



Ethnomathematics Exploration Types of Angles in The Ampel Religious Area for Elementary School Mathematics Learning

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ABSTRACT

Mathematics is one of the branches of science that has developed since ancient times and has become part of human life and culture. The relationship between mathematics and culture is called ethnomathematics. This study aims to explore the mathematical concept of various types of angles found in the Ampel Religious Area. The main focus is on the forms of buildings or architecture, ornaments, and objects in them. The research location is the Ampel Mosque and its surroundings located on Jalan Ampel Masjid, Semampir District, Surabaya City. Data were collected through observation and documentation techniques. There are three data analysis techniques used, namely data reduction, data presentation, and drawing conclusions. The data reduction stage is carried out by selecting appropriate data. The data presentation stage is carried out by providing a narrative on the images/photos obtained. The conclusion drawing stage is carried out by concluding the findings based on the research objectives. The results of this study indicate that in the area there are acute, right, obtuse, straight, reflex, and 360° angles. This research can be used by elementary school teachers as an idea and reference for mathematics learning, so that students can learn more about local culture and understand mathematics.

Keywords: ethnomathematics, exploration, religion, Ampel, angle, elementary school

ABSTRAK

Matematika merupakan salah satu cabang ilmu yang berkembang sejak dulu dan menjadi bagian dari kehidupan serta budaya manusia. Hubungan antara matematika dan budaya disebut etnomatematika. Penelitian ini bertujuan untuk mengeksplorasi konsep matematika tentang berbagai jenis sudut yang terdapat di Kawasan Religi Ampel. Fokus utamanya yaitu bentuk-bentuk bangunan atau arsitektur, ornamen, dan benda-benda di dalamnya. Tempat penelitian adalah Masjid Ampel dan sekitarnya yang terletak di jalan Ampel Masjid, Kecamatan Semampir, Kota Surabaya. Data dikumpulkan melalui teknik observasi dan dokumentasi. Teknik analisis data yang digunakan ada tiga alur yaitu reduksi data, penyajian data, dan penarikan kesimpulan. Tahap reduksi data dilakukan dengan memilih data yang sesuai. Tahap penyajian data dilakukan dengan memberi narasi pada gambar/foto yang diperoleh. Tahap penarikan kesimpulan dilakukan dengan menyimpulkan penemuan berdasarkan tujuan penelitian. Hasil penelitian ini menunjukkan di kawasan tersebut terdapat sudut lancip, siku-siku, tumpul, lurus, refleksi, dan 360° . Penelitian ini dapat dimanfaatkan oleh guru sekolah dasar sebagai ide dan referensi pembelajaran matematika, agar siswa dapat mengenal lebih dalam tentang budaya lokal setempat sekaligus memahami matematika.

Kata Kunci: etnomatematika, eksplorasi, religi, Ampel, sudut, sekolah dasar

INTRODUCTION

Humans have abilities that can be developed through education and experience. Law Number 20 of 2003 Article 3 concerning the National Education System states that the goal of national education is to develop students' potential to become human beings who believe in and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Nasional, 2003). Anwar (2015) said that education has an important role in human life because education is recognized as a strength. Education can determine achievement and productivity in other fields. Education has an important role for humans and the state because of the development of the era that continues to develop (Yudianto et al., 2021). Education is so important that it must receive special attention from all citizens including the government. One of the important subjects that supports educational progress is mathematics. Mathematics is seen as an activity carried out in addition, subtraction, and division or an activity that involves solving calculation problems and is presented in the form of questions (Netson & Ain, 2022). The development of logical, flexible, and precise thinking in solving everyday problems can be prepared through mathematics learning. This is because mathematics has a very important influence on life and is one of the basic sciences (Fendrik, 2019). The goal of mathematics education in elementary schools is to form abilities including understanding concepts, reasoning, and problem solving (Sukmawarti et al., 2021). Mathematics is considered important because it is part of the language used in society (Azizah, 2022).

