

## Ethnomathematics Exploration at the *Grebeg Tape Tawaran* Festival and Its Implementation in Elementary Mathematics Learning

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**Abstract.** This research aims to explore the concept of ethnomathematics in the *Grebeg Tape Tawaran* festival in the Kenduruan District, Tuban Regency, and its application in mathematics learning in elementary schools. Ethnomathematics is a learning approach used to help students integrate culture with mathematics learning. This research includes qualitative research with a type of field research. Data was collected through observation, interviews, and documentation. The research subjects were residents of Tawaran Village. Data collection techniques include direct observation and interviews. The results of the research show that the *Grebeg Tape Tawaran* festival contains many mathematical concepts that are relevant for elementary school learning. The shape of a mountain of tape resembling a cone can be used to teach the concept of spatial shapes and measurements. In addition, the tape creation process includes the concepts of comparison, arithmetic, and time measurement. Implementing the results of ethnomathematics exploration can enrich mathematics learning resources in elementary schools by integrating local culture so that learning becomes more meaningful and interesting for students.

**Keywords:** Ethnomathematics, *Grebeg Tape Tawaran*, Mathematics Learning.

### Introduction

Mathematics is one of the branches of science that students must master. Everyone needs mathematics in daily activities to develop logical, systematic, and critical thinking skills and to support their future learning success. (Fadiana et al., 2021). Apart from being related to daily activities, mathematics also has a relationship with culture and can be learned in a fun way. (Winahyu et al., 2020). In learning mathematics, students still have difficulty understanding abstract concepts, so they need an approach that directs the concept to something more concrete. (Fadiana et al., 2022; Widiyanti et al., 2023). By understanding mathematical concepts, it is expected that they can be applied in daily life. In line with this, mathematical concepts should be related to problems in daily life. (Prahmana, Zulkardi, & Hartono, 2012). Teachers do not just transfer mathematical concepts to students; students are also actively involved in rediscovering mathematical concepts according to their own way and learning environment. (Aikpitanyi & Eraikhuemen, 2017).

Ethnomathematics is conceptually designed as mathematics that can be practiced, used, or integrated into societal cultural practices. (Wiryanto, Primaniarta, & de Mattos, 2022; Yudianto et al., 2020). Furthermore, Ethnomathematics emerges as a broader view of the relationship between mathematics and the real world. Ethnomathematics concerns mathematical concepts that can be integrated into mathematics teaching and learning activities at both primary and secondary levels. (Nurhalisa et al., 2022; Resfaty et al., 2019). It can be defined that ethnomathematics is the integration of culture in mathematics learning, or, in other words, mathematics that is extracted from cultural elements. The culture to be explored depends on where and to whom mathematics is taught. (Prahmana et al., 2012; Sroyer, Naingolan, & Hutabarat, 2018). Assuming that ethnomathematics can increase student engagement and interest in learning mathematics.

Mathematics learning is only sometimes taught in the classroom (Fadiana, 2023). However, mathematics learning can be carried out outside the classroom so that students can

Article info:

<https://doi.org/10.52760/ijerd.v5i1.85>

Received 21 December 2024; Received in revised form 10 February 2025; Accepted 24 March 2025

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introduce and connect mathematics with local wisdom, make mathematics learning fun and meaningful, and better understand mathematical concepts contextually (Zulaekhoh & Hakim, 2021). Cultural aspects are essential in introducing mathematics as part of everyday life, developing connection skills, and deepening mathematical understanding (Setiawan, 2018). According to Musanna (2012), culture can be understood as a pattern of meaning, historically constructed and socially transmitted, embodied in symbols and language, where humans communicate, perpetuate, and develop their knowledge and understanding of life. Therefore, introducing and cultivating culture to students is essential from an early age. On the other hand, cultural values are cultivated to support national character development (Yahya, 2019). With the understanding and application of cultural values, one can filter the influence of globalization, which now has a clear negative impact (Zulaekhoh & Hakim, 2021).

Tuban Regency is one of the regencies in East Java Province. Tuban is known as Bumi Wali because it was once the center of the spread of Islam. Due to its strategic location, Tuban was also an essential part of Majapahit's territory and became one of the kingdom's main ports and trading ports. Tuban has cultures, tourist attractions, and crafts that can be learning resources. One of the cultures in Tuban is the *Grebeg tape* festival offered in the Kenduruan sub-district