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Exploring Ethnomathematics in Jala Siddhi Amerta Temple

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Abstract: Many people think that mathematics is an abstract science filled with complex and confusing symbols and formulas; therefore, an intermediary is needed to learn it. Mathematics is one of the sciences that emerged from culture, so mathematics and culture cannot be separated. Ethnomathematics is a field that combines mathematical concepts with the cultural aspects of society. Therefore, this study aims to describe the results of an exploration of Sidoarjo cultural ethnomathematics activities at Pura Jala Siddhi Amerta, focusing on six basic mathematical activities within the culture. This study employs a qualitative approach, utilizing an ethnographic method. The data were collected through interviews and observations conducted by researchers with one of the administrators of Pura Jala Siddhi Amerta, using research instruments in the form of interview guidelines, observation sheets, and field notes. Then, the data will be analyzed using data analysis techniques of data reduction, data presentation, and conclusion drawing. The results showed that the form of ethnomathematics in Pura Jala Siddhi Amerta includes counting activities, locating activities, measuring activities, designing activities, playing activities, and explaining activities. It is related to the concept of number, geometric transformation, quadrilateral pyramid, and measurement. Therefore, it is hoped that teachers can use Pura Jala Siddhi Amerta as a bridge to teach math concepts, enabling students to understand the material more easily.

INTRODUCTION

Mathematics is influential and useful in various aspects of life, encompassing science, technology, and culture (Amirah & Budiarto, 2022; Noto et al., 2018). Mathematics plays a crucial role as a fundamental science, as evident in the high demand for mathematical skills that must be possessed, especially in the 21st century (Nahdi, 2019). However, many people still have the view that mathematics is a dry, abstract, theoretical science full of symbols and formulas that are difficult and confusing (Gazali, 2016). The objects of study in mathematics are abstract. (Himmah et al., 2021). So, in the study of mathematics, mathematical objects are challenging to observe and understand using the five senses. Therefore, a bridge or intermediary is needed to teach it.

Indonesian culture is the entire local culture that exists in every region in Indonesia (Nahak, 2019). According to Koentjaraningrat, culture is defined as the whole system of ideas, feelings, actions, and works produced by humans in social life that are made their own through learning (Syakhrani & Kamil, 2022). Mathematics is one of the sciences that emerged from culture, so mathematics and culture cannot be separated (Abdullah, 2016; Wulandari & Setianingsih, 2022). Without realizing it, mathematical concepts are often used

in everyday life. For example, they are used in daily shopping calculations, household budget management, and decision-making based on data and statistical analysis. Therefore, culture and mathematics are closely related.

Ethnomathematics is a field that combines mathematical concepts with a society's culture (Budiarto & Setianingsih, 2021). The integration of these two elements will produce contextual and realistic mathematics, making it more easily understood. In addition, through ethnomathematics, learning will be more engaging, and it will also help preserve a culture that supports the development of the Indonesian nation (Aprilyani & Hakim, 2020). The object of ethnomathematics is any culture around students that contains mathematical concepts (Hasan & Budiarto, 2022). Initial knowledge needs to be developed in mathematics learning to produce meaningful mathematical knowledge (Hasanah et al., 2022). According to Bishop (1997), ethnomathematics activities involve six fundamental mathematical activities that are developed in all cultures and societies, namely Counting, Locating, Measuring, Designing, Playing, and Explaining. One study related to ethnomathematics is "Exploration of Ethnomathematics in Sidoarjo Community Culture" (Hasan & Budiarto, 2022). Ethnomathematics: Mathematical Concepts in Sidoarjo Culture (Amirah & Budiarto, 2022), and Ethnomathematics at Pura Mandara Giri Semeru Agung as Mathematics Learning Materials by (Wahyu et al., 2018).