Mathematics is a science that has developed since ancient times and has become part of human life and culture. Mathematics that grows and develops in a particular community culture is called ethnomathematics. Ethnomathematics is developed through the study of various relevant sciences. Ethnomathematics was first introduced by a Brazilian mathematician named D'Ambrosio in 1977. D'Ambrosio (Nuryami & Apriosa, 2024) said that the meaning of ethnomathematics comes from the word "ethno", which is something related to social, myth, culture, language, symbols, and behavior. The meaning of the word "mathema" is to explain, know, classify, understand, conclude, and model. The word "tics" means technique. Gazanofa & Wahidin (2023) said that the combination of mathematical approaches with culture is called ethnomathematics. Meanwhile, I. Wahyuni & Hasanudin, (2023) said that a tool that can connect culture with mathematics and later can help students understand mathematics learning is also the definition of Ethnomathematics. Based on these definitions, it can be said that Ethnomathematics is an approach to mathematics and culture so that students are able to understand mathematics. Ethnomathematics-based learning will create a transformation of a fun learning environment for both teachers and students, to be able to actively explore their familiar cultural environment so that learning takes place optimally (Aminah et al., 2023)

Indonesia uses the PISA results to evaluate the quality of its education system and has been participating in the assessment since 2000. The results of PISA 2022 which were released by the Ministry of Education and Culture on December 5, 2023, showed that Indonesia experienced an increase in ranking, but its score decreased from 2018 (Kemdikbud, 2023). In fact, mathematics is the foundation in various scientific fields (Andriono, 2021). Of course, mathematics learning must be meaningful for students, including by linking students' daily

lives and culture. Learning mathematics can improve students' ability to think logically, analytically, systematically, critically, and creatively. These abilities are very much needed so that learners are able to obtain, manage, and utilize information to survive in a world that is constantly changing, full of uncertainty, and very competitive while still maintaining their culture.

Indonesia is a country rich in cultural diversity. Local culture is a reflection of the national culture that needs to be preserved (Santoso & Kurino, 2021). Local culture that is not well maintained and ignored can lead to cultural recognition by other countries. In addition, culture must be preserved because it is the noble heritage of the Indonesian nation. The development of mathematics also cannot be separated from existing culture because mathematics and culture are two things that are interrelated. Indonesia has great potential in the application of ethnomathematics because there are many cultures in this country. However, mathematics learning is still rarely associated with culture. Ethnomathematics invites students to be able to think logically and critically through the culture around them, then be able to apply it in a mathematical concept. Of course, this can be a renewal or innovation in the process of learning mathematics in schools without leaving its culture (Y. D. Kurino et al., 2023).

Culture has various types, including traditional houses, traditional clothing, music, dance, religious buildings (places of worship), and others. Through these parts of culture, it is hoped that they can become innovations in mathematics learning in schools. As (Turmuzi et al., 2022) said, we should strive for various alternatives and innovations in order to improve students' mathematics skills, one of which is improving the learning process in schools, especially by increasing reasoning, problem solving, argumentation, and communicating through more contextual teaching materials. Learning must be contextual, namely linking mathematics to the real world (A. Kurino, 2022). There are many cultural heritages from the Indonesian nation, including the Ampel religious area whose ethnomathematics can be explored. In this area there are buildings or architecture, ornaments, and objects resulting from cultural heritage which are still well preserved to this day. The ornamental symbol on a building element can be a determinant of the building element that is more sacred. The Ampel Religious Area contains mosques, cemetery complexes, and markets, and so on. Many parts of this area can be associated with mathematics learning, including the material on types of angles. These parts include the roof of the mosque, gate, bedug, door, and so on. The integration of ethnomathematics in mathematics learning allows students to learn mathematics through local culture, so that they can more easily understand and appreciate mathematics. In addition, it can also strengthen the identity and sense of pride in their local culture.

Until now, there has been no research to explore the concept of angles in the Ampel religious area. Previous ethnomathematics research on angles was found in a journal entitled *Ethnomathematics Exploration in the Architecture of the Kanoman Palace, Cirebon, Siti Inggil Area*, that the concept of angles is found on the walls of the Lawang Syahadat gate, the supporting pillars of the Pancaniti building, and the roof of the Lumpang building which include acute angles, right angles, and obtuse angles (Prabawati et al., 2022). Another study in the journal entitled *Ethnomathematics: Geometric Exploration in the Design of the Surakarta Grand Mosque* found the concept of acute angles, right angles and 180° (S. A. B. Wahyuni et

al., 2024). In addition, it was also found in the study entitled *Ethnomathematics: Geometric Concepts on Stone Boats in Sangliat Dol Village, Wertamrian District, Tanimbar Islands Regency* that on the upper front of the stone boat there are acute angles, right angles and obtuse angles (Ratuanik & Filindity, 2021).

