of Pondok Tinggi which is three storey. The “tigea” level represents the three-step structure, meaning that there are three levels of government structure, starting from the lowest to the highest level, namely the “tengganai sko”, “ninik mamak sko”, and “depati sko”.

3.2 Walls

Figure 3. Rectangular flat area on the mosque wall

The Great Mosque of Pondok Tinggi has a wall made of boards which have been cut short and are slabs of wood which are installed in plots without using nails but with a peg technique by using orong-orong so that they are holding each other [12]. If you pay attention to the composition of the wall from the bottom up, there are three wall plots. Rassuh [12] states that the three wall plots at the Great Mosque of Pondok Tinggi relate to customary provisions, namely the stepped up and down stairs.

Uniquely the wall at the Great Mosque of Pondok Tinggi was built by not standing upright like a wall in general but rather tilted towards the outside of the mosque, it aims to prevent fatal damage, if an earthquake and shock occurs, the wall will not break immediately.

3.2 Mast

Figure 4. Build a flat circle on a mosque pole

The Great Mosque of Pondok Tinggi was built with simple and improvised building equipment. This is evidenced by the size of the length of the pole that still uses the size with the frontal conversion. The Great Mosque of Pondok Tinggi is supported by many poles, there are 36 poles which are connected to the floor which are divided into three groups of poles namely “tian panjan sambilea” which consists of 4 poles called “tian panjan sambilea” because the length of this pole is nine fathoms or ± 16.2 m.

“Tian panjan limao” (five-pole length) has a pole length of 5 fathoms or ± 9m, five pillars is 8 poles. The number of five long poles of 8 pieces with 8 sides shows that there are customs that have severe penalties, namely "the top 8 restrictions" which means 8 prohibitions that must not be carried out in society. The third pole

group is the "Panjan Duea' pole. Called tian panjan duea (two long pole) [12] because this pole has a length of two fathoms or ± 3.6 m.

3.4 Adhan Place

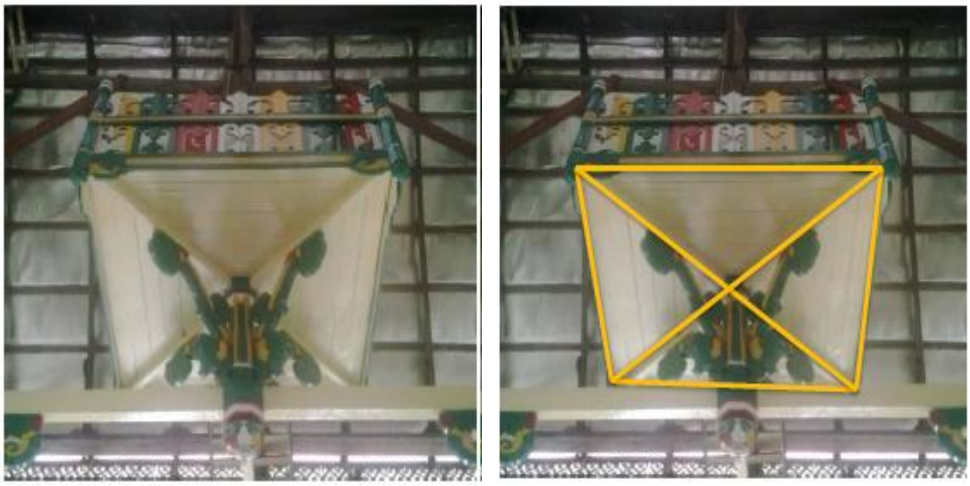

Figure 4. Triangular flat plane at the call to prayer

At the top of the Great Mosque of Pondok Tinggi there is a large beam-shaped tower that was once used as a place to make the call to prayer. This bowl-shaped platform with carvings and ornaments above the reeds is connected with a ladder of 17 steps + 5 steps. 17 steps symbolize 17 the number of compulsory prayers a day and one night and 5 steps symbolize 5 times the obligatory prayer a day and nights.

3.5 Mosque Door

Figure 6. Build a flat circle at the door of the mosque

Like the mosque door in general, the Great Mosque of Pondok Tinggi also has two main doors that function as one entrance and exit for male worshipers and one entrance and exit for female worshipers, at first the Great Mosque of Pondok Tinggi only had one door which was small in size which is in the middle of the mosque.

The Great Mosque of Pondok Tinggi building does not use windows, in order to keep healthy air changes, there is a considerable amount of air ventilation around the walls of the mosque. This ventilation is decorated with carvings so it does not look like ventilation but is seen as carvings that add to the beauty of the Great Mosque of Pondok Tinggi.

3.6 Motives

Figure 7. Build a flat circle on the motif of the mosque

The motifs that adorn the building of the Great Mosque of Pondok Tinggi were designed by H. Ridho, M. Tiru's father from "Rio Mandaro" who in general the motifs were designed in the shape of the letter S and bend the starfruit nut nails, the shape of the letter S symbolizes the characteristics of Kerinci batik and the nut nails. starfruit has the meaning of a child on the knees of a guided mother who means a "Ninik mamak", "Rio or Depati" besides taking care of and guiding their own children, they are also responsible for their nieces and nephews.

