p-ISSN 2828-5573
AL JABAR: Jurnal Pendidikan dan Pembelajaran Matematika e-ISSN 2828-6731

ETHNOMATHEMATICS EXPLORATION OF THE ISTIQLAL MOSQUE JAKARTA

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Abstract

Ethnomathematics is a branch of mathematical study that was developed in a cultural context. This research aims to explore the concept of ethnomathematics in the Istiqlal Mosque in Jakarta. The method used is descriptive exploratory with an ethnographic approach, which aims to explore information thoroughly to describe and analyze cultural elements in society. Data collection techniques include two types, namely library data collection through literature studies and field data collection through observation and documentation. The collected data is then analyzed using the data reduction method, which involves sorting, centralizing, and simplifying information. The results of the study show that the structure and ornaments of the Istiqlal Mosque Jakarta contain various flat and spatial structures, such as half-spheres, tubes, rectangles, and circles.

Keywords: *Ethnomathematics, Geometry, Istiqlal Mosque Jakarta*

INTRODUCTION

Mathematics, although often considered an abstract subject in schools, plays a very crucial role in understanding and developing science and technology. Without the contribution of mathematics, progress in various fields of science and technology would not have been possible (Sukmawati & Amelia, 2020). By studying mathematics, a person can develop the ability to think rationally, logically, and systematically. This process contributes to improving skills in solving various problems. The ability to think rationally allows individuals to make reasoned decisions, logical thinking helps in analyzing relationships between concepts, and systematic thinking facilitates a structured approach to problem-solving. As a result, these skills improve one's ability to formulate effective and efficient solutions to various challenges faced (Noprianilubis et al., 2017).

However, there are obstacles in achieving these abilities, such as fear and difficulties faced by students (Sunardi et al., 2019; Sunardi & Yudianto, 2015). To overcome fear and difficulty in math, support from educators, peers, and parents is essential, accompanied by strong self-motivation. With the appropriate approach, many learners can improve their confidence and math skills. In addition, the mathematics learning process that emphasizes too much on memorizing formulas without giving enough emphasis to understanding concepts and problem-solving exercises can hinder the development of critical thinking skills and the application of mathematics in daily life (Soviawati, 2011).

To support mathematics learning in daily life, one of the solutions that can be applied is to integrate local or cultural wisdom commonly found in the surrounding environment into the learning process. This method allows students to understand the material more quickly

because of its connection to familiar cultures and often encountered in daily life, making it easier to remember and understand (Rohaeti, 2011). The approach that associates mathematics with culture is known as ethnomathematics. Ethnomathematics is a field of study that explores the relationship between mathematics and culture, as well as how mathematics is applied in people's daily lives (Khofifah et al., 2018). Ethnomathematics helps learners realize that mathematics is not only limited to the classroom, but also exists in their surroundings.

One of the cultural objects that is close to the daily life of students is the mosque. Choosing a mosque as a cultural object in mathematics learning is an interesting approach and has great potential. A number of studies have been conducted to explore ethnomathematics related to mosques. Some examples include ethnomathematical exploration at the Great Mosque of Probolinggo City (Rofiq et al., 2022), research on ethnomathematics at the Great Mosque of Bandung (Janan, 2022), as well as a more in-depth ethnomathematical study at the Al-Akbar Mosque in Surabaya (Janan et al., 2023). In addition, there is research on ethnomathematical exploration at the Al-Alam Marunda Mosque (Faturrahman & Soro, 2021) and the Great Mosque of Yogyakarta (Rohayati et al., 2017). These studies show how important it is to understand the relationship between cultural elements in mosque architecture and the mathematical concepts contained in them, thus providing a broader insight into the application of mathematics in cultural and religious contexts.

In this study, the Jakarta Istiqlal Mosque was chosen as the main object of study. The buildings and ornaments of the Jakarta Istiqlal Mosque are rich in geometric elements. A wide variety of flat plane shapes such as ellipses, squares, circles, and rectangles, as well as space constructs such as limas and tubes, are found in them. This prompted researchers to conduct ethnomathematical exploration studies at the Istiqlal Mosque in Jakarta, focusing on geometric concepts applied in the architecture and ornaments of the mosque. This research will explore more deeply how these geometric elements are part of the beauty of architecture. In addition, this research will explore the relationship between geometric shapes and mathematical concepts that may not have been widely disclosed before. Through an ethnomathematical approach, it is hoped that this research can provide new insights into how traditional architecture such as the Jakarta Istiqlal Mosque can be a source of inspiration in mathematics learning, as well as enrich understanding of the role of culture in the development of science.