Based on this background, the purpose of this study is to explore the ethnomathematical aspects related to the types of angles found in the Ampel Religious Area, including those present in its buildings, architecture, ornaments, and other objects. Apart from that, it also helps to add references to mathematics learning, especially more realistic mathematics learning .

METHODS

Type and Design

This research is qualitative in nature and employs an ethnographic approach. Qualitative research is research that is descriptive in nature and tends to use an inductive approach analysis where the research process is emphasized and the use of theoretical foundations is carried out so that the focus of the research is in accordance with the facts in the field. In addition, to provide a general overview of the research background and as material for discussing the research results. While ethnography writes about a community group or writes about the culture of a community group (Rukin, 2021). So research with an ethnographic approach here is to describe, explain, and analyze mathematical elements about the types of angles in the Ampel Religious Area

Data and Data Sources

The research was conducted in the Ampel religious area located on Jl. Ampel Masjid No. 53, Ampel Village, Semampir District, Surabaya City. The research was conducted in August 2024. This research was conducted to explore the Ampel Religious Area with a focus on the Ampel Mosque and surrounding buildings such as gates, ablution places, ornaments (decorations), or objects of cultural value, for example, bedug, and so on. The data taken in this study are 8 examples.

Data collection technique

The data collection techniques used are observation and documentation. Observations made are by coming to the location to obtain complete data. Observations are made with the aim of obtaining information and data about the conditions in this area directly. In conducting observations, researchers use observation sheet instruments to collect data. The contents of the observation sheet include what buildings, ornaments, or relics will be studied in the study. Documentation is carried out by documenting the research results process in the form of photographs of buildings, ornaments, and relics that can be excavated regarding the types of angles in the Ampel religious area. The purpose of this documentation is to gather data and support the research findings.

Data analysis

Data analysis techniques are carried out with three activity flows. Miles and Huberman (Anggito & Setiawan, 2018) said that data analysis consists of 3 activity flows, namely data

reduction, data presentation, and conclusions. The first is the data reduction stage, namely the researcher sorts the data by selecting interesting, important, useful data, and then grouping it into data that is the focus of the research. In this study, the researcher collected a lot of data in the Ampel religious area and then selected which ones were appropriate, useful, and interesting related to the ethnomathematics of types of angles. The second is the data presentation stage. The presentation of research data can be in the form of tables, graphs, pictures, charts, photos, or other forms of data presentation (Ekasari, 2023). The presentation in this study is in the form of pictures (photos) then given an explanation or narrative regarding the types of angles contained in the Ampel Religious Area. Third, the conclusion stage, namely drawing conclusions from the results of the data presentation according to the research objectives. In this study, the conclusions drawn are about the existence or absence and what can be associated with the types of angles. The observation guide is written in the following table:

Table 1. Ampel Religious Area Ethnomathematics Observation Sheet

| No | Name of Building/ Ornament/Heritage Object | Picture | Types of Angles Found |
|----|---|---------|---|
| 1. | Roof of the Mosque | | acute/right angle/obtuse/180°/reflex/360° |
| 2. | Mosque Door | | acute/right angle/obtuse/180°/reflex/360° |
| 3. | Door | | acute/right angle/obtuse/180°/reflex/360° |
| 4. | Inner Roof | | acute/right angle/obtuse/180°/reflex/360° |
| 5. | Wall Decoration | | acute/right angle/obtuse/180°/reflex/360° |
| 6. | Bedug | | acute/right angle/obtuse/180°/reflex/360° |
| 7. | Place of Ablution | | acute/right angle/obtuse/180°/reflex/360° |
| 8. | Gate | | acute/right angle/obtuse/180°/reflex/360° |

RESULTS AND DISCUSSION

The Ampel Religious Area is the area of the Ampel Mosque and its surroundings. The mosque, whose full name is the Ampel Denta Mosque, is located on Jalan Ampel Masjid No. 53, Ampel Village, Semampir District, Surabaya City. This mosque was founded in ±1,420 AD and is the largest Islamic center in Surabaya City. Currently, the Ampel religious area is a tourist potential and is one of the religious tourism destinations in the city of Surabaya. The Ampel Denta Mosque building is included in the Surabaya Cultural Heritage based on the Mayor's Decree dated September 26, 1996 (Wardji, 1996).

