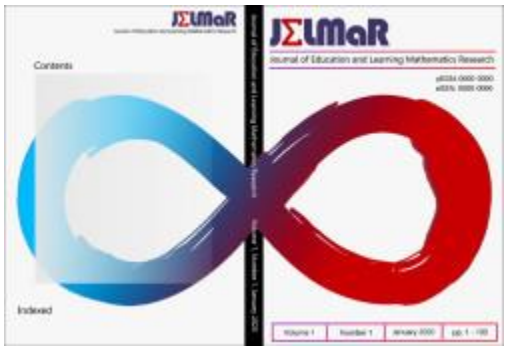

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# Exploring Ethnomathematics to Gayasan Tobacco Warehouse at Jember, East Java, Indonesia

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***Abstract**: Ethnomathematics which link culture with community activities, certainly has characteristics that support each other with mathematical concepts. Ethnomathematics is mathematics practiced by specific cultural groups in society. This study examines the mathematical concepts in the Gayasan tobacco warehouse building in Jenggawah District, Jember Regency. In the study, researchers used qualitative descriptive research with an ethnographic approach. Data collection techniques are observation, interviews, and documentation. Data analysis techniques are done through data reduction, presentation, analysis, and exposure. The results showed that in the Gayasan tobacco warehouse, Jenggawah District, Jember Regency, there are mathematical concepts that will be studied further in the future. The author focuses on applying geometric concepts such as building flat, building space, lines, angles, number patterns, congruence, and awakening in research. Each longkang is bordered with bamboos that function as poles, also known as "longkang sides," which have different distances and are arranged into a pattern of numbers. The conclusion is that the structure of tobacco warehouses contains mathematical concepts such as number patterns, angles, flat builds, space builds, lines, congruents, and awakening*
***Keyword**: ethnomathematics, tobacco warehouse, geometric concepts*

## INTRODUCTION

Mathematics is a universal science that is able to develop human thinking and functions as a symbolic language that allows careful and precise communication. In addition, information and communication technology development and modern culture are based on mathematical progress (Nurhasanah & Luritawaty, 2021). Mathematics is one of the fields of science that has an essential role in the development of science and technology, both as a tool for the application of other fields of science and for the development of mathematics itself (Rahmi & Basuki, 2021). The challenges faced by people from various cultural backgrounds in various places result in the progress and growth of mathematics (Ismayanti & Sofyan, 2021). Susanti et al. (2020) stated that mathematics is related to life because there are social and cultural interactions to create good mathematics learning in learning. The application of mathematics learning should be in line with everyday life. Solving everyday problems related to mathematics needs to be more focused. Also, related to geometry, spatial and flat shapes are very close to human life.

Learning whose orientation is related to mathematics and culture is referred to as ethnomathematics. According to Lusiana et al. (2019), the study of mathematics (mathematical ideas) about culture and social life is known as ethnomathematics. Ethnomathematics is a field that investigates how mathematical concepts or practices are used in various cultural activities that show the relationship between mathematics and culture. Because math exists in the culture, this is following the statement of Wardah, N.R.P, et al. (2023) that ethnomathematics is a branch of science that studies the relationship between mathematics and culture. In ethnomathematics, mathematics is considered part of human culture and is applied to various aspects of life, including art, music, architecture, knowledge systems, and daily life practices. As an

emerging science, ethnomathematics continues to attract the interest of researchers and practitioners from various disciplines.

Ethnomathematics connects culture and community activities with mathematical concepts, which certainly have characteristics that support each other (Wahyudi, 2022). By using ethnomathematics in learning mathematics, it is hoped that students will feel comfortable while learning because this lesson discusses numerical calculations and studies related to cultural aspects. It is confirmed by the statement of Balila et al. (2023) that ethnomathematics is a field that studies, understands, and verbalizes the concept of mathematics. Ethnomathematics learning is a practical approach that connects mathematical concepts with cultures that exist in people's daily lives and improves the ability to understand mathematical concepts. Ethnomathematics learning is a practical approach that connects mathematical concepts with the culture that exists in people's daily lives and improves the ability to understand mathematical concepts.

