

The 2D Geometry Concepts at Al-Mashun Great Mosque: An Ethnomathematics Exploration

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Abstract. This research aims to identify the elements of mathematics, especially two-dimensional geometry concepts in Al-Mashun Great Mosque's building, to be implemented as a source of learning mathematics in the classroom. This research is descriptive-qualitative with an ethnographic approach. The main instrument in this research is a human instrument. Data were obtained from two interviewees, observations, and documentation. Data were analyzed by Spradley's design: domain analysis, taxonomy, compatibility, and cultural themes. The research results show the elements of the plane figure in the Al-Mashun Great Mosque like triangles, quadrilaterals, octagons, polygons, and circles. These findings indicate that the Al-Mashun Great Mosque can be used in developing learning material like student worksheets or ethnomathematics-based textbooks.

Keywords: Ethnomathematics Exploration; Geometry Concepts; Mosque Building

Abstrak. Tujuan dari penelitian ini adalah untuk mengidentifikasi unsur-unsur matematika khususnya konsep geometri dua dimensi di gedung Masjid Raya Al-Mashun untuk diimplementasikan sebagai sumber pembelajaran matematika di kelas. Penelitian ini bersifat deskriptif kualitatif dengan pendekatan etnografi. Data diperoleh dari dua orang yang diwawancarai, observasi, dan dokumentasi. Instrumen utama dalam penelitian ini adalah instrumen manusia. Data dianalisis dengan desain Spradley: analisis domain, taksonomi, kompatibilitas, dan tema budaya. Hasil penelitian menunjukkan bahwa terdapat unsur bangun ruang di Masjid Raya Al-Mashun seperti segitiga, segiempat, segi-delapan, segi-banyak, dan lingkaran. Temuan ini menunjukkan bahwa Masjid Raya Al-Mashun dapat digunakan dalam mengembangkan materi pembelajaran seperti LKS atau buku teks berbasis etnomatematika.

Kata kunci: Bangunan Masjid; Eksplorasi Etnomatematika; Konsep Geometri



INTRODUCTION

North Sumatra is one of Indonesia's regions with many cultures (Dewita et al., 2019). One of the cultural heritages in the form of artifacts in North Sumatra is the Al-Mashun Great Mosque (Pane et al., 2018), located on Jalan Sisingamangaraja XII Medan City, North Sumatra. Al-Mashun Great Mosque was founded in the era of the Maamun Al-Rasyid Perkasa Alamsjah XI Sultanate, precisely on 1 Rajab 1324, coinciding with August 21, 1906 (Syahputra et al., 2020). This mosque was completed and started operating on Friday in the month of Shaban 1327, coinciding with September 10, 1909 (Askwana, 2015). It can be seen in the Arabic-Malay script engraved on the inscriptions carved on the right and left wings of the entrance gate to the mosque. Al-Mashun Great Mosque is an octagonal shape and has wings in the south, east, north, and west. Al-Mashun Great Mosque is historical evidence of the greatness of the Malays from the Deli Sultanate (Medan City) (Harahap et al., 2020). Based on the information listed on the official website of the Culture and Tourism Office of North Sumatra Province, the architectural style of the Al-Mashun Great Mosque consists of typical Middle Eastern, Indian and Spanish architecture. This mosque is designed for an area of 13,200 meters square (Nasution, 2017). There are many elements of 2D geometry in the Al-Mashun Great Mosque. It can be seen from several components in the buildings in the mosque, such as the gate, roof, dome, and each wing.



Figure 1. The Great Mosque of Al-Mashun

In addition, to being the center of tourist destinations, the Al-Mashun Great Mosque is still used as a place of worship for the Muslims of Medan City (Hidayat & Ganie, 2020). Visitors to the Al-Mashun Great Mosque come from all over the country. However, after conducting many interviews with the visitors, the researcher found that most visitors did not know the meaning or philosophical basis of the architectural forms in the Al-Mashun Great Mosque. Like the philosophical meaning of the *sahn* (main room) surrounded by a four-sided hallway as a *mugatha*. Some call it touching a certain height with the yard's floor to emphasize the dimensions of the *u'la*.

The position of the higher floor is symbolically generally interpreted as *murū'ah* or *darajah*; meaning distinguishes the glory of humans who prostrate from humans in general.

Cultural values at the Al-Mashun Great Mosque need to be preserved. Cultural values need to be instilled early on so that individuals can better understand, interpret, and appreciate the importance of cultural values in life (Susilo & Widodo, 2018). One of the efforts in cultural preservation carried out by the Nagari Pagaruyung community is to make the Baso Pagaruyung Palace a traditional tourist destination. The palace is a museum, so visitors know the cultural values found in the Minang Nagari Pagaruyung Tribe (Young, 2021). The way that can be used to preserve the cultural values of the Al-Mashun Great Mosque is to introduce the cultural values of the Al-Mashun Great Mosque building in learning at school. It is in line with the opinion that learning mathematics in schools can be meaningful for students if it is adapted to the cognitive development of students and uses the context of the surrounding environment so that it is easy to understand mathematical material (Wahyuni et al., 2013). Therefore, the building foundations and ornaments in the Al-Mashun Great Mosque can be used as learning materials for mathematics taught from elementary to high school.

