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Exploring Ethnomathematics in the Menara Kudus as a Learning Resource for Geometry

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Abstrak

Pembelajaran matematika siswa akan lebih bermakna ketika materi berkaitan dengan kondisi yang sesuai dengan apa yang ada di sekitarnya. Pentingnya penelitian ini dilakukan karena Menara Kudus yang merupakan salah satu peninggalan budaya dapat dilestarikan melalui pembelajaran disekolah sebagai sumber belajar yang bermakna bagi siswa. Penelitian ini bertujuan untuk mengeksplorasi dan memperdalam etnomatematika di Menara Kudus sebagai sumber belajar bagi siswa. Dalam penelitian ini menggunakan jenis penelitian deskriptif kualitatif dengan pendekatan etnografi. Teknik pengumpulan data menggunakan observasi dan pencatatan. Teknik analisis data yang digunakan reduksi data, penyajian data dan penarikan kesimpulan. Objek pengamatan pada kegiatan ini adalah bangunan Menara Kudus. Simpulan dari penelitian ini didapatkan bahwa geometri yang terdapat pada bangunan Menara kudus adalah bagian dasar menara yang menampilkan banyak dekorasi batu bata dan dapat dimodelkaan menggunakan geometri persegi panjang, persegi, segitiiga, dan berlian. Untuk badan menara dimodelkan pelat dan batu bata menggunakan geometri lingkaran, persegi panjang, dan berlian. Sebaliknya tangga tower dengan dinding dan pintu dapat dimodelkan sebagai trapesium, segitiga sama kaki, segitiga siku-siku, trapesium.
Kata Kunci: Etnomatematika; Geometri; Menara Kudus.

Abstract

Students' mathematics learning will be more meaningful when the material is related to conditions that are in accordance with what is around them. The importance of this research is that the Menara Kudus, which is one of the cultural heritages, can be preserved through learning at school as a meaningful learning resource for students. This research aims to explore and deepen ethnomathematics at Menara Kudus as a learning resource for students. This research uses a qualitative descriptive research type with an ethnographic approach. Data collection techniques use observation and recording. The data analysis techniques used are data reduction, data presentation and drawing conclusions. The object of observation in this activity is the Menara Kudus building. The conclusion from this research is that the geometry found in the Menara Kudus building is the base of the tower which displays many brick decorations and can be modeled using rectangular, square, triangle and diamond geometries. For the tower body, plates and bricks were modeled using circle, rectangle and diamond geometry. On the other hand, tower stairs with walls and doors can be modeled as trapezoids, isosceles triangles, right triangles, trapezoids.
Keywords: Ethnomathematics; Geometry; Menara Kudus.

I. INTRODUCTION

Indonesia, as a vast archipelagic nation, is home to extraordinary cultural diversity. This diversity encompasses various languages, customs, arts, and traditions that enrich our identity. In facing the challenges of globalization, we bear the responsibility of preserving and passing down this cultural wealth to future generations. Achieving this requires a collective effort to raise awareness about the importance of safeguarding our cultural heritage. It is equally vital to foster pride and love for our culture so that future generations will be inspired to continue these traditions and ensure their sustainability. By doing so, we can ensure that Indonesia's cultural wealth remains vibrant and develops in the future (Sundoro, Kalbuana, & Cahyadi, 2024).

Cultural heritage is undeniably intertwined with daily life, especially in education, including mathematics education. Integrating culture into the curriculum is an effective way to introduce students to cultural principles and raise awareness about preserving and passing down cultural heritage. This approach not only helps students develop an appreciation for cultural diversity but also enriches their understanding of the values upheld by society (Umbara, Wahyudin, & Prabawanto, 2021). The fusion of mathematical concepts into culture forms the essence of a field called ethnomathematics (Septia, Nuraini, & Wahyu, 2024). By integrating cultural aspects into mathematics teaching, ethnomathematics proves highly beneficial, helping students grasp mathematical concepts in real-world situations, making lessons more meaningful and relevant (Kadonsi, Kenneth, & Magdalene, 2023).

Ethnomathematics is an approach that allows us to uncover mathematical concepts embedded within cultural products (Ja'faruddin & Naufal, 2023). These cultural products may refer to various societal aspects, such as art, music, folklore, and language. Ethnomathematics encourages us to explore the relationship between mathematics and everyday life, appreciate the role of mathematics in cultural heritage, and explain how mathematical principles manifest in cultural practices. As such, ethnomathematics makes mathematics more comprehensible and closely linked to real-life contexts (Prahmana, 2022; Nugraha, Maulana, & Mutiasih, 2020). According to Mania and Alam (2021), implementing ethnomathematics in the classroom not only makes learning more meaningful but also becomes more effective in classrooms with diverse ethnic, cultural, and social backgrounds.