The Ampel Denta Mosque is used as a place of worship and preaching. In addition, near this mosque there is also an Arabic language education/teaching institution. The Ampel Mosque building has undergone several renovations/renovations. In the application of traditional Javanese architecture to the roof of the Sunan Ampel Mosque, the use of a canopy roof cannot be separated from the acculturation of Islamic culture in it where the tip of the roof is a symbol of the relationship between humans and God (Satwiko et al., 2023). The tajug roof is symbolic of Javanese architecture. In the Ampel Mosque building, the roof used is a three-tiered tajug roof with the meaning of faith, Islam, and ihsan (Yusuf, 2022). The roof of the Ampel Mosque adapts Majapahit architecture (Santoso et al., 2023). The Ampel Mosque also has a tower as one of its characteristics. The tower of this mosque rises high reaching ± 50

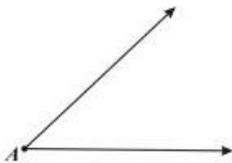
meters. The Ampel Mosque has 48 doors that are maintained in their originality with a height of ± 2 meter (Ramadhani & Kurniawati, 2019).

Around the Ampel Mosque there is a burial complex of Sunan Ampel, Nyai Condrowati (Sunan Ampel's wife), Mbah Sholeh, and so on. Sunan Ampel is a figure who is known by Muslims in Java and is a member of the Wali Songo (Setiawati et al., 2023). Before entering the burial complex, you will pass through buildings such as a gate called Paduraksa. Gapura berasal dari bahasa Sanskerta "go" yang berarti lembu dan "pura" yang berarti depan sehingga dapat diartikan arca lembu yang terdapat pada bangunan keraton atau tempat peribadatan yang terletak di depan bangunan tersebut. Adapula yang ditafsirkan dalam Bahasa Arab Ghafuru yang artinya pengampunan (Stanza, n.d., 2019). This mosque has 5 gates which are often interpreted as the five pillars of Islam. The five gates (Rohhana & Tucunan, 2019) are the paneksen gate (syahadat), madep gate (prayer), ngamal gate (zakat), poso gate (fasting), and munggah gate (hajj). These gates still stand strong today.

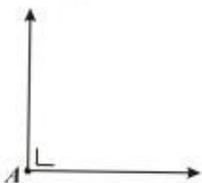
The ornaments on the gate and tomb of Sunan Ampel are almost all taken and processed from traditional Javanese decorative motifs and Majapahit or pre-Islamic styles, namely Surya Majapahit and lunglungan or suluran (Budiono et al., 2021). Ornaments have an aesthetic function to decorate objects or goods so that they make them more beautiful, more valuable, and more meaningful. Ornaments serve both technical construction purposes and symbolic roles. Islamic traditional decorative arts (ornaments) have a non-physical function as a reminder of God, a transfiguration of materials and structures, and a function of beauty (S. A. B. Wahyuni et al., 2024). Around the tomb there is an ablution area for visitors. In addition, near the burial complex there are jars filled with water which can be drunk directly by pilgrims or visitors.

There are 6 types of angles, namely as follows (Makkullau & Vidya, 2024) :

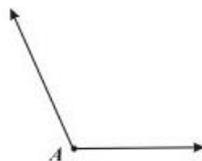
1. Acute angle (between $0^\circ - 90^\circ$)



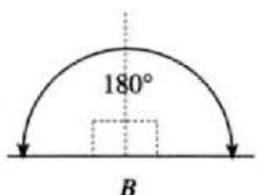
2. Right angle (90°)



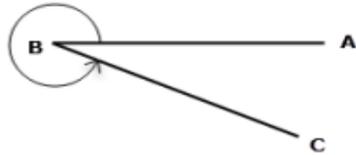
3. Obtuse angle (between $90^\circ - 180^\circ$)



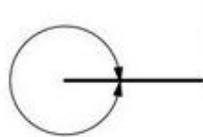
4. Straight angle (180°)