Al-Mashun Great Mosque can be discussed as an ethnomathematical idea. The idea of ethnomathematics has clear implications for education (Matang & Owens, 2004). Ethnomathematics is mathematics practiced by cultural groups, such as urban and rural communities, labor groups, children of specific age groups, indigenous peoples, and others (Okta Sarwoedi et al., 2018). The hope is that the cultural context can stimulate students' knowledge so that they are easy to remember and easily connected directly to their daily lives (Rahmawati Z & Muchlian, 2019). From some of the opinions above, it can be concluded that the definition of ethnomathematics is a method used to learn mathematics by involving activities or the culture of the surrounding area, making it easier for someone to understand mathematics.

Several researchers have previously researched ethnomathematics in mosque buildings (Delviana & Putra, 2022) like the Jami' Al Baitul Amien Mosque in Jember (Yudianto et al., 2021), the Soko Tunggal Mosque in 2D Geometry (Putra et al., 2020), and the Great Mosque of Bandung (Purniati et al., 2021). The results of the three studies mentioned the existence of mathematical elements in the object under study. The existence of research from several mosques from various provinces in Indonesia made researchers interested in bringing up research on ethnomathematics from the province of North Sumatra, which had not previously existed. Thus, the research of the Al-Mashun Great Mosque with ethnomathematical studies is a new thing in mathematics education research. In this regard, it is necessary to conduct an ethnomathematical research study at the Al-Mashun Great Mosque so that it can be used as a means of learning mathematics on geometry

material. Therefore, this research aims to identify the mathematical elements in the Al-Mashun Great Mosque building.

METHOD

This research is descriptive qualitative research with an ethnomathematical approach. Researchers manage descriptive data collected in words, pictures, and not numbers (Anggito & Setiawan, 2018). While in the ethnographic method, the researcher describes, explains, and analyzes what cultural elements are contained in the Al-Mashun Great Mosque. The instrument in this study is the human instrument, where the researcher acts as a data collector and cannot be replaced, so the role of the researcher is as the main instrument (Sugiyono, 2013).

This research was carried out at the Al-Mashun Great Mosque, Medan City, on February 1, 2022. The research object was the Al-Mashun Great Mosque, and the interviewees were two *takmir*s (servants) of the Al-Mashun Great Mosque. The primary data collection techniques are interviews, observation, and documentation. Interviews were conducted to find out about the geometric elements contained in the mosque. Observations were made directly by observing the buildings and ornaments related to the two-dimensional geometric concept of the Al-Mashun Great Mosque. Observation guidelines are unstructured, so the researcher can develop observations according to field conditions. At the same time, documentation is carried out to take photos of objects observed to complete field notes. Secondary data was collected with a literature review to complement research data sourced from journals, theses, dissertations, and proceedings.

The stages of data analysis in this study are data collection obtained through observation, direct documentation from the field, and interviews; data classification, where the data will then be grouped based on two-dimensional geometric elements; presentation of the data in the form of a narrative text; and data analyzation, the data is analyzed by comparing the results of direct observations with secondary data, namely the literature review that has been obtained; and drawing conclusions after being analyzed.

RESULTS AND DISCUSSION

At the Al-Mashun Great Mosque can be found several geometric objects that can be clearly defined. Some geometric objects in the Al-Mashun Great Mosque include the triangular pulpit on the men's row, the square floor of the mosque, and the windows formed from a combination of rectangles and circles. To find geometric objects in Masjid Raya Al-Mashun requires a clear idea of knowledge. The following is a discussion of the results of ethnomathematical exploration at the Al-Mashun Great Mosque.

Triangle

There are several triangular elements in the Al-Mashun Great Mosque. The most striking part is the ornament on the central pulpit used for preaching, as in Figure 2. The ornament used on this pulpit is taken from a typical Malay ornament *kaluk pakis*, meaning that the hardships of human life will not run out at all (Suri, 2019).



Figure 2. Ornament on The Central Pulpit

The triangle context can also be seen in the gate ornaments such as Figure 3, which forms an equilateral triangle. The ornament on this gate also means a symbol of physical experience and the physical world of materiality, meaning a symbol of experience and objects in the real world (Kartini, 2014). Another triangular context can also be found in the small ornament on pulpit 2 on the women's *shaf*, as in Figure 4.