Sidoarjo is one of the districts in East Java with a long history, resulting in a diverse range of cultures. In Sidoarjo, there are also several places of worship from various religions. Among the many cultures in Sidoarjo, researchers selected a specific culture, namely Pura Jala Siddhi Amertha (a religious system), as the subject of this research. Based on the search conducted, there has been no research on the exploration of ethnomathematics forms in this culture. This study aims to describe the results of the exploration of Sidoarjo cultural ethnomathematics activities at Jala Siddhi Amerta Temple

METHOD

This study employs a qualitative approach, utilizing an ethnographic methodology. The characteristics of ethnographic research are a meaningful research topic, systematic and explicit research procedures, empirically conducted data verification, the use of a natural setting as the direct source of data, and a descriptive nature. In this study, researchers explored ethnomathematics activities in the culture of Sidoarjo, specifically at Pura Jala Siddhi Amerta. The Jala Siddhi Amerta Temple, located in Gedangan District, Sidoarjo Regency, is one of the temples where Hindus pray in Sidoarjo. This temple reflects inter-religious harmony, as it is situated adjacent to St. Paul's Catholic Church and the Jannatin Mosque of the 2nd Marine Brigade. The data collection techniques used were interviews, documentary observations, and field notes. The necessary research instruments include interview guidelines, observation sheets, and field notes. The observation sheet and interview guidelines were developed based on the indicators of the six ethnomathematics activities. The data obtained came from interviews and observations conducted by the researcher with the informants, then analyzed based on ethnomathematics activity

indicators using data analysis techniques of data reduction, data presentation, and conclusion.

RESULT AND DISCUSSION

Jala Siddhi Amertha Juanda Temple (JSA Temple) is a Hindu place of worship established on land owned by the Indonesian Navy which is located in the Navy/ Marine Brigade complex with the boundaries of the East of the official house complex of the 1st Marine Brigade, south of the 1st Marine Brigade, west of the Navy Psychology Service, north of St. Paul's Church. The area of the JSA Temple is 3,000 m², with a length of 60 m and a width of 50 m. Additionally, shared parking facilities between the temple and the church cover an area of 3,200 m².

This temple stands on land owned by the Navy, which was initially devoted to Hindu members of the Navy but was eventually opened to the public. Land ownership is still under the Navy, but Hindu self-help efforts, without assistance from the Navy, fund the construction of this temple. The Building Permit (IMB) of Pura JSA was issued on June 6, 2006. The inauguration of Pura JSA was held on June 23, 2009, along with the initial ceremony at the temple.

Pura is a place of Hindu worship; *jala* means water because of its location in the naval area, *siddhi* implies success, and *amerta* means life. The selection of the name is in the hope that this temple will become a source of blessings for Hindus, particularly in the areas of success and prosperity. The name of the temple comes from the Sanskrit language of India. Overall, the temple's layout adheres to the Tri Mandala system. The *Tri Mandala* is a typical Balinese structural division commonly found in temples, where the regional space is divided into three distinct areas. The temple area is divided into three parts, namely *Nista Mandala, Madya Mandala, and Utama Mandala*.

Nista Mandala displays an area that is not sacred, characterized by the lowest level of sanctity. Consequently, it still features supporting structures, including parking lots, multipurpose buildings, bathrooms, and guard rooms. *Madya Mandala*, a semi-sacred area located in the center, has evolved into a sacred place where sacred buildings, typically used for arts related to prayers, are found. This area, known as *Utama Mandala*, is the most core, holy, and sacred area, reserved exclusively for prayer and worship.

There are special rules for visitors or Hindus who wish to enter the temple. When entering the temple, it is required to wear a shawl or traditional Balinese attire. Additionally, spiritually unclean people may not enter the temple except the *Nista Mandala*. Women who are menstruating, people who are grieving, large pregnant women over 8 months, and parents whose children have not been prayed for 40 days after birth. Moreover, some rules require one to remove footwear before entering *the Madya* and *Utama Mandala*.

Some of the ceremonies routinely performed at the JSA Temple include the *Nitya Karma* and *Naimitika Karma* ceremonies. *Nitya Karma* is a daily ceremony, so every day, a holy person *(pemangku)* performs it at a simple level in the temple. *Naimitika karma* is a ceremony held on specific days, such as once every 15 days, on *Purnama* and *Tila*. The *purnama* ceremony commemorates the full moon, and after 15 days, a *tilem* ceremony is held

to celebrate the new moon; this cycle repeats. Ceremonies are held every 6 (six) months, such as *Galungan, Kuningan,* and *Saraswati.* Once a year, *Saka* new year (*Nyepi*), and *ogoh-ogoh* during *Nyepi*. The temple anniversary ceremony is held every 6 months in the Balinese calendar or approximately 7 months in the Gregorian calendar, which corresponds to 210 days.

