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ETHNOMATHEMATICS INTEGRATION IN MATHEMATICS EDUCATION: A CASE STUDY OF FORT ROTTERDAM IN MAKASSAR

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Abstract

This research investigates the integration of ethnomathematics into mathematics education through a case study of Fort Rotterdam in Makassar. The urgency of this study lies in the recognition of the significance of ethnomathematics in enriching students' learning experiences and fostering cultural understanding in mathematics education. The study use a qualitative case study method, focusing on Fort Rotterdam as a historical and architectural landmark. Data collection involves observational techniques to examine the mathematical principles inherent in the fort's design and construction. Through systematic observation and analysis, the research aims to uncover how mathematical concepts are manifested in the architecture and layout of Fort Rotterdam, thereby illustrating the integration of mathematics into cultural artifacts. The findings reveal the intricate relationship between mathematics, culture, and history exemplified by Fort Rotterdam. Geometry, trigonometry, and other mathematical principles are intricately woven into the fort's structure, reflecting the practical applications of mathematics in historical contexts. This study underscores the importance of ethnomathematics in mathematics education, emphasizing its role in broadening students' perspectives and fostering a deeper understanding of the subject. In conclusion, the integration of ethnomathematics into mathematics education, as exemplified by the case study of Fort Rotterdam, offers valuable insights into the practical applications of mathematics within cultural contexts. By recognizing and appreciating the mathematical practices embedded in cultural artifacts, educators can enhance the relevance and significance of mathematics education, promoting cultural appreciation and understanding among students.

Key Words: Ethnomathematics, Fort Rotterdam

A. Inroduction

Indonesia is an archipelagic country consisting of various ethnic groups, languages, arts and cultures, and a diverse range of natural resources. In this era, globalization is rapidly increasing, making it not an easy task to preserve the diversity of ethnicities and cultures in Indonesia. Currently, the combination of

education and culture has a positive impact on development in Indonesia. It is hoped that the future generations will continue to uphold this so that cultural preservation will continue to thrive even as globalization increases. One of the alternative mathematics teaching methods that is currently trending in mathematics education is teaching that connects mathematics with everyday life based on local culture (own region). Mathematics and culture are two interconnected aspects. A student can increase their interest in learning mathematics from concrete things they already know, such as exploring information related to what they have learned in their daily lives regarding mathematics.

Mathematics teaching related to local culture is a good learning model to be further developed in the teaching and learning process so that mathematics learning becomes more enjoyable, interesting, and familiar to students because each learning activity is based on the students' daily culture. This is in line with (Turnudi, 2018), (Marsigit, Stiana, & Hardiarti, 2016), (Sulistyani, 2017), generally stating that another way to understand mathematics teaching is through local culture. In contrast, D'Ambrosio's view in Marsigit et al (2018) suggests that "the term requires a dynamic interpretation because it describes concepts that are not rigid or singular within themselves, namely ethnic and mathematics" (D'Ambrosio, 2011). Etno describes everything that creates local culture such as language, beliefs, food, clothing, habits, physical characteristics, and so on. Meanwhile, according to Gerdes (1994) in Wahyuni, he stated that Ethnomathematics is mathematics learning carried out by certain cultural groups such as worker/farmer groups, children from certain groups, communities, professional classes, and so on (Wahyuni, 2016).

In fact, almost all students, especially in the Makassar region, still consider mathematics as not being related to daily life, causing students to fail to understand basic mathematical concepts. Another reason is that most teaching aids used by teachers do not have a connection between students and learning in everyday life, whereas mathematics learning should be related to concrete things known by students. These concrete things act as a knowledge bridge for students to understand mathematical abstractions. The knowledge bridge referred to is Ethnomathematics. This is in line with D'Ambrosio's view (1985) in Hardiarti, stating that on the

contrary, there is a considerable amount of literature entering this by anthropologists (Hardiarti, 2017). Building a bridge between anthropologists and cultural historians as well as mathematicians means creating a bridge between culture and mathematics is an important step in recognizing various ways of thinking that can shape mathematical forms; it is an important step in advancing different yet mathematically related thinking patterns; this is the field we call Ethnomathematics. It can be interpreted that various mathematical concepts can be explored and found in culture, thus clarifying that mathematics and culture are interconnected; mathematics can be created from culture, and mathematics can be explored within culture to be one of the concrete forms of learning resources available to students. This is in line with (Wahyunni, 2016), (Fajriyah, 2018), (Putri, 2017), (Hardiarti, 2017), and (Maryati & Prahmana, 2018), generally stating that mathematics should be linked to daily life based on its abstraction.

One historical object that can be used as a learning medium in the teaching and learning process is the historical relics in Fort Rotterdam, located in the city of Makassar. Fort Rotterdam is one of the relics of the Gowa kingdom and has many historical relics. Some buildings and historical objects in Fort Rotterdam seem to have similarities with mathematical concepts, especially geometry material. Learning resources come from these historical objects which can be used to introduce various flat and spatial shapes. Marsigit et al. (2018) stated that Ethnomathematics serves to reveal the relationship between culture and mathematics. Therefore, Ethnomathematics is a science used to understand various forms of mathematics adapted from a culture.