5. Reflex angle (between $180^\circ - 360^\circ$)

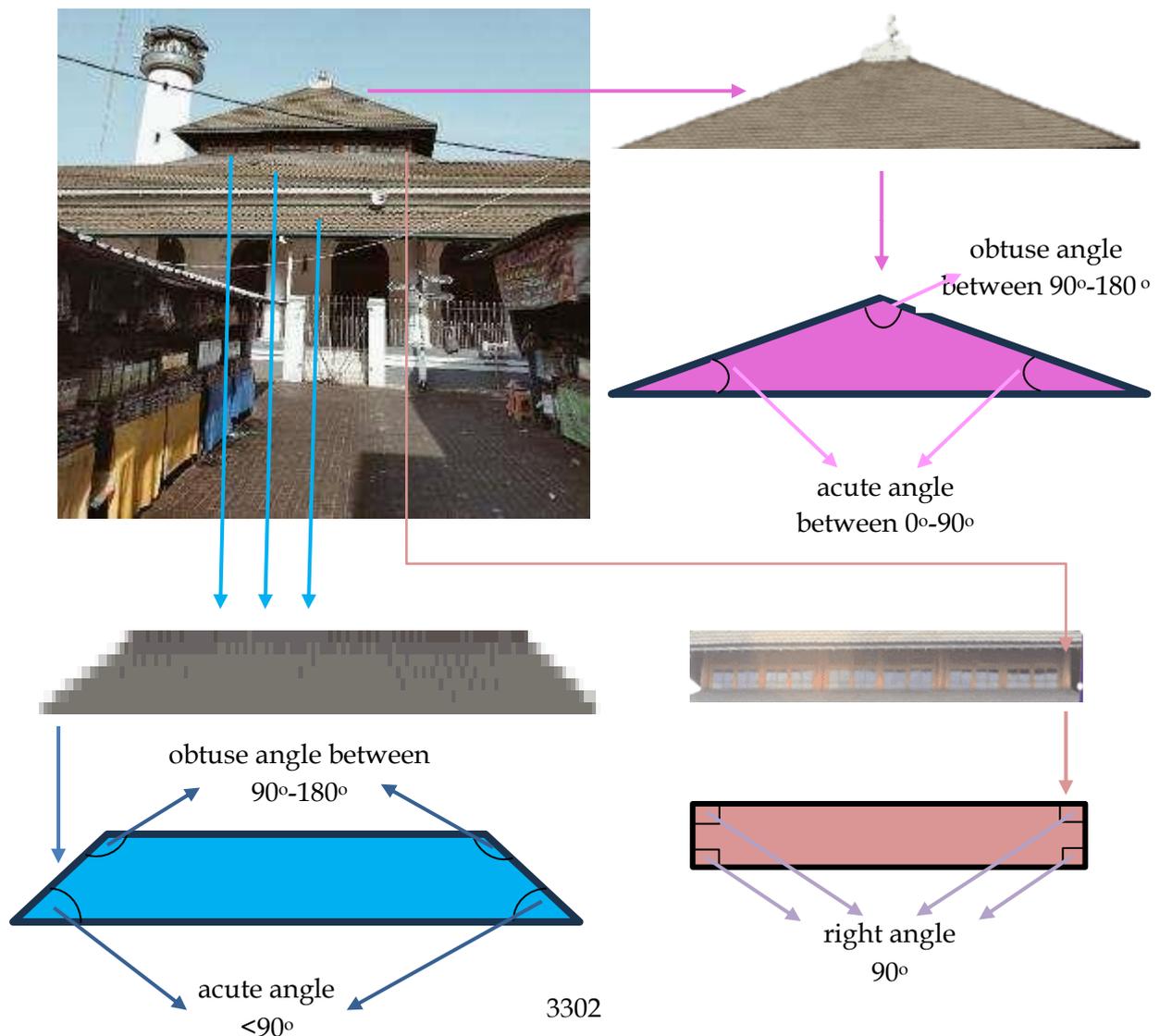


6. One full turn angle (360°)



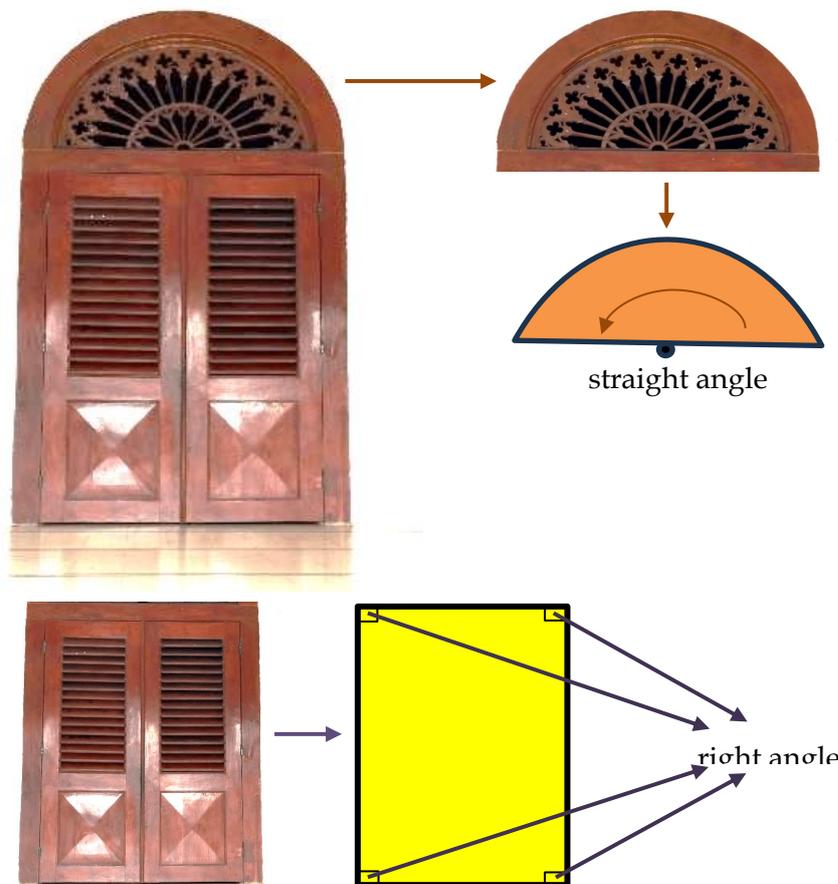
The results of the study obtained showed that ethnomathematics about angles was found in the Ampel Religious Area. The following is the concept of angles in the Ampel Religious Area:

1. Roof of the Mosque



The results of observations of the mosque roof structure show several corner concepts. The topmost roof section, which is triangular on its flat side, has the concept of acute and obtuse angles. The lower roof