Besides being used for Hindu worship, the JSA temple also has other functions. There are educational, cultural, and social functions. The JSA temple serves as a learning medium for Hindus, often referred to as Sunday school or *pasraman*. Inside, there is a special building dedicated to learning activities, ranging from kindergarten to high school, which takes place every Sunday. It is used to facilitate Hindu children whose schools do not have Hindu teachers, covering topics such as exams and grades, and promoting cooperation with schools.

Ethnomathematics activities in Jala Siddhi Amerta Temple

a. Forms of Ethnomathematics in Counting

Bishop (1997) stated that counting activity is an activity related to determining how to calculate and performing numerical calculations with math topics that can be derived, such as numbers, calculation methods, number systems, number patterns, and statistics.

Figure 1. Padmasana

Figure 2. Temple Gate

The *Jala Siddhi Amerta* Temple employs an odd-numbered pattern in its building structure. According to information from sources, odd numbers, such as 1, 3, and 5, are applied to the number of stairs in Jala Siddhi Amerta Temple. The level of the main temple building is also an odd number, for example are 3, 5, adn 7. . JSA Temple itself has 5 (five) levels in the main temple building. This number pattern has the philosophy that odd numbers are sacred numbers that symbolize the gods. The results of this study align with research by Yudanti et al. (2022), which indicates that the average number of stairs in Rumoh Aceh is odd number.

b. Forms of Ethnomathematics in Locating

Bishop (1997) stated that the activity of determining location is an activity related to finding one's way in the spatial world by directing oneself and other objects, which is a geographical aspect of mathematics involving mathematical concepts that appear in the activity of determining location, namely, dimensions and Cartesian coordinates.

Figure 3. Padmasana Loaction in Pura

The activity of determining the location involves identifying the main temple building, which is situated in the eastern part and faces west. In addition, the sacred building is also located at the highest point in the entire Jala Siddhi Amerta Temple area, symbolizing that the more sacred the region, the higher its location. In this *Tri Mandala* zoning and space, a main sacred building serves as an orientation for prayers or worship for Hindus, located in the east with the highest elevation compared to the two zonations (Bhattacharya & Riyanto, 2022). Etymologically, the word *Tri* means three and the word *Mandala* means place, space, or region. The spatial structure and boundaries of the Tri Mandala are guided by the orientation of the mountains and sea (*kaja*/north–*kelod*/south) and the direction of sunrise and sunset (*kangin*/east–*kauh*/west), which contain religious values and benefits for its users. This explanation indicates that ethnomathematics was used to determine the location of the sacred building of the JSA Temple (Padmasana). This is in line with research by Yuningsih et al. (2021), which explains that the activity of determining the location of a traditional house involves placing house ornaments to make it visually appealing, such as positioning doors to face north.

c. Forms of Ethnomathematics in Measuring

Bishop (1997) states that an activity can be measured. In determining an amount, measurement techniques and all units involved are considered, including those related to mathematical concepts such as order, size, units, measurement systems, and quantity.

Figure 4. Distance from Building to Fence

Measuring activities are found in the Jala Siddhi Amerta Temple, which employs a measurement system based on the shape of the human body. For example, using the size of the soles of human feet to determine the distance from the roof of the building to the outer fence. For example, from the image above, the distance between the building and the outermost fence is 5 (five) feet. It is intended that when rain falls from the ceiling, it does not hit the fence so that the outer wall of the temple will still look beautiful. Additionally, calculations are made using *hasta* (hands) and *depa* (arm spans). Besides, the height of the existing buildings is adjusted to the size of the human body, ensuring it is neither too high nor too low. If the calculations are in accordance with the science used, the building will look more beautiful, function well, minimize splashes during rain, and prevent flooding. The application of measurements in Balinese houses usually uses the body of the homeowner. Meanwhile, in the process of building a temple, there is an *undagi* who is a person who specifically worships Sang Hyang Vishvakarma or the architect of the Gods, he will design the temple building according to existing rules based on his body parts. The measurement activity at the JSA Temple also appears when measuring the temple area, which is 300 x 500 m long x 150,000 m^2 with an area of 150,000 m^2. It is also explained by Prahmana (2020) that the people of Yogyakarta use a special mathematical language in Javanese, which is used to measure length units, such as *njari, kilan, dhepa,* and *siku*.

d. Forms of Ethnomathematics in Designing

Bishop (1997) states that designing activity involves creating an object form, encompassing differences in shapes, properties, and the way shapes are interconnected. The decline of mathematical topics in this activity includes shape, order, harmony, similarity, construction drawings, and geometric properties.