IV. DISCUSSION

In the aspect of the geometry of the plane it was found that there are 6 geometry shapes of the plane contained in the structure of the building of the Great Mosque of Pondok Tinggi namely the square aspect found on the roof, mihrab, floor and place of the call to prayer. Rectangular shapes are found in almost all structures of the Great Mosque of Pondok Tinggi building, namely on walls, doors, "mihrabs", call to prayer rooms, poles, motifs and on the ceiling of the mosque. There are triangular shapes on the roof, door, "mihrab", call to prayer, motifs and walls. Flat build of rhombus is generally found in the motifs that adorn the mosque. Trapezoidal forms are found on the roofs, doors, "mihrabs" and ceilings of mosques and circular shapes are found on 5 parts of mosque buildings, namely on doors, walls, "mihrabs", poles and mosque motifs.

Ethnomathematics aspects [2] contained in the structure of the Great Mosque of Pondok Tinggi, namely:

1) counting aspect found in the context of general information about the construction of the Great Mosque of Pondok Tinggi, the number of sides of several building structures, the number of several building structures at the mosque and the motifs that adorn the building of the Great Mosque of Pondok Tinggi.
2) measuring aspect contained in each structure of the Great Mosque of Pondok Tinggi, namely the size of each Pondok Tinggi Great Mosque building structure.
3 locating aspect, which shows the position of the Great Mosque of Pondok Tinggi located in Pondok Tinggi Village, Sungai Penuh District, Sungai Penuh, Jambi Province, Indonesia with geographic coordinates 2 ° 3'58 "S 101 ° 23'37" E,
4) design aspects are found in every structure of the Great Mosque of Pondok Tinggi, which starts from the building design, building forms and motifs that adorn the building of Great Mosque of Pondok Tinggi.
5) explaining aspect contained in the explanation of the formation of the name of the mosque with the name of the Great Mosque of Pondok Tinggi and the reason the forms of the structure of the Great Mosque of Pondok Tinggi were made with a certain shape.

If analyzed based on the mathematical curriculum of flat geometry shapes found through the process of abstraction [11] in the structure of the Pondok Tinggi Great Mosque and subsequently through idealization [10], the findings can be integrated in mathematics learning, namely in the geometry material for Unit Level Curriculum Education (KTSP) and triangles and quadrilateral material for the 2013 curriculum, where the material is equally studied in Grade VII second semester in Junior High School [9].

Another interesting thing that was found was the Great Mosque of Pondok Tinggi was an earthquake-proof building that had been built for ± 142 years ago with construction and simple tools. The earthquake resistant building is supported by several theories, namely:

1) The building of the Great Mosque of Pondok Tinggi if it is observed to have a simple symmetrical building plan, a simple symmetrical building plan turns out to be one of the building blocks for earthquake resistant building [6]. Floor plan of the Great Mosque of Pondok Tinggi in a square shape with a size of $30m \times 30m$.
2) The Great Mosque of Pondok Tinggi has many pillars and solid reeds to support the mosque. The reeds are arranged to form several triangles. The triangle shape will form a stable configuration in the building. As stated by Schodek [14] that the triangle configuration on the bars cannot change shape or collapse thus the shape of the triangle is a stable configuration which must also meet the formula $n = 2j - 3$, where n is the number of bars needed and j is many connecting points.

V. CONCLUSION

Based on the results of research and discussion that have been presented previously, conclusions can be drawn namely:

Philosophical aspects contained in the structure of the Great Mosque of Pondok Tinggi are found in 6 building structures, namely (1) the roof in the form of "Bapucouk Satau", "Barampek Jure", "Batige Tigea", (2) the walls of the Great Mosque of Pondok Tinggi which were built with wood preparation without using nails and not perpendicular to the floor, (3) mosque poles totaling 36 which are divided into 3 groups of poles and there are also hanging poles to support the mosque, (4) place of prayer that is located at the top of the mosque which is connected by stairs symbolizes the number of "rak'at" of prayer, (5) two doors found in the mosque and (6) various motifs that adorn the building of the Great Mosque of Pondok Tinggi.

There are 6 aspects of the geometry of the plane contained in the structure of the Great Mosque of Pondok Tinggi, namely the square aspect found on the roof, mihrab, floor and place of the call to prayer. Rectangular aspects are found almost throughout the structure of the Great Mosque of Pondok Tinggi building, namely on the walls, doors, "mihrab", adhan place, poles, motifs and on the ceiling of the mosque. Triangle aspects are found on the roof, doors, "mihrab", call to prayer, motifs and walls. Flat build of rhombus is generally found in the motifs that adorn the mosque. Trapezoidal aspects are found on the roof, doors, mihrab and ceiling of the mosque and circular aspects are found on 5 parts of the mosque building, namely on the doors, walls, "mihrab", pillars and mosque motifs.

There are 5 aspects of ethnomathematics contained in the structure of the Great Mosque of Pondok Tinggi namely counting aspects, measuring aspects, determining aspects of location, designing aspects and explaining aspects. The flat geometry shapes found in the Great Mosque of Pondok Tinggi structure can be integrated in mathematics learning, namely the geometry material for KTSP and the triangle and quadrilateral material for the 2013 curriculum, where the material is equally studied in the second semester of grade VII Junior High School.

Ethnomathematic elements and geometrical shapes of flat fields in the building structure of the Great Mosque of Pondok Tinggi Kota Sungai Penuh can be used as a reference for the development of local culture-based mathematical learning resources whose application is expected to not only introduce and preserve local culture, make it easier for students to understand the geometry of flat fields but also provide impression and meaning in learning mathematics itself.

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