Several studies link culture and mathematics learning concepts (Laukum et al., 2024). Mathematics is learned and applied by specific communities, such as urban and rural communities, children of specific age groups, labor groups, indigenous peoples, etc. Rosita et al. (2020) said that in contextualized mathematics learning, ethnomathematics could be used by teachers to encourage students to be actively involved in exploring sources relevant to the topic or problem being studied; this allows students to connect their experiences in their environment with their knowledge structure.

Ethnomathematics has the advantage that it can help students develop social, emotional, and intellectual political learning by using the cultural guidelines of the students. The disadvantages of ethnomathematics applied to students are: (1) lack of culturally based mathematics subject matter; (2) lack of appropriate assessment tools; and (3). Multicultural learning is different from culture-based learning. According to Andriono (2021), ethnomathematics can improve student learning outcomes, improve students' mathematical abilities, and foster their curiosity about their own culture. In line with Wulandari et al. (2024), who revealed that the ethnomathematics approach effectively improve student's mathematical understanding.

A tobacco warehouse is a building used to store the harvested tobacco leaves. Tobacco is one of God's gifts given to the Land of Java, especially Jember City. Since the Portuguese arrived in the archipelago hundreds of years ago, they have recognized Java as a tobacco producer. Jember is one of the areas in East Java that has been the site of tobacco plantations since colonial times. Dutch entrepreneurs competed to establish tobacco companies in several cities; Landbouw Maatschappij Oud Djember (LMOD)was one of them. Tobacco must be placed in a particular place during the drying process. A tobacco warehouse is a building specifically designed to store freshly harvested tobacco, which is then stacked (arranged for easy storage in the warehouse) and opened (dried) by fumigation to maximize the drying process. In the early stages of tobacco leaf processing, activities. Drying is very important to ensure good-quality tobacco leaves (Nuraini, 2023).

The tobacco warehouse building is used as an object of research because it has its uniqueness when viewed in terms of the shape of the building. Each element of the tobacco warehouse building has a shape related to mathematical concepts, such as the concept of geometry of space, flat buildings, lines, number patterns, angles, and so on. The purpose of the Gayasantobacco warehouse research is to identify various types of geometry concepts that exist in the Gayasan Jember tobacco warehouse, identify the ethnomathematics of the tobacco warehouse from the perspective of mathematical literacy of geometry concepts, and describe the results of ethnomathematics exploration related to mathematical geometry concepts in the Gayasan tobacco warehouse. The perspective of mathematical literacy in the context of geometry concepts refers to the understanding, selection, and use of geometry concepts in everyday life and in problem-solving (Malasari et al., 2017).

Meanwhile, according to Kolar & Hodnik (2021), geometry concepts represent several aspects of mathematical literacy as follows: (1) Understanding Geometry Concepts: Mathematical literacy means understanding geometry concepts such as points, lines, planes, angles, shapes, and geometry transformations. Those proficient in math can explain the meaning and characteristics of these geometry elements. (2) Application in Real Concepts: One should be able to use geometry concepts in everyday life. Some examples are calculating land area, creating building designs, or planning room layouts. Those proficient in math can find and solve geometry problems in the real world. (3) Geometric Thinking Ability: The ability to visualize and manipulate geometric objects in the mind is based on mathematical literacy. This ability helps solve problems involving geometry concepts without drawing or calculating them. (4) Tool Use: Mathematical literacy involves properly using tools such as computers, software, or traditional geometry tools. People proficient in mathematics can use technology to measure, model, or calculate more efficiently. (5) Language of Mathematics: Mastery of the language of mathematics, including terms and symbols used in geometry, is necessary for mathematical literacy. The ability to write, read, and communicate using the language of mathematics.

In the study of ethnomathematics, there are many studies on mathematical geometry in Indonesian culture (Uula et al., 2024). Geometry allows students to learn and explore objects around them, such as balls, walls, and clocks (Listiani, 2020). Visualizing the geometric shapes that objects have requires the concept of geometry. (Amaliyah et al., 2022). Wahyuni et al. (2022) said that geometry is a field of mathematics where the relationship between points, lines, and angles is studied. Geometry is also a field of spatial representation in the brain that is not scientifically known and is interesting to study (Zhang et al., 2023). Based on the relationship between mathematics and cultural potential in mathematics learning, the research aims to identify ethnomathematics on geometry concepts in the Gayasan Jember tobacco warehouse building.