section, on its flat side, is trapezoidal in shape with acute and obtuse angles. While the roof window has a right angle. Likewise, on the other sides of the roof section, there are acute angles between 0° - 90° , right angles 90° , and obtuse angles between 90° - 180° .

2. Mosque Door



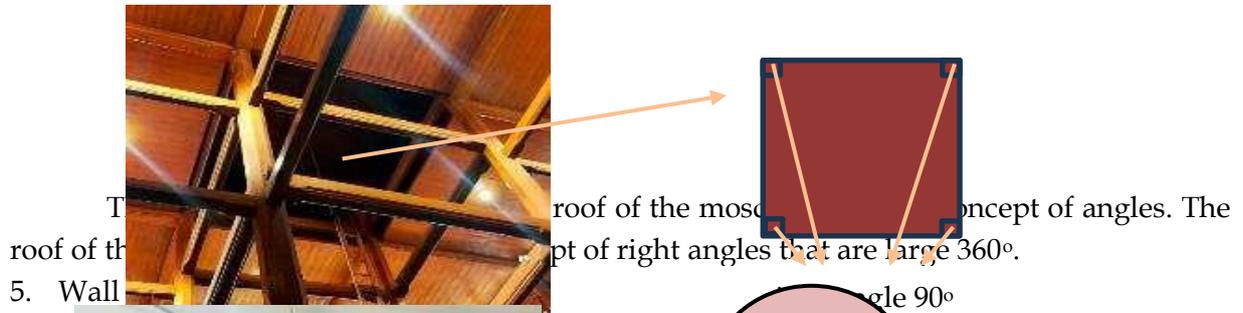
The results of the observation of the mosque door contain several corner concepts. The upper door is in the form of a semicircle, there is a straight corner concept, namely 180° . The lower door is in the form of a rectangle which has a right angle of 90° .