Through mathematics learning resources derived from socio-cultural environments, it is hoped that it will facilitate students in understanding the basic concepts of mathematics because the learning process is carried out from mathematical knowledge in informal learning as a form of developing students' insights into the diversity of cultures they possess, especially local culture. Ethnomathematics-based Mathematics Learning is one alternative that can make learning more meaningful, contextual, interesting, and enjoyable. This is in line with Putri (2017) in her research that exploration in cultural studies related to mathematics can provide new information about the diversity of local cultures and

make it easier to understand mathematics learning because it is not considered 'strange' to students.

Embracing alternative mathematics teaching methods that connect mathematical concepts with everyday life, particularly through local cultural contexts, holds significant potential for enhancing students' interest and understanding in mathematics. Ethnomathematics emerges as a valuable approach, recognizing the interconnectedness of mathematics and culture. By utilizing historical artifacts, such as those found in Fort Rotterdam, as learning resources, educators can bridge the gap between mathematical abstractions and students' lived experiences, fostering a deeper understanding of mathematical concepts. Ultimately, the incorporation of ethnomathematics-based learning can contribute to making mathematics education more meaningful, contextual, and enjoyable for students, aligning with the broader goal of promoting cultural diversity and knowledge dissemination.

This research aims to explore and explain the concepts of geometry found in historical objects in Fort Rotterdam and how to utilize them in mathematical concepts in mathematics learning.

B. Research Method

This study is a descriptive qualitative research employing an ethnographic approach. The ethnographic approach enables researchers to gain a deep understanding of the culture and behavior of the groups under study. The research was conducted at the La Galigo Museum in Fort Rotterdam, Makassar, South Sulawesi, focusing on ethnomathematics related to historical artifacts in the La Galigo Museum.

The data sources for this research consist of two types: primary data sources and secondary data sources. Primary data involves data collection through observation, interviews, and documentation. Primary data is obtained directly through interviews with informants or sources. In this study, primary data was collected through observation of the La Galigo Museum in Fort Rotterdam.

Secondary data, on the other hand, is data collected from other sources, not directly from the research subjects. Secondary data may include literature reviews, documentation, books, newspapers, etc. Secondary data can help researchers

complement primary data and facilitate data collection and analysis. In this research, secondary data was obtained by documenting the forms of historical artifacts in the La Galigo Museum in Fort Rotterdam and using references from several journals and theses on ethnomathematics.

The data collection techniques used in this research include observation, interviews, and documentation. Direct observation was employed to understand the forms of buildings and historical artifacts in the La Galigo Museum in Fort Rotterdam, with researchers visiting the research location and making direct observations. Interviews were conducted through a structured interview guide. The documentation approach involved collecting relevant documents and data for the research, followed by comprehensive analysis to strengthen and validate specific occurrences.

The data analysis technique in this research utilizes qualitative descriptive analysis. From the data obtained, both from interviews and observations conducted directly in the field, transcripts of interviews were made, followed by providing narrative explanations regarding the overall analysis of the data obtained. Finally, conclusions will be drawn based on the acquired data.

C. Result and Discussion

Fort Rotterdam o is a historical remnant from the Kingdom of Gowa-Tallo. Located on the western coast of Makassar City, South Sulawesi, this fort was initially built in 1545 by the 9th King of Gowa, named Daeng Matanre Karaeng Tumapa'risi' Kallonna. The purpose of its construction was to strengthen the defense base of the Kingdom of Gowa along the Makassar coast in order to face the expansion of the VOC (Dutch East India Company), which continuously extended its influence in the political and economic spheres in eastern Indonesia (Sulasteri et al., 2020). The fort was later handed over to the Dutch VOC under the Bongaya Treaty of 1667 for occupation. The fort has six bastions and is surrounded by seven-meter-high walls and a two-meter-deep moat.

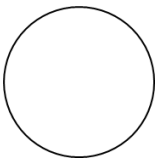
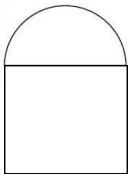
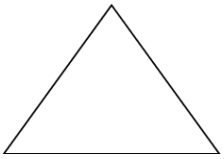
The fort was later used by the Dutch as a center for storing spices from eastern Indonesia. It also served as a military headquarters and regional government center for the Dutch until the 1930s. In 1937, the ownership of Fort Rotterdam by the Dutch East Indies government was transferred to the Fort Rotterdam Foundation.

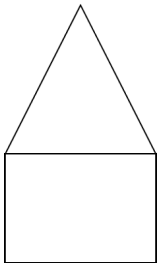
The fort was listed as a historical building on May 23, 1940. It underwent extensive restoration in the 1970s and now serves as a cultural and educational center, a venue for various music and dance events, and a tourist destination.