Based on the explanation above, the researcher wants to show how the results of the ethnomathematics exploration of the Gayasan tobacco warehouse in Jenggawah District, Jember Regency, especially about the ideas contained therein. In the ethnomathematics of tobacco warehouses, test packs can be presented to help students learn geometry materials such as flat shapes, space shapes, calculating angles, and other geometry concepts. Based on the explanation above, the author wants to conduct research with the title "Exploring ethnomathematics to Gayasan tobacco warehouse at Jember, East Java, Indonesia."

## METHOD

Researchers use qualitative descriptive research methods with an *ethnographic* approach. Qualitative descriptive research explains and analyzes events at a specific time (Zainuddin et al., 2021). With the qualitative description research method, researchers will describe the exploration results obtained regarding ethnomathematics in tobacco warehouses. The aim is that with this method, researchers can describe every part of the tobacco warehouse related to mathematical concepts.

The research uses an *ethnography* approach, which in language ethnography means writing or writing notes about individuals or groups of individuals to describe their socio-cultural activities and patterns. Ethnographic research is an attempt to simultaneously describe and analyze the culture of a group, society, or ethnic group. The process of research and understanding is based on methodologies that investigate social phenomena and human problems. Using an ethnographic approach, we study the life and culture of a community or ethnic group, such as customs, laws, art, religion, and language (Andarini et al., 2019). The purpose of using an *ethnography* approach is to obtain comprehensive data based on intensive field research.

The tobacco warehouse that was the subject of the research was located in Jenggawah Subdistrict, Jember Regency. The researcher collected data using observation, interview, and documentation techniques. Researchers conducted a data reduction and selection process to obtain data relevant to the research objectives. Researchers used data selection based on the data they obtained from observation, documentation, and interviews. Researchers found different structures of tobacco warehouses. After determining the necessary data, proceed to the data presentation stage. Descriptive data presentation is the result of data reduction used in research. Furthermore, it is analyzed using related mathematical concepts, such as geometry used to build tobacco warehouses. Concluding is the final step of the analysis process. Researchers conclude the presentation of data following the formulation of research problems.

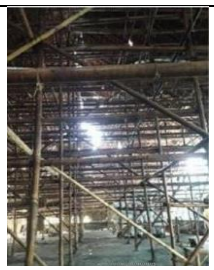
## RESULT AND DISCUSSION

The tobacco warehouse is a traditional building of the Jember Regency community that functions as a place to store and process tobacco crops. It is estimated that the Gayasan Jember tobacco warehouse has existed since the Dutch era. When was the first tobacco warehouse built in Jember? The Jember tobacco warehouse began with the term "tobacco under the shade," which is considered to maintain the quality of the tobacco made. Gayasan Jember tobacco sheds are large, elongated traditional buildings that store and dry tobacco leaves. The shapes of each part of the tobacco shed have mathematical concepts that can be studied in research.

Research activities on the tobacco warehouse in Gayasan Village, Jenggawah Subdistrict, Jember Regency produced data related to the parts of the tobacco warehouse and the geometry concept implied in the tobacco warehouse building. Almost all geometry concepts are contained in the building, such as flat shapes, reflections of flat shapes, spaces, lines, angles, and number patterns. The first discussion concerns the parts of the tobacco warehouse in the Jember Regency. The identification of the parts of the tobacco warehouse will be presented in Table 1 below.

**Table 1. Identification of Parts of Gayasan Jember Tobacco Warehouse**

| No. | Part Name | Documentation | Description |
|---|---|---|---|
| 1. | Joglo/hat Tobacco warehouse |  | The tobacco warehouse *joglo* is the part of the warehouse located at the front. J*oglo* usually serves as a place for guards or workers to rest. Local people call it a hat because of its conical roof shape, like a farmer's hat. |
| 2. | Longkang |  | Each room in the tobacco warehouse is called a "longkang" and consists of rooms of the same size. Each longkang is bordered by bamboo poles, known as "longkang sides." |

| No. | Part Name | Documentation | Description |
|---|---|---|---|
| 3. | Wuwung |  | Wuwung is the part that covers the central roof by utilizing black plasticor cloth. |
| 4. | Roof |  | The roof of the tobacco shed is made from dried alang-alang leaves. The dried alang-alang leaves are arranged and clipped using bamboo. The alang-alang leaves, which measure 1.25 meters, are arranged to cover the entire roof of the warehouse. |
| 5. | Mast |  | The pole supports the tobacco warehouse building frame. The poles are made from quality bamboo and are more extensive. The base of the pole uses cast stone made of cement. |
| 6. | Ventilation |  | Ventilation is a channel for airflow. The vents in the tobacco warehouse building are rectangular and can be opened and closed. |
| 7. | Tralis |  | The trellis is a wall made of bamboo slats at the bottom of the tobacco warehouse. |
| 8. | Tabing Pilar |  | A *pillar cliff* is a fabric clipped with bamboo strips and positioned on the side of a vent. Pillar cliffs are also used as warehouse walls. |