Figure 1. Istiqlal Mosque Jakarta

RESEARCH METHODS

The research method used is descriptive exploratory with an ethnographic approach, which is effective in revealing the relationship between mathematics and the culture and architecture of a particular mosque. This method is applied to examine the relationship between the concepts of geometry and mathematics with buildings and ornaments in the Istiqlal Mosque Jakarta, through the description and analysis of existing ethnomathematical elements. Data collection is carried out through literature studies and field observations, creating a holistic approach. Literature studies provide an understanding of the theory and context of ethnomathematical history, while field observations allow for direct observation and documentation of mosques and their ornaments. These observations include the measurement, calculation, and analysis of existing geometric and mathematical elements, which is key in understanding the application of these concepts in real contexts.

The collected data will be re-examined by researchers to ensure its accuracy and validity. Verification is carried out to ensure that the data accurately reflects the observations. Once validated, the data will be analyzed through a reduction process, such as sorting, centralizing, and simplifying, to make it easier to understand. Furthermore, the researcher will draw conclusions based on the findings of the research, explain the relationship between mathematics and geometric concepts with mosque buildings and ornaments, and identify emerging ethnomathematical patterns or aspects.

RESULTS AND DISCUSSION

The Istiqlal Mosque, located in the center of Jakarta, is the national mosque of Indonesia and is known as the largest in Southeast Asia, and occupies the sixth largest position in the world based on its congregation capacity (Perlez, 2002). The mosque was established as a symbol of Indonesia's independence commemoration, and was named "Istiqlal," which in Arabic means "independence," reflecting the spirit of freedom and independence on which it

was built. This mosque not only has a religious meaning, but also historical, because it reflects the struggle of the Indonesian nation in achieving independence. After going through a long construction process, the Jakarta Istiqlal Mosque was finally opened to the public on February 22, 1978, and until now it remains one of the important architectural icons and national pride for the people of Indonesia.

The Istiqlal Mosque in Jakarta carries a striking new and international formalism architectural style. The walls and floors of the mosque are lined with high-quality marble, while the geometric ornaments that adorn the building are made of stainless steel. The main structure of the mosque consists of five floors on top of one ground floor, with a large dome 45 meters in diameter rising above the main building, supported by 12 large sturdy columns. In the south corner of the mosque hall, there is a single minaret that rises to a height of 96.66 meters. The mosque is designed to accommodate more than 200,000 worshippers, making it one of the largest places of worship in the world. The majestic architecture and well-integrated design create a space that is not only functional but also impressive in terms of aesthetics and majesty.

Figure 2. Mosque Dome

The Istiqlal Mosque in Jakarta has a very large dome with a diameter of up to 45 meters. The number 45 on this dome size is not only a prominent design element, but it also has a deep symbolic meaning. The diameter of 45 meters symbolizes the year 1945, which is an important year in Indonesia's history because it is the year of the proclamation of independence of the Republic of Indonesia. The dome of this mosque not only reflects the splendor and strength of the architectural structure, but also is a significant tribute to the historic moment in the nation's struggle for independence. This element adds a historical and symbolic dimension to the mosque's architecture, linking aesthetic aspects with historical values and nationalism.

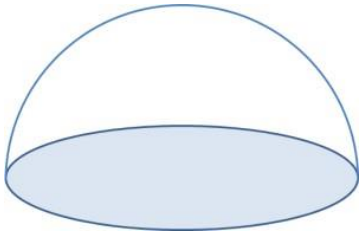

Figure 3. Half Ball

The dome of the Istiqlal Mosque Jakarta has a semi-spherical shape, a distinctive and striking shape in the architecture of this mosque. In geometry, a sphere is a collection of points that are at the same distance from a single central point in three-dimensional space. Spheres have several unique properties that make them different from other geometric shapes. One of its properties is to have one side that curves perfectly indefinitely, as well as a central point that serves as a reference for all the other points on its surface. Additionally, the sphere has no corners or flat planes, making it a perfect and smooth shape. This property also means that the sphere has an infinite number of radii, since each point on its surface is at the same distance from the central point. The formula of the surface area of the sphere is $L = 4 \times \pi \times r^2$, while the volume is $V = \frac{4}{3} \times \pi \times r^3$ where r states the radius of the ball (Lumbantoruan, 2019). The semicircular shape used on the dome of this mosque not only reflects the beauty of symmetry in architectural design, but also symbolizes perfection and unity, which is often associated with the concept of spirituality in many religious traditions.

Figure 4. Mosque Tower

The uniqueness of the Jakarta Istiqlal Mosque lies in the existence of only one minaret, an architectural decision that is loaded with symbolic meaning. This single tower is not just a design element, but is designed to symbolize the oneness of Allah Subhanahu wa Ta'ala, as a symbol of monotheism in Islam. With a diameter of 5 meters, the tower is covered in marble which adds to the impression of splendor and sturdiness of the structure. The tower is 66.66

meters or 6,666 cm tall, a figure deliberately chosen to symbolize the number of verses in the Qur'an, directly linking the mosque's architecture to the essence of the Islamic holy book. At the top of the tower, there is a towering 30-meter-high steel frame, symbolizing the 30 juz in the Qur'an, which adds to the spiritual significance of the tower's design. Thus, every detail on the minaret of the Istiqlal Mosque not only serves as part of the physical structure, but also serves as a visual reminder of the fundamental principles in Islam.