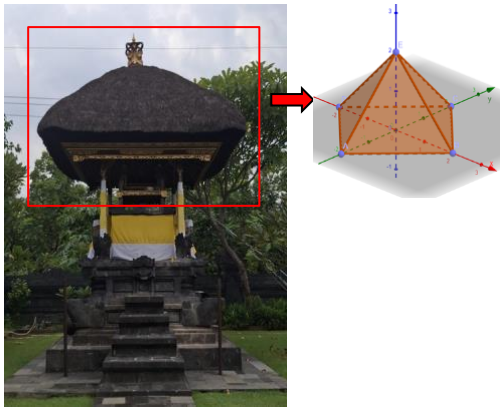

Figure 5. Square Pyramid in building

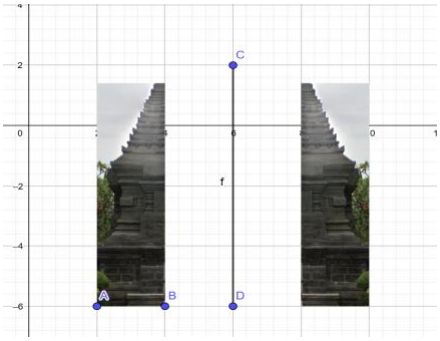

Figure 6. Reflection in Bentar Temple

There are several objects or building shapes that resemble spaces, such as rectangular pyramids and rectangular prisms, as seen in the picture above. The building is called Bale Pepelik which has a roof in the shape of a square pyramid and is made from palm fiber. At the entrance of Jala Siddhi Amerta Temple, there is a gate called Candi Bentar. Philosophically, the gate is actually one building divided into two parts, so that the right and left sides have the same shape as a mirror image. The gate in the temple also shows one of the concepts of geometric transformation, namely reflection (mirroring). In line with Azizah et al.'s (2024) research, the Bentar Temple features a mathematical element of reflection, while the carving ornaments incorporate elements of reflection and translation.

e. Forms of Ethnomathematics in Playing

According to Bishop (1997), play activities are behaviors that involve fun and utilize skills, strategic thinking, guessing, and planning. In play activities, mathematical ideas can be derived, including procedures, rules, plans, and strategies for carrying out a particular action.

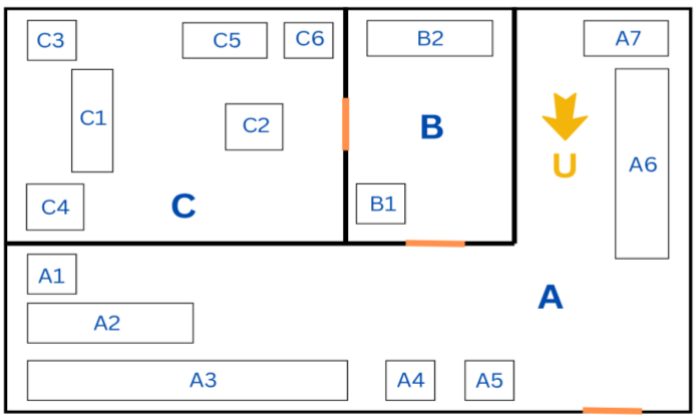

Figure 7. Map Illustration Jala Siddhi Amerta Temple

A : *Nista Mandala* B1 : Balai Dana Punia

B : *Madya Mandala*
C : *Utama Mandala*
A1 : *Palinggih Beji*
A2 : Aula
A3 : Bangunan Sekolah Minggu
A4 : Bale Kulkul
A5 : Patugan Karang
A6 : Tempat Istirahat
A7 : Ruang Terbuka
B2 : Bale Gong
C1 : Palinggih Padmasana
C2 : Bale Pawedan
C3 : Sedahan Panglurah
C4 : Bale Pepelik
C5 : Balai Tajuk Panjang
C6 : Gedong Penyimpanan