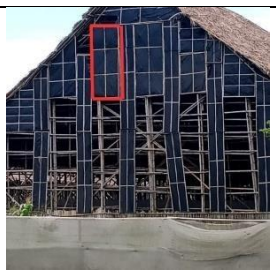
In Table 1, we obtained the results of the core parts of the tobacco warehouse in Gayasan Village, Jenggawah District, Jember Regency. These parts are joglo, longkang, wuwung, roof, pole, ventilation, trails, and pillar tabing. These parts are united into a tobacco warehouse building as a storage place for tobacco harvests, which will later be traded or processed. Researchers can find mathematical concepts like flat shapes, spaces,

lines, angles, and number patterns from these parts. The analysis of geometry concepts in the tobacco warehouse building will be explained in detail below.

**Table 2. Identification of Geometry Concepts**

| No. | Part Name | Documentation | Geometry Concepts |
|---|---|---|---|
| 1. | Joglo/tobac coshed hat |  | Joglo roof:<br>Flat Buildings: Isosceles TriangleAngle: 180° with equal angle magnitude at both base angles. |
| 2. | Wuwung |  | Wuwung<br>Flat Buildings: Rectangle<br>Angles:<br>90° (Right angle at all four corners) |
| 3. | Longkang |  | Longkang room<br>Flat Buildings: Rectangle<br>SpatialBuildings: Blocks<br>Angle: 90° |
| | |  | Longkang side<br>Angle: 90° (Right Angle) |
| | |  | Longkang side<br>Angle: >90° (obtuse angle) |

| No. | Part Name | Documentation | Geometry Concepts |
|---|---|---|---|
| | |  | Longkang side<br>Angle: <90° (acute angle) |
| | |  | Long side<br>of theline:<br>Perpendicu<br>lar<br>Angle: 90° (Right angle) |
| | |  | Reflection of a triangle.<br>The process of mirroring each point of a geometric object (triangular flat building) to a certain line, which is on the x = 0 axis. |
| | |  | Longkang<br>The odd number referred to in the Jember tobacco house is the size of the room or longkang, which is 1m per room. The number pattern formed is 1,3,5,7,. etc. |
| 4. | Roof |  | Roof of tobacco<br>warehouse Build Space:<br>Triangular Prism |
| | |  | Roof of tobacco warehouse<br>Flat Buildings: Isosceles<br>TriangleAngle: 180° with<br>equal angle magnitude at<br>both base angles. |

| No. | Part Name | Documentation | Geometry Concepts |
|---|---|---|---|
| 5. | Mast |  | Pole warehouse tobacco inside. Lines: Vertical line |
| | |  | Outer tobacco shed pole Line:Parallel lines |
| 6. | Ventilation |  | Ventilation Flat Buildings: Rectangle Angle: 90° (Right angle) |
| | |  | Congruence and Equivalence of Shapes and size have similarities with each other. Same angle magnitude of $90^{o}$ (right angle) |
| 7. | Tralis |  | Tralis Flat Buildings: Rectangle Angle: 90° (Right angle) |
| 8. | Tabing Pilar |  | Pillar cliff Flat Buildings: Rectangle Angle: 90° (Right angle) |

The geometry concept of the Gayasan tobacco warehouse in Jember Regency is shown in Table 2. The structure includes Joglo, roof, longkang, wuwung, pillars, vents, trellis, and pillar cliffs. Geometry concepts such as flat shapes, space, lines, and angles are included in the nine existing parts of the tobacco warehouse. According to a previous study by Kholisa (2021), the Joglo Pati House has geometry concepts such as congruence, space (blocks), Pythagoras theorem, flat shapes (triangles, rectangles, trapezoids, and

triangles), and lines and angles. Mar's study (2021) found that elements of uim re'u Manunis Ka'umnais, such as poles, walls, and roofs, contain mathematical concepts such as point, line, flat, space, congruence, and geometric transformation (reflection).