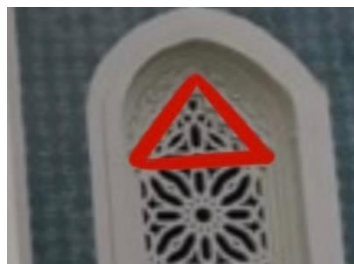


Figure 3. Ornaments at the Entrance Gate of The Al-Mashun Great Mosque



Figure 4. Small Ornament on Pulpit 2 on the Women's Line

A triangle is a geometric figure made of three sides in the form of a straight line and three angles (Unaenah et al., 2020). The sum of all the angles of a triangle is 180° . In general, triangles are divided into three: equilateral triangle, isosceles triangle, and right triangle. An equilateral

triangle is a triangle whose sides are the same length. While a right triangle is a triangle in which one of the three angles forms an angle of 90° .

Quadrilateral

A quadrilateral is a flat shape that has four sides. The quadrilateral is divided into six: square, rectangle, rhombus, kite, trapezium, and parallelogram (Unaenah et al., 2020). The following is the concept of a flat rectangular shape found in the Al-Mashun Great Mosque.

Square

A square is a flat shape formed with four ribs of the same length, where these four edges form 90° angles on each side (Unaenah et al., 2020). The context of a square in the Al-Mashun Great Mosque can be seen in the ornaments along the inner walls, as in Figure 5. Likewise, the outer floor is square, as in Figure 6.

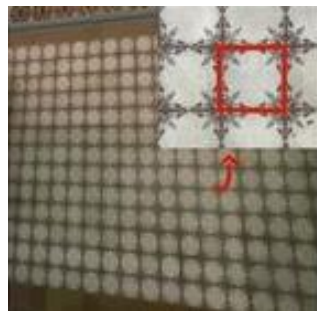


Figure 5. Ornaments along The Inner Walls



Figure 6. The Outer Floor of Al-Mashun Great Mosque

Rectangle

The rectangle context of the Al-Mashun Great Mosque can be found at the main gate, as shown in Figure 7. At the end of the gate, we find bamboo shoot ornaments that philosophically have the meaning of fertility and happiness in human life (Kartini, 2014). The concept of a rectangle can be found easily in the decoration of the facade or outer wall of the Great Mosque of Al-Mashun, as shown in Figure 8. A rectangle is a four-sided flat shape where the two opposite sides are longer than the other two opposite sides and the four corners. forming an angle of 90° (Unaenah et al., 2020).



Figure 7. The Main Gate of Al-Mashun Great Mosque

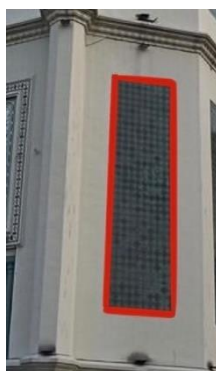


Figure 8. Decoration of The Facade or Outer Wall of the Great Mosque of Al-Mashun

Rhombus

The concept of a flat rhombus in the Al-Mashun Great Mosque can be seen in the wall ornaments along the corridor, as shown in Figure 9. Philosophically, the ornament means a symbol of human consciousness and the principle of harmony, also meaning the symbol of humans, awareness, and harmony (Kartini, 2014). The concept of a rhombus can also be found on the mosque's main door, as shown in Figure 10. A rhombus is a flat shape with four sides of the same length, two diagonals, and two pairs of angles that are not 90 degrees, each of which is equal to the angle opposite it (Wulandari, 2017).

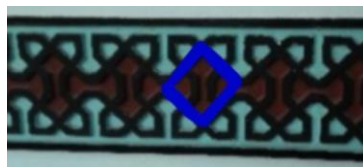


Figure 9. The Wall Ornaments Along The Corridor



Figure 10. The Ornament on The Mosque's Main Door

Trapezium

The geometric concept of the trapezoid can be found in the ornaments on the ventilation of the Nazirite doors as in Figure 11 and the mosque stairs as in Figure 12. A trapezoid is a flat rectangular shape where the two sides are parallel and not the same length (Unaenah et al., 2020). A trapezoid with one of its angles forming an angle of 90° is called a right trapezoid (Unaenah et al., 2020; Wulandari, 2017).



Figure 11. The Ornaments on The Ventilation of The Nazirite Doors



Figure 12. Al-Mashun Great Mosque's Stairs

Octagon

The grand mosque is an octagonal building. In Islam, the octagon has its meaning in the form of giving an impact of empowering potential that radiates to all corners or is referred to as *Rahmatan lil 'alamin*. An octagon is flat with eight sides (Wulandari, 2017). We can see the octagonal concept in Masjid Raya Al-Mashun on the dome as in Figure 13, the mosque's ceiling as in Figure 14, the wings as in Figure 15, and the floor of the wing as in Figure 16.