Play activities are found in the explanation of the division of areas in the temple. This temple employs the Tri Mandala concept, which comprises three areas with their distinct philosophies, *Nista Mandala, Madya Mandala,* and *Utama Mandala*. *Nista Mandala* or jaba sisi is the outermost area of the temple and is not considered sacred; anyone can enter this area. In this area, there are supporting buildings such as halls, parking lots, classrooms, bathrooms, etc. Then, enter the *Madya Mandala* or jaba tengah area in the middle. This area has begun to become a holy place, so footwear must be removed, and at least a shawl should be provided or traditional Balinese clothing used. In this area, there are sacred buildings related to worship, such as the *Balai Dana Punia* hall for collecting monetary offerings and the *Bale Gong* for storing artistic instruments such as gamelan. The most sacred area is the *Utama Mandala* or jeroan, where only prayer activities are carried out by Hindus. Mathematically, it demonstrates a systematic and measurable division of territory. The temple's territories are connected by stairs, indicating that the higher the territory, the more sacred it is. This concept is also similar to the human body and the universe. The human body is divided into three levels: from the waist down, from the waist to the neck, and from the neck to the head, with the highest level being the head. The results of this study align with Aini's (2021) research, which states that play is a fun activity, has a specific pattern, and encourages strategy and modeling. These results align with research indicating the presence of play activities in the Gebang Temple building. Specifically, during the construction or restoration of the Gebang Temple, strategies were employed to arrange stones and predict the shape and size of the temple body (Dhinda et al., 2023). Meanwhile, in the Jala Siddhi Amerta Temple, there is a process of determining the area/region of the Tri Mandala concept which is adjusted to the size of the temple location.

f. Forms of Ethnomathematics in Explaining

Explaining activities are activities related to a person's behavior in trying to explain both to themselves and others why things happen based on their way (Bishop, 1997). The activity of explaining arose when the speaker described the characteristics of Pura Jala Siddhi Amerta in comparison to other temples. JSA

Temple is one of the large temples in Sidoarjo that applies the Tri Mandala regional division concept, while other small temples only apply the Dwi Mandala. Because it is located on the island of Java, the temple architecture reflects the acculturation between Javanese and Balinese cultures. It can also be observed that in the JSA Temple, there is a Bentar Temple, serving as a gate or entrance that has existed since the Majapahit era and is typically found in temples on the island of Java. In addition, the Kori Agung building also adapts to the Majapahit era temple building style, incorporating lava black stone from Bali, whereas the typical Majapahit temple uses red bricks. This aligns with Novalena and Listiani's (2022) research, which suggests that the Explaining aspect of the Betang Ensaid Panjang traditional house focuses on the meaning behind the building design, which appears natural yet straightforward in style.

CONCLUSION AND SUGGESTIONS

Based on the results and discussion of the exploration of ethnomathematics at Jala Siddhi Amerta Temple derived from the results of interviews and observations. It can be concluded that there are six ethnomathematics activities at the temple. The activities that appear include counting, determining location, measuring, designing, playing, and explaining. Counting activities are displayed in odd numbers on the stairs and roof of the main temple building. It can be used to develop understanding of numbers, arithmetic operations. The activity of determining the location appears in the main sacred building located in the eastern part of the highest area of the entire temple. It is for the coordinat and location concept. Measuring activity involves using body parts to measure the distance between buildings. It can help the students to understanding about standard and non-standard units. The design of the activity appears in the shape of a building that resembles a quadrilateral pyramid, and the geometry transformation (mirroring) is evident in the Bentar Temple. In design acitivities can make the student learn about geometry and patterns visually and creatively. Engage in playing activities that correspond to the division of temple layouts based on the Tri Mandala concept. In this activities can develop about the strategy and reasoning. Lastly, the activity of explaining is evident in the characteristics of the Jala Siddhi Amerta Temple building and the acculturation of Javanese and Balinese cultures. This activities can practice the ability to explain a concepts, thinking logically, and connect the teory and pratice. Therefore, the six acitivities of ethnomathematics can discover the understanding of student. Ethnomathematics can help the teaching on mathematics in the class to help the students understanding by combining culture and formal mathematics. With the visual representation of existing culture, it hoped that students will find it easier to remember existing concepts. In addition, ethnomathematics makes the learning environment more interesting and engaging for students, making them more interested in learning.

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