3. Floor

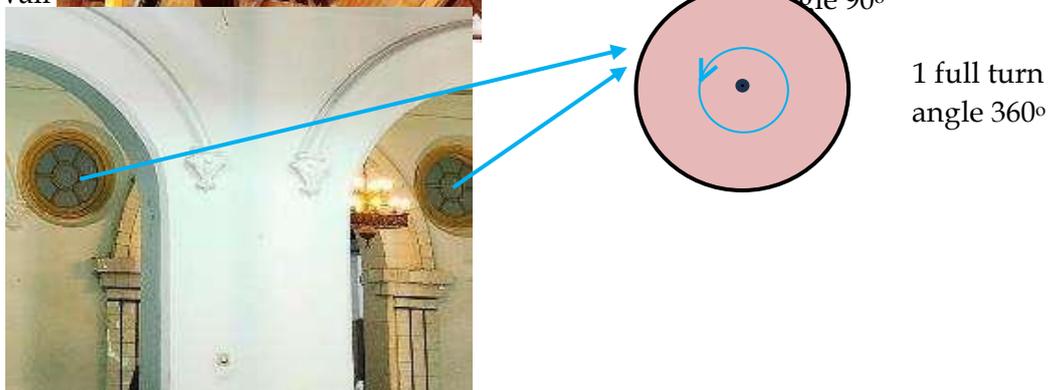


The results of observations on the floor of the mosque show the concept of angles. The square-shaped floor has right-angled corners. The size of each right-angled corner is 90° .

4. Inner Roof

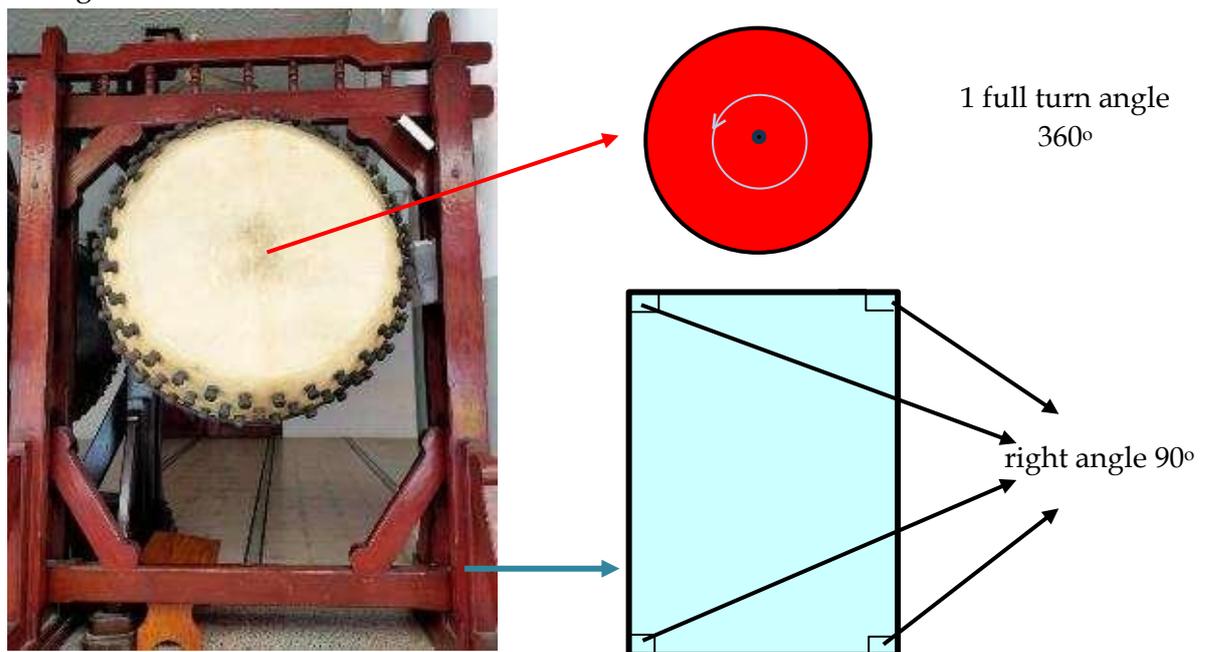


5. Wall

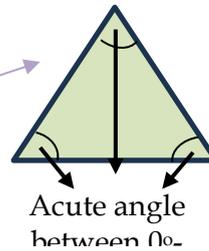


The results of the observation of the mosque wall contain the concept of angles. The decoration on the wall is in the form of a circle. The concept of the angle in this circle is the angle of one full rotation which is large 360° .

