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ETHNOMATHEMATICS: LEARNING GEOMETRY FROM HOK TEK BIO TEMPLE IN PURWOKERTO, INDONESIA

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Abstract

Hok Tek Bio Temple in Purwokerto, Central Java, Indonesia as one of the cultural sites rich in symmetrical architectural elements, carved ornaments, and geometric shapes, offers a unique opportunity for students to visualize various types of geometric transformations. However, so far it has not been widely used as a medium in mathematics learning. This study aims to explore Hok Tek Bio Temple in Purwokerto as a medium for mathematics learning through ethnomathematics studies. This study uses a qualitative method with an ethnographic approach. Data collection techniques use in-depth interviews, observations and document studies. The results of the study show that most of the Hok Tek Bio Temple ornaments are built using geometric transformation patterns, both reflection, translation, dilation, and symmetry, which have various philosophical meanings in life. The results of this study can be recommended as a medium for learning geometry based on local wisdom and at the same time character education.

INTRODUCTION

Hok Tek Bio Temple located in the Pasar Wage Purwokerto area, is not only a place of worship for the local Chinese community, but also holds architectural beauty that is rich in historical and cultural value (Permatadewi, R., & Gunawan, T., 2022). In addition, Putro, M.Z.A.E. (2021) emphasized that this temple is decorated with geometric shapes that are not only aesthetically beautiful but also hold important lessons about geometric concepts in mathematics, such as symmetry, rotation, reflection, and dilation. However, it has not been widely used as a medium for learning mathematics in schools. Even though the existence of this temple is no longer foreign to the Baanyumas community in general or students in general. This temple can be a real example of how mathematical concepts are not only applied to the field of exact sciences, but also to art and culture which are rich in symbolism. The integration of art and culture with mathematics is what is called ethnomathematics. (Sirate, S.F.S. 2015).

Ethnomathematics is a study that connects mathematics with local culture or community traditions. (Putri, R.I.I. 2020). The basic concept of ethnomathematics is centered on the idea that mathematics is not only universal but also influenced by the cultural, social, and environmental practices of a particular community. (Nursantoso, A.2023). In line with the pace of cultural and artistic development, the study of ethnomathematics has been a hot topic of discussion. In addition to being more realistic and contextual, ethnomathematics touches on aspects of art and values that are

more meaningful to life. (Rahmadani, S., Putri, D.P., & Rahmadeni, F. 2024). Research on ethnomathematics has contributed greatly to the development of more meaningful learning because it is by students' daily experiences. Ethnomathematics-based learning becomes more interesting for students because in addition to being closer to the students' culture (Arif, D.S.F., Purnomo, D., & Sutrisno, S. 2019), ethnomathematics offers more contextual material (Yohanes, K., Zaenuri, M., & Budi, W. 2019), realistic (Kurniasari, I., Rakhmawati, R., & Fakhri, J. 2018) and artistic so that it is easier and more enjoyable.

Contextual learning that connects mathematical concepts with real objects or sites significantly improves students' understanding of the material. Ethnomathematics-based learning increases their enthusiasm and involvement in the geometry learning process (Novitasari, T.V., Aulia, A.S., & Meirani, A.P. 2023). Real experiences in culture can help students visualize how mathematical concepts are applied in real life. (Budiyanto, A., 2024). Building design as a medium for learning mathematics introduces students to the application of geometry in different cultural contexts. (Kusno, K., Yolanda, G., & Supiyati, S. 2024). This shows that ethnomathematics can increase students' appreciation for cultural diversity while broadening their understanding of the application of mathematics globally. (Nova, I.S., & Putra, A., 2022; Sirate, S.F.S. 2015). By focusing on the shape and pattern of symmetry, at Klentheng Hok Tek Bio, it is hoped that students can better understand the structure and concept of geometric transformation in a more practical and direct form. Therefore, ethnomathematics research at Klentheng Hok Tek Bio to analyze the concept of geometric transformation as a medium for learning mathematics is very important.

METHODS

This study uses a qualitative approach with an ethnographic method. Ethnography is a research method that is more closely related to anthropology that studies cultural events and people's perspectives. The main focus of the ethnographic method is to collect data using observation, interviews, describing and building socio-cultural structures for the community. (Sari, M. P., et.al,. 2023). By using a qualitative approach, the researcher describes ethnomathematics in building artifacts found in the Hok Tek Bio Klentheng. The objects of analysis in this study are the Gate, Wuwungan, Lantern, Window, and Cushion found in the Hok Tek Bio Klentheng. The subjects selected in this study as informants were the Klentheng managers as informants needed regarding the philosophical values in the Klentheng construction. Interviews were conducted to obtain direct information from the resource person, namely regarding the Klentheng and its philosophical values, if any Questions that have been prepared by the researcher to obtain accurate data.