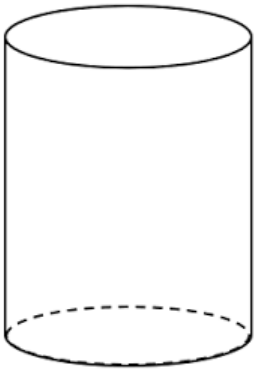

Figure 5. Tube

Tower of Istiqlal Mosque Jakarta It has a tubular space, a distinctive three-dimensional shape and is often used in architecture, including in the design of towers. A tube is one of the three-dimensional space structures that has some special properties that distinguish it from other shapes. The tube is made up of two identical circles that are aligned, namely the base and the cap, which form the base and top of the tube. These two circles are connected by a tube blanket, a rectangular plane that curves and surrounds the entire surface of the tube side, seamlessly connecting the base and lid. This tube blanket, when unfolded, is actually a rectangle, but when it is formed into a tube, it circles around the circle of the base and lid, giving it a distinctive curved shape. The formula for the surface area of the tube is $L = 2 \times \pi \times r \times (r + t)$ and the volume of the tube is $V = \pi \times r^2 \times t$ where r states the radius of the base or tube cap and t states the height of the tube (Lumbantoruan, 2019). The tubular shape on the mosque tower not only serves as a sturdy structural element, but also as a symbol of simplicity and steadfastness. This design allows the tower to rise high with strong stability, while providing an elegant and proportioned aesthetic. The presence of tubes in the architecture of mosque towers also reflects the beauty of geometry in the design of the building, combining function with beauty in a harmonious and effective way.

Figure 6. Mihrab Mosque

Figure 7. Rectangle

In the mihrab of the Istiqlal Mosque in Jakarta, it is clear that the use of geometric objects in the form of a rectangle, a rectangular flat shape that is often found in various aspects of architecture. Rectangles have several distinctive features that distinguish them from other geometric shapes. The parallel sides are of equal length, creating perfect symmetry in the design. In addition, each angle on the rectangle is a right angle, with a large angle of 90°, which provides stability and clarity of shape (Fioiani, 2019). One of the uniqueness of a rectangle is its diagonal which has the same length and divides each other in half into two parts of equal length. This diagonal also intersects in the middle of the building, creating a meeting point that is central to the internal symmetry of the rectangle. The formula for the area of a rectangle is $L = p \times l$ and the formula for the circumference of a rectangle is $K = 2 \times (p + l)$ where p states the length of the rectangle and l states the width of the rectangle (Lumbantoruan, 2019). In the context of the mihrab of the Jakarta Istiqlal Mosque, the use of rectangles not only serves as a structural and decorative element, but also has a symbolic meaning, reflecting justice, balance, and order in Islamic teachings.

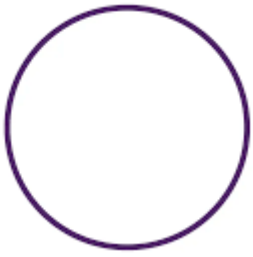

Figure 11. Circle

At the mihrab of the Istiqlal Mosque Jakarta, there are ornaments in the shape of a circle. A circle is a collection of points that are equally spaced from the central point. The circle has several important parts: the center point that is the reference, the radius that measures the distance from the center to the edge of the circle, and the diameter that is twice the length of the radius. In addition, there is a bow, which is the edge of a circle between two points, as well

as a bow string that connects two points in a circle. Juring is an area formed by two spokes and a bow, while tembereng is the part bounded by a bow string and a bow. The apothema is the shortest distance from the center point to the bowstring, providing a deeper understanding of the structure of the circle (Fioiani, 2019). The formula for the area of the circle is $L = \pi \times r^2$ and the formula for the circumference of the circle is $K = 2 \times \pi \times r$ where r states the radius of the circle (Satyawati et al., 2016). The use of circles in mihrab ornaments not only adds beauty, but also contains a deep symbolic meaning, symbolizing the unity and oneness of Allah Subhanahu wa Ta'ala.

CONCLUSION

The results of the study show the practical application of geometric concepts in daily life by utilizing the building and ornaments of the Istiqlal Mosque Jakarta as a medium for learning mathematics. The geometric concept in the form of flat buildings found on the buildings and ornaments of the Istiqlal Mosque includes rectangles and circles. Meanwhile, the identified build space includes half a sphere and a tube.

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