6. Bedug

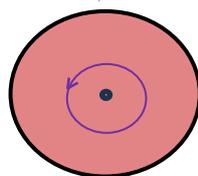
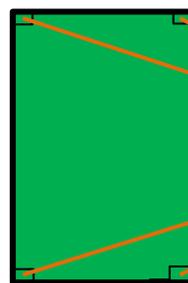
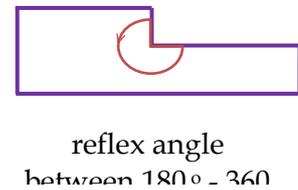


The results of observations of the mosque bedug contain several concepts of angles. The circles on the left and right sides of the bedug are circular. There is a concept of an angle in this circle, namely the angle of one full rotation which is 360° . The frame section where the bedug is hung or its support is rectangular. The four sides of the support frame are each in the form of a right angle with a size 90° .



The results of observations in the place of ablution for men show the concept of angles. This is because the flat side of the roof is in the form of an isosceles triangle. Each of these angles is included in the acute angle with the size of each angle between 0° - 90° .

8. Gate



The results of the observation of the mosque gate contain several corner concepts. The upper right and left gates contain a reflex angle concept between 180° - 360° . In addition, on

the side of the gate that stands there is a right angle concept of 90° . While on the gate ornament there is a circle that can be explored the concept of a full rotation angle 360° .

Based on the results of exploration in the Ampel Religious Area, namely in the Ampel Mosque and its surroundings, there are buildings (architecture), ornaments, and historical objects that can be excavated ethnomathematically. This exploration found the concept of types of angles, namely acute angles (between 0° - 90°), right angles (90°), obtuse angles (between 90° - 180°), straight angles (180°), reflex angles (between 180° - 360°), and angles of one full turn (360°). This indicates that the concept of angles can be associated with culture. Types of angles are taught in elementary school mathematics learning. Students must understand the concept of angles so that they can be associated with their daily lives.

According to Ausubel, there are four types of learning, namely learning by receiving, learning by discovering, learning by memorizing, and meaningful learning (Darmayanti et al., 2023). Teachers also have an important role in creating meaningful learning.

Meaningful learning can be done with realistic things. According to Treffers, contextual problems in realistic learning that exist around students function to help students find a concept, form basic mathematical Kurino, A. (2022). *Ethnomathematical Exploration At Home Panjalin custom in Majalengka. CEE-4 "The Direction of Elementary Education in the Future Challenge*, 931.

Kurino, Y. D., Herman, T., & Turmudi, T. (2023). Exploring elementary science teaching and learning in Canada. *Education 3-13*, 1-2. <https://doi.org/10.1080/03004279.2023.2245407> can make learning meaningful.

Based on the results of ethnomathematics exploration, learning tools such as teaching materials, learning media, and so on can be developed. Several previous studies have discussed the effectiveness of ethnomathematics in learning. The SLR study entitled *The Effectiveness of Using Ethnomathematics to Improve Elementary School Students' Mathematical Understanding* concluded that the use of ethnomathematics has a positive impact on improving students' mathematical understanding and recommends the use of ethnomathematics as an element of integrated learning. In addition, ethnomathematics-based learning can also foster students' interest in mathematics subjects (Wildan et al., 2024).

Exploration of the types of angles in the Ampel religious area will be useful if teachers are able to make it a source of innovation in learning. Students are also expected to be able to master the concept of angles from the culture around them. That is expected to improve numeration and students' interest in mathematics and their culture. The concept of angles can be applied to other cultural heritages, including religious buildings, batik, dance, and so on. This can increase broad cultural insight for students and teachers alike. Apart from that, ethnomathematics can also be used as a positive contribution in the field of mathematics in particular and in the world of education.

CONCLUSION

Based on the results of the study of mathematical concepts, it can be concluded that ethnomathematics can be explored in the Ampel Religious Area. Through ethnomathematics exploration of the area, mathematical concepts for learning in elementary schools were found, namely about the types of angles. Ethnomathematics can be seen in objects in the Ampel religious area, namely the Ampel Mosque and its surroundings, such as in buildings

(architecture), ornaments, and relics. The concept of angles that can be explored for learning in elementary schools include acute angles, right angles, obtuse angles, straight angles, reflex angles, and one full rotation or 360° . Mathematics learning based on ethnomathematics is expected to help students find mathematical concepts about angles. In addition, it is expected to make it easier for teachers to instill mathematical concepts. Teachers are also expected to be able to use this as inspiration in developing school curricula based on ethnomathematics. For further researchers, it is hoped that they can explore the ethnomathematics of the Ampel Religious area in discussing different learning materials. Further researchers can also develop learning media, learning tools, and so on related to ethnomathematics in the Ampel Religious area.

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