In the real world, culture and mathematics are closely connected (Aprisal & Arifin, 2023). While mathematics is a discipline often used for problem-solving in life, culture is a multifaceted entity. Thus, it is impossible to separate the strong ties between teaching mathematics in schools and addressing cultural and societal issues (Susanto, Setiawan, & Daniaty, 2023). Mathematics, according to Branes (in Acharya et al, 2021), is a cultural construct providing symbolic techniques and representations that simplify cognitive processes. Therefore, mathematics is not merely a formal field of knowledge. This aligns with Abrahamson et al. (2023) that

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social interaction produces mathematical knowledge, a culmination of facts, principles, ideas, concepts, and essential skills developed within cultural frameworks.

Bishop (1994) asserted that mathematics is a type of culture. Every aspect of human existence incorporates mathematics as an expression of culture. Additionally, mathematics as a symbolic technology emerging from cultural practices or abilities (Kaput, Hegedus, & Lesh, 2020; Lestari et al., 2022). Cultural backgrounds influence how people perceive mathematics, shaping behaviors and contributing to personal knowledge growth, particularly in learning mathematics. Wahyuni et al. (2013) argued that ethnomathematics bridges the gap between cultural perspectives and mathematics education. The term "ethno" refers to ethnicity or culture, while "mathematics" denotes the study of mathematics within cultural contexts. Together, they form the concept of ethnomathematics.

Bishop (1994) identified six core activities performed by various ethnic groups in ethnomathematics: counting, measuring, sketching, designing, playing, and describing. Ethnomathematical objects are cultural artifacts containing distinctive mathematical ideas within specific societies. Bishop suggested that mathematical tasks such as calculations, measurements, sketching, designing, playing, and explaining employ ethnomathematical items, which include traditional games, crafts, artifacts, and culture-based activities.

Ethnomathematical activities within a culture represent a learning process inherent to every culture, known as ethnomathematics. It highlights the potential of communities in mathematics, particularly in mathematics tailored for cultural groups, whether indigenous peoples or mathematical societies (Hasanuddin, 2017). Ethnomathematics successfully combines culture and mathematics, especially in education (Wahyuni et al., 2013). It employs culture as a medium for learning mathematics, thereby appreciating both culture and mathematics. This approach gives critical contextual meaning to abstract mathematical concepts (Masamah, 2019).

The Menara Kudus is an example of an ethnomathematical object worth exploring. Located in Kudus Regency, Central Java, the Menara Kudus offers significant potential for ethnomathematical studies, particularly its structure, which includes numerous geometric elements, especially plane shapes.

While many recognize the Menara Kudus, not all are familiar with its history. It is widely known as a masterpiece built by Sunan Kudus, housing his tomb. In the modern era, introducing cultural heritage to younger generations, particularly students, is crucial (Auliya, 2021).

Observing the Menara Kudus, one can see sections resembling geometric shapes such as triangles, rectangles, squares, cubes, cylinders, pyramids, and more. This makes the Menara Kudus an educational resource for educators and a means to express and preserve culture.

This study underscores the importance of utilizing the Menara Kudus as a

meaningful learning resource for students by incorporating its cultural significance into school lessons. Using ethnomathematics to explore the Menara Kudus offers an opportunity to study and learn from the culture surrounding it, serving as a valuable educational resource when teaching geometry in mathematics.

II. METHOD

In this study, we employed a qualitative descriptive research method with an ethnographic approach. Qualitative research is a process that generates descriptive data in various forms, including verbal, written, and thematic descriptions, which illustrate the observed subjects and objects (Sugiyono, 2013). The use of an ethnographic approach in this study aims to explain, describe, and analyze all cultural elements present in society (Zayyadi, 2021). This approach seeks to obtain an in-depth understanding of the cultural object of *Menara Kudus* and the values passed down from previous generations through direct research conducted over a specific period.

The research framework applied is suitable for describing, analyzing, and explaining the elements of a cultural group, such as beliefs, behavior patterns, and language, which evolve over time, aligning well with an ethnocentric approach.

The data collection methods chosen were observation and documentation. In this study, observation was conducted first. The observation method aimed to describe aspects related to *Menara Kudus* and to draw conclusions from the observations, which were then compiled into a report. The observation was carried out on May 11, 2022, at *Menara Kudus*, located on Jalan Menara, Ds. Kauman, Kec. Kudus Kota, Kab. Kudus, Central Java. The observation process involved recording and documenting the objects encountered and observed, which were then classified into mathematical concepts.