The similarities between buildings and cultural objects can be used as a medium in mathematics education, especially related to geometric material. Buildings and cultural objects help students form concrete initial concepts and make it easier for them to build their understanding. Based on field observations conducted at Fort Rotterdam on December 6, 2023, several images of buildings and historical objects were found in the La Galigo Museum that relate to ethnomathematics. It was found that there are many historical objects that can be used as ethnomathematics media, including:

a. Plane Figure

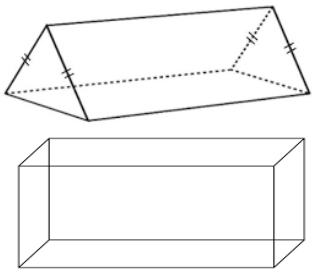
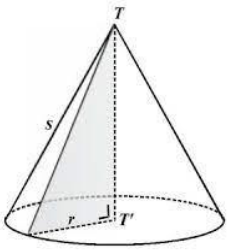
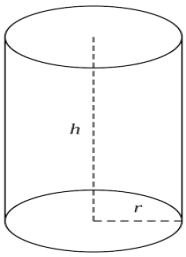
Table 1. Plane Figure Object in Fort Rotterdam

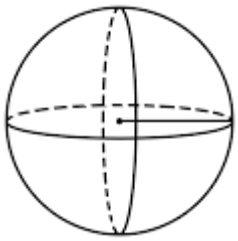
Concrete Object	Mathematics Representation
	 The birth tools of the Makassar tribe are similar to circles
	 Rotterdam fort windows resemble a stack of Square and Semicircular
	 The roof frame of the Rotterdam Fort is an isosceles triangle

Concrete Object	Mathematics Representation
	 Timpa Laja resembles a pile of rectangles and triangles

b. Space Geometry

Table 2. Space Geometry Object in Fort Rotterdam

Concrete Object	Mathematics Representation
	 This building consists of triangular prisms and Cuboid
	 This hat has a resemblance to a cone
	 Dimples have similarities to tubes

Concrete Object	Mathematics Representation
	 Cannon bullets have a shape that resembles a ball.

The objects above are among the thousands of historical items in Fort Rotterdam that resemble flat and solid shapes. Therefore, these objects can be used as teaching media in mathematics, particularly in the field of geometry. This is important for several reasons:

Contextual Learning: Using buildings and cultural objects in mathematics education provides relevant and tangible contexts for students. This helps them better understand abstract concepts as they can see and interact directly with these objects. Student participation in learning on contextual teaching and learning are better (Halawa & Darmawan Harefa, 2024).

Increased Learning Motivation: When students see the connection between the lesson material and their everyday lives or culture, they tend to be more motivated to learn. This can enhance their interest and engagement in mathematics. In line with (Villarin, et al. 2024). Ethnomathematics enhances student engagement, motivation, and conceptual understanding by connecting mathematical concepts to students' cultural backgrounds and lived experiences.

Multidisciplinary Approach: Integrating culture and mathematics introduces students to a multidisciplinary learning approach. This helps them develop critical thinking and creativity as they see how different fields of knowledge are interconnected. In addition (Indriani et al. 2024) developed modules based on ethnomathematics that can improve students' critical mathematical thinking skills.

Appreciation of Local Culture: Using cultural objects in education helps students recognize and appreciate their own cultural heritage. This can foster a sense of pride and a strong cultural identity. Someone who studies local wisdom in their education will raise the quality of the human resources themselves to be virtuous, civilized, and knowledgeable in science who are qualified in various scientific fields (Marlina & Aziz, 2023).

Strengthening Geometric Concepts: Buildings and cultural objects often have complex and interesting geometric shapes. Using them as teaching media helps students understand and apply geometric concepts in real and meaningful contexts.

This approach incorporates ethnomathematics, which recognizes and values the ways specific communities use mathematics in their daily lives. It enriches students' learning experiences and shows that mathematics is an integral part of various cultures worldwide. For these reasons, using buildings and cultural objects in mathematics education not only makes it easier for students to understand concepts but also enriches their overall learning experience.

D. Conclusion

Fort Rotterdam in Makassar serves as an intriguing example of how architectural elements and cultural history can be integrated into mathematics education using an ethnomathematics approach. When studying Fort Rotterdam, we can observe how this structure reflects the application of mathematical principles in its design and construction during its time. For instance, we can explore geometry in the architectural layout, volume calculations for fortification walls, or even trigonometric principles in determining cannon positions and firing angles.

Furthermore, Fort Rotterdam also embodies the rich history and culture of Makassar. By understanding the historical and cultural context surrounding the fort's construction, students can see how mathematics is not just a collection of abstract concepts but is closely intertwined with everyday life and the cultural evolution of a society.

By leveraging Fort Rotterdam as a case study, the ethnomathematics approach can be applied by exploring how mathematics is utilized within specific cultural and historical contexts, and how this understanding can be translated into meaningful and relevant learning experiences for students.

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