The researcher conducted interviews according to the interview guide that had been prepared and interviews were conducted in turns by the researcher. Documentation is the collection of data used as evidence in the form of photos, videos, and recordings. Documentation is done by taking photos related to artifacts in the Hok Tek Bio Klentheng area as data to explore ethnomathematics. The results of the observation are used to understand the artifacts found around the Klentheng. The analysis method

used is to use passive participatory observation techniques. With this technique, researchers only visit the research site without being directly involved in the activities there, so that researchers act as passive observers. Researchers observe the research location without making any changes. The way to analyze interview data is to see the responses given by the informants to the questions asked. Data obtained from interviews are used to add information and help to conduct analysis. in the context of ethnomathematics. The results of the documentation data are used to strengthen observation and interview data. This study uses technical triangulation and uses reference materials for validity testing. Technical triangulation is an approach that uses various techniques or methods to collect and analyze data to strengthen the validity and depth of understanding of research results. Technical triangulation is used to check the validity of the data that has been obtained. Technical triangulation means collecting more than one different data to obtain the same data by checking its validity (Tiara, W. 2022). The method used in technical triangulation is using interviews, observations, and documentation. In this case, the researcher compares the results of the interview with the results of observations and documentation.

RESULT AND DISCUSSION

This study focuses on the study of ethnomathematics applied to the structure and ornaments of the Hok Tek Bio Temple in Purwokerto, as a representation of cultural and mathematical values that are interwoven into the daily lives of the Chinese community. In this context, ethnomathematics refers to how geometric concepts are found and applied naturally in various aspects of the temple building, which are an inseparable part of the identity and cultural traditions of the local community. This study will identify and describe the geometric elements found in the Hok Tek Bio Temple, as well as understand the philosophical meaning behind these geometric forms. By analyzing geometric elements such as symmetry, proportion, and patterns found in the architecture of the temple, this study is expected to provide new insights into how mathematics, especially geometry, is not only a theoretical concept, but also manifested in the form of culture and tradition.

Through a descriptive qualitative approach, the results of this study present various geometric forms found in the design of the temple building structure, ranging from floor patterns, roof shapes, to ornaments that are full of symbolic value. This discussion describes how these elements not only have aesthetic value, but also contain deep philosophical meanings by the beliefs and values of Chinese society. This discovery is expected to enrich the understanding of mathematics in culture, as well as support cultural context-based geometry education for students in Indonesia.

a. Parallel lines on the Front Gate Wuwungan

Based on the results of observation and documentation, the Front Gate Wuwungan at the Hok Tek Bio Klentheng is constructed using parallel lines. According to the results of the analysis of the Source and experts, this reflects the concept of balance and order, which are important principles in Chinese culture. In Chinese tradition and beliefs, parallel lines are considered a symbol of the order of the universe, where all elements go hand in hand in harmonious balance. This is related to the

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concept of Yin and Yang which describes the balance between two complementary aspects. These parallel lines also reflect a straight and orderly path of life, a depiction of the importance of harmony between humans, nature, and spirituality. This is by what was put forward by Aprison, W. (2016) regarding the principle of a straight and orderly life. With the presence of regular geometric patterns on the wuwungan, the message to be conveyed is the importance of maintaining balance in all aspects of life, both in actions and thoughts, to achieve a harmonious life. Furthermore, the image of the Wuwungan at the Front Gate of the Klentheng is presented in Figure 1 below:

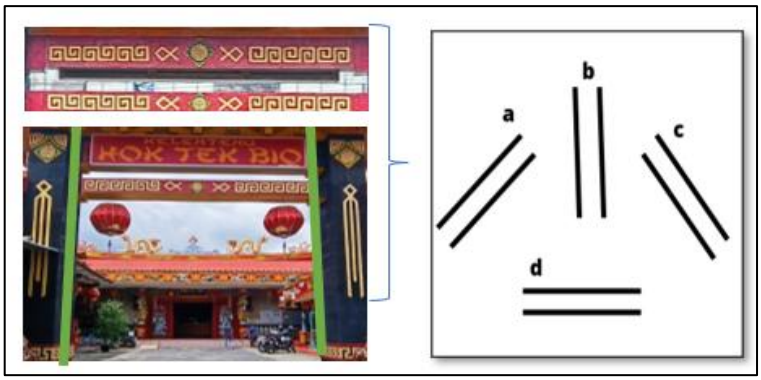

Figure 1. Front gate of the temple

In the form of the Wuwungan culture, the front gate contains a form that contains parallel lines. This is marked by the parallel black pillars and the Wuwungan supports as a connector. There are 2 parallel lines found in this cultural form. The two examples above are said to be two parallel lines because the two lines have the same slope, so that if we extend them, the two lines will not intersect. It can be seen in the picture that the direction of the line is the same and the gradient is also the same. Therefore, the cultural form above is said to fulfill the parallel lines.

b. Reflection Concept on Wuwungan

Based on the results of observations and documentation, the Wuwungan at the Hok Tek Bio Klentheng is constructed reflexively to symbolize deep balance, reminding people that balance, order, and harmony are the essence of a peaceful and happy life. More details can be presented in Figure 2 below.