III. RESULT AND DISCUSSION

There are actually two versions regarding the origin of the Menara Kudus, depending on who its founder and successors were. The first version states that the Menara Kudus is a legacy from ancient societies, while the second version claims it as the heritage of Sunan Kudus. These two versions have led the people of Kudus to firmly believe that the tower located in Kudus is a relic of Sunan Kudus.

One reason why some Kudus residents support the first version is based on the tower's orientation. The Menara Kudus faces west, as its gateway is on the west side. Another reason is that during its construction, no statues or reliefs depicting the lives of predecessors were discovered. A third reason is the absence of any reliefs or statues in the structure.

To this day, there is no definitive evidence regarding when the Menara Kudus was built, as there are no records or precise data discussing its construction date. Its construction period can only be estimated based on its function: the tower was used as a place to call the adhan (Islamic call to prayer). This suggests a connection between the mosque and the Menara Kudus, where the mosque served as a place of worship for Muslims, and the tower complemented this function.

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The founding date of the mosque can be determined from an inscribed stone located on the mosque's pulpit. This inscription provides four key points: First, the mosque was named Al-Aqsa, built by Sunan Kudus. Second, it states the location of the mosque's construction, identified as al-Quds. Third, it mentions the establishment date as Tuesday, the 19th day of the Hijri month of Rajab in the year 956 AH. Lastly, the founder is named as Jafar Sadiq, also known as Sunan Kudus.

The Menara Kudus is approximately 18 meters high, with a base measuring 10 x 10 meters. The surrounding area is decorated with 32 panels, 20 of which are blue and depict images of mosques, camels, and palm trees. The remaining 12 panels are red and white, featuring floral carvings on plates.

The Menara Kudus reflects a blend of Hindu and Javanese cultural influences. Its structure consists of three main sections: the base, the body, and the top, each exhibiting distinct Hindu-Javanese architectural traits. The building is adorned with motifs reminiscent of small hills, and its construction incorporates traditional Javanese architectural techniques, such as the use of bricks assembled without adhesive materials like glue or cement. The roof features a pinnacle similar to those found on traditional Javanese mosque roofs.

The application of ethnomathematics can be observed in the cultural aspects of the Menara Kudus's architecture, particularly the fusion of Islamic and Hindu cultures. This is evident in the ornaments and carvings resembling Hindu temples and its tripartite structure: the base (foot), the body, and the top (peak).

The lower part of the Menara Kudus features geometric ornaments, including rectangular stone tiles connected at their ends by triangular ornaments. The tiles at the tower's base are rectangular, joined with triangular and square decorations. The body of the tower is adorned with geometric patterns, such as circular porcelain panels set into smaller circular and diamond-shaped panels.

At the top, the tower has a two-tiered tajug roof, resembling a meru-style roof commonly used to shelter sacred works. The stepped entrance to the tower is flanked by trapezoidal, isosceles triangle, and right triangle stone decorations, further highlighting its intricate architectural style (see Figure 1, 2, & 3).

Figure 1. The Menara Kudus as Seen from the East

Figure 2. Entrance Building of the Menara Kudus Complex

Figure 3. The Mosque Building at the Menara Kudus

The Menara Kudus, a significant cultural heritage site, can be preserved through its integration into school curricula as a meaningful learning resource for students. This aligns with the statements of Kumala (2022), Herawati & Sumboro (2023), and Huda (2018), who assert that learning resources can be derived from abundant cultural elements, making education more meaningful.

IV. CONCLUSION

Based on the research mentioned above, the Menara Kudus is adorned with decorative educational features, making it a structure rich in Islamic and Hindu cultural influences, as well as a legacy of Sunan Kudus. Embedded within this heritage are mathematical concepts. Thus, we can conclude the following:

The geometry found in the Menara Kudus can be analyzed as follows: The base of the tower, showcasing numerous brick decorations, can be modeled using rectangular, square, triangular, and diamond shapes. The body of the tower can be modeled with plates and bricks using circular, rectangular, and diamond geometries. The tower's stairs, walls, and doors can be represented with trapezoidal shapes, isosceles triangles, right triangles, and other geometric forms.

In applying ethnomathematical learning based on the Menara Kudus, educators must first develop a structured lesson plan. They then determine the teaching approach, methods, and resources to be employed. By implementing ethnomathematics in the context of the Menara Kudus, educators can use approaches such as field trips, where students are taken directly to the source. This allows students not only to imagine but also to experience the subject matter firsthand.

Educators guide students in observing and analyzing the Menara Kudus's structure to identify its mathematical elements. By conducting ethnomathematics-based learning at the Menara Kudus, it is hoped that students can broaden their knowledge and deepen their understanding of local culture through mathematics education.

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