Figure 13. The Dome of Al-Mashun Great Mosque



Figure 14. Al Mashun Great Mosque's Ceiling



Figure 15. Al-Mashun Great Mosque's Wings



Figure 16. The Floor of The Wings

Polygon

The concept of polygonal geometry in the Al-Mashun Great Mosque can be seen in the horse saddle ornament on the mosque's ceiling, as shown in Figure 17. In Islam, this geometric element has a meaning in the form of respect for Prophet Daud AS and Prophet Sulaiman AS as prophets and kings. The polygon is a flat shape that has many sides (Wulandari, 2017).



Figure 17. The Horse Saddle Ornament On The Mosque's Ceiling

Circle

A circle is a flat shape that has an angle of 360° . The circle has one central point and has infinitely folding and rotating symmetry (Unaenah et al., 2020). While the concept of the circle can be found in the corridor window at Masjid Raya Al-Mashun, as shown in Figure 18. Also, in the windows in the mosque in Figure 19, the ceiling ornaments along the corridor as in Figure 20, and the arches in the corridor as in Figure 21.

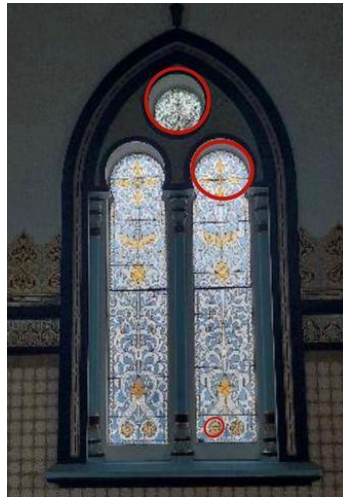


Figure 18. The Corridor Window Of Al-Mashun Great Mosque



Figure 19. The Window in The Mosque



Figure 20. The Ceiling Ornaments Along The Corridor

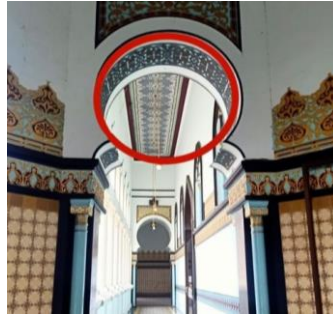


Figure 21. The Arches In The Corridor

Based on the description above, the Al-Mashun Great Mosque building can be used to learn mathematics, especially two-dimensional geometry. It is because the context of triangles, rectangles, octagons, polygons, and circles are found in this mosque. School mathematics learning, primarily two-dimensional geometry, can be done using the Al-Mashun Great Mosque building.

We can find a right triangle on the men's *staff* pulpit ornament (Figure 1). The properties of a right triangle are two sides that form a right angle and have a hypotenuse. Also, the formula calculates the area of a right triangle $L = \frac{1}{2} \times a \times t$ and the perimeter of a right triangle $K = s + s + s$. From the properties of this right triangle, contextual questions can be made, for instance:

Pay attention to the kaluk pakis ornament on the male pulpit of the Al-Mashun Great Mosque (Figure 1), which forms a right triangle. If it is known that the figure's base is 30 mm, the height is 40 mm, and the hypotenuse is 50 mm, find the area and perimeter of the figure!

To solve these problems, students can use known variables so that the area of a right triangle is $L = 1/2 \times a \times t = 1/2 \times 30 \times 40 = 60 \text{ mm}^2$, and the perimeter of the shape is $K = s + s + s = 30 + 40 + 50 = 120 \text{ mm}$.

The results of this study are related to the research conducted by Yudianto et al. (2021) about the ethnomathematical exploration of the Jami' Al-Baitul Amien Mosque in Jember. The results of his research indicate that in the activity of making the Jami' Al-Baitul Amien Jember Mosque, there are elements and mathematical concepts used. The same thing was done by Putra et al. (2020) with the research about Soko Tunggal Mosque. The results of his research indicate that the mathematical concepts that exist in the construction of the Soko Tunggal Mosque are in the form of flat and spatial concepts. In addition, the research conducted by Purniati et al. (2021) shows that a mathematical concept is found in the form of geometric transformation of the Great Mosque of Bandung ornaments. This study pays attention to the two-dimensional geometric shapes in the Al-Mashun Great Mosque from an ethnomathematical perspective regarding mathematical concepts.

CONCLUSION

Based on the results of the exploration and discussion above, it is concluded that there are elements of two-dimensional geometry in the Al-Mashun Great Mosque. It explains that cultural elements can be used in learning mathematics. This research is still within the identification limit. The researcher hopes that the results of this study can be developed into further research. The results of this study indicate that the Al-Mashun Great Mosque can be used as material for developing student worksheets or ethnomathematical-based textbooks.

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