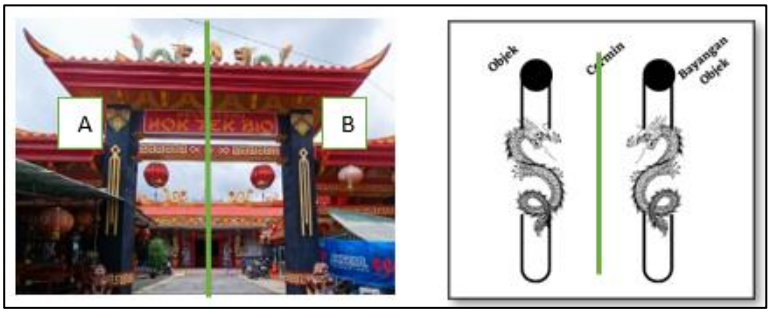

Figure 2. Reflection on Wuwungan

On the wuwungan above, 2 dragons are fighting over the gemstone, this can be said to be a reflection or mirroring because besides facing each other, we can assume that A is an object, B is the shadow of the object, and the green line is a mirror. It can be seen that the green line is a symmetrical line that represents a reflection. So that the Hok Tek Bio Pasar Wage Temple

building, most of its architectural buildings are symmetrical which can represent a reflection. Simply put, the distance from the object to the mirror is the same as the distance from the shadow to the mirror.

c. Translation Concept on Lanterns

Based on the results of observations and documentation and what was stated by the resource person, the Lanterns at the Hok Tek Bio Temple are installed in a translation manner depicting a dynamic but directed life journey. Translation, which involves movement without changing orientation or shape, reflects the continuity and continuation of ancestral traditions and values that are maintained from generation to generation in Chinese culture. Each lantern that is installed in a different but parallel and similar position symbolizes that even though life moves and changes, there is harmony and balance that is maintained, as presented in the following image

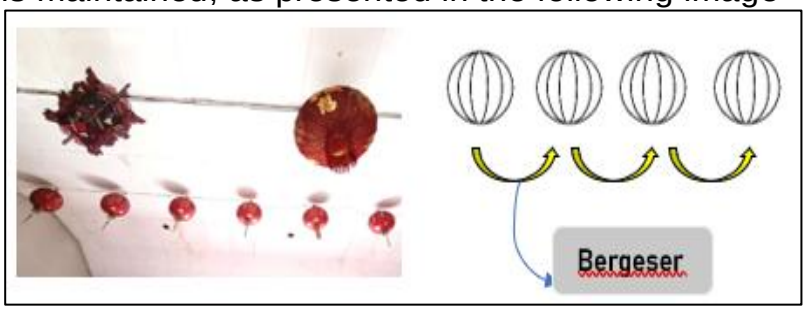

Figure 3. Translation on Lanterns

The image above shows the part of the ornament that is translated. It can be said to be a translation or shift because the lanterns have a distance and direction that contains the displacement of points (between lanterns) on a plane along a straight line (marked with a cable) with a direction and distance and does not change the size and shape at all. It is seen that between one lantern it will shift in the direction following the cable with a fixed size, one lantern with another lantern is said to have shifted (translation).

d. Dilation on the Klentheng Window

Based on the results of observations and documentation and what was stated by the resource person that the Windows in the Hok Tek Bio Temple were constructed using a dilation technique showing the nature of openness, breadth of view, and perspective in life. In mathematics, dilation involves changes in size while maintaining the basic shape, which in the context of installing windows in this temple can be interpreted as a broad perspective but still rooted in principles and identity. The dilation nature in installing windows symbolizes the ability to "see further" or broaden perspective without losing the core values or traditions inherent in a person or community. Windows with varying sizes but remaining similar in shape reflect flexibility in accepting changes in the outside world, but still holding firmly to the cultural roots and beliefs that exist within the temple. This illustrates openness to receiving knowledge, experience, and wisdom from outside, while still maintaining traditional identity and values. Furthermore, the dilation nature is presented in Figure 4 below:

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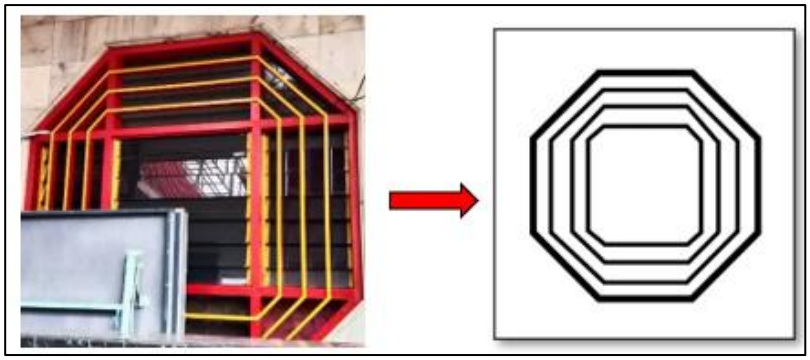

Figure 4. Dilation on the Klentheng Window

One of the interesting ornaments is the window of the temple, where the design of this window is different from usual, Chinese people make windows through calculations, in addition to making it look like it has an element of beauty (aesthetics). This temple window has an increasingly outer shape, the larger it is and its geometric shape remains the same, therefore it can be said to represent dilation or change in size.

e. The Concept of Circles on Bearings

Based on the results of observations and documentation and what was stated by the resource person, the Bearings in the Hok Tek Bio Temple are made circular and have a deep philosophical meaning, reflecting the concept of unity, eternity, and the endless cycle of life. In Chinese culture, the shape of a circle symbolizes harmony and perfection, because it has no beginning or end. This reflects the belief that life is a continuous cycle where everything will return to its origin. Circles are also often associated with the balance between the elements of Yin and Yang, which form the harmony of the universe. In a spiritual context, this circular bearing depicts harmony in the inner life and the relationship between humans and the universe. By sitting or praying on a circular cushion, visitors and worshippers are directed to reflect on their unity with nature, energy, and the universe. Furthermore, the cushion is presented in Figure 5 below:

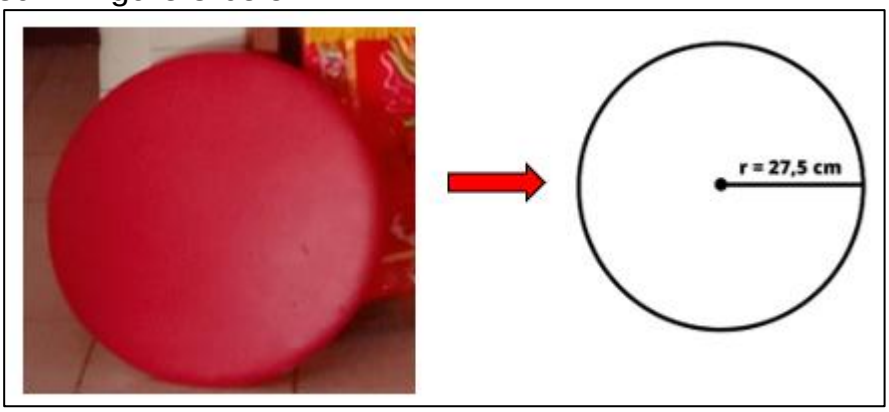

Figure 5. Circle Concept on Bearing

An ornament above can be said to be a circular plane shape because it can be seen directly that it is formed from a collection of all points surrounding an origin point with the same distance or it can also be said that a perfectly curved line has a center point as in the illustration. In addition, the bearing is shaped like a circle, which has an angle of 1 full rotation.

CONCLUSION

This research on ethnomathematics at the Hok Tek Bio Temple in Purwokerto has revealed that geometric concepts are not only present in theory, but are also closely intertwined with culture and tradition. Through the analysis of various geometric elements such as parallel lines, translations, dilations, and circular shapes found in the building structure and ornaments of the temple, it can be concluded that these mathematical aspects have deep philosophical meanings. The parallel lines on the temple's wuwungan depict the balance and order of life, while the translation pattern on the installation of lanterns shows the importance of the continuity of tradition and a clear direction in the journey of life. The dilation properties seen on the windows of the temple symbolize openness to expand the view without losing the core identity, and the circular shape of the cushions symbolizes unity, the cycle of life, and the harmonious relationship between humans and the universe. These findings show how geometry in the Hok Tek Bio Temple is not only an architectural element, but also a medium for conveying spiritual and social values. This research enriches our understanding of how mathematical concepts can be integrated in a cultural context, and inspires the development of more contextual and meaningful culture-based geometry learning. Ethnomathematics in this temple shows that mathematics and culture are intertwined in everyday life, offering insights into human relationships with traditional values, spirituality, and natural harmony.

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