The discussion of all data that has been obtained related to the perspective aspects of mathematical literacy in geometry concepts is as follows:

1. Understanding the concept of geometry, there are geometry concepts, including flat shapes, spatial shapes, and angles, in the tobacco warehouse. These results align with the Probolinggo Museum's research, which shows that there are mathematical elements of flat and spatial geometry. (Wahyuni, 2022).
2. Application in actual concepts, in the illustration of images by creating auxiliary lines to bring up the geometry of flat buildings, space buildings, and angles in each part of the Yayasan tobacco warehouse. The results of Faozan and Kusno's research (2024) show that existing cultures in Indonesia can be utilized as mathematics learning materials. This also aligns with Siregar et al. (2024) ethnomathematics in Indonesia. Angkola Batak culture can be used in mathematics learning, and it seeks to know which cultural artifacts or ethnomathematics philosophy are more widely used in learning.
3. Geometric thinking skills, implementation in learning that is expected to be able to think geometrically, critically, and analytically through objects in all parts of the Gayasan tobacco warehouse.
4. Tools and aspects of the tobacco warehouse in the form of roofs, pillars, wuwung, longkang, longkang sides, and joglo represent flat shapes, spaces, and angles in the concept of geometry in ethnomathematics exploration. In temple buildings, we can find mathematical concepts, including the application of geometry to each structure, alignment, equations, lines, angles, and calculations (Nisa & Hidayati, 2024).
5. Mathematical literature involving mastery of mathematical concepts in Geometry learning is presented with illustrations along with images displayed and can be used as a reference for the learning process, especially as a test package for the geometry of flat shapes, space shapes, and angle material. This is because mathematical literacy is one of the most critical abilities for advancing mathematics education today (Runtu et al., 2023).

The ethnomathematical concept of triangular flat shapes in the tobacco warehouse building is found in the shape of the warehouse's roof and the front joglo, as well as the ornamentation on the top of the entrance joglo. The concept of rectangular geometry is found in the joglo top ornament, ventilation, trellis, and pillar tabbing. The beam space's geometric concept in the Jember tobacco warehouse is found in the room or longkang. The build tube space is found in each pole of bamboo pliers. Because bamboo is basically shaped like a tube. A triangular prism is a space with a base and lid in the form of a triangle with rectangular upright sides, and it is in harmony with the shape of the roof of the tobacco warehouse. The concept of existing lines is very diverse in shape, such as horizontal, vertical, perpendicular, intersecting, and parallel lines. The line element is found on the pole of the warehouse building and on the side of the longkang. The concept of angle is also seen in the building; Gayasan Jember tobacco warehouse has an acute angle, right angle, and obtuse angle on each bamboo pole in the tobacco warehouse room. Congruence and congruence are also found in the ventilation arrangement of the tobacco warehouse. The number pattern arranged for the size of the lokangis is 1,3,5,7, etc.

## CONCLUSION

Ethnomathematics in the Gayasan Jember tobacco warehouse were studied using the concept of geometry, which produces harmony between mathematical elements and a building. The concepts of geometry found in the tobacco warehouse are flat shapes, spaces, angles, lines, number patterns, and congruence. The Jember tobacco warehouse has triangular, rectangular, and square flat shapes. The ethnomathematical concept of triangular flat shapes in the tobacco warehouse building is found in the shape of the roof of the warehouse, the joglo at the front, and the ornament at the top of the entrance jog. Cubes, beams, tubes, and triangular prisms are spatial geometry concepts already existing in the Jember tobacco warehouse. A triangular prism is a space with a triangular base and lid with rectangular upright sides, and it is in line with the shape of the roof of the tobacco warehouse. In the Gayasan tobacco warehouse in Jember Regency, the geometry of lines and angles is also found in each combination of bamboo. The existing lines are very diverse in shape, such as horizontal, vertical, perpendicular, intersecting, and parallel lines. At the same time, angles are in the form of acute angles, right angles, and obtuse angles. The concepts of congruence and congruence are found in the arrangement of vents, and the concept of odd number patterns is found in the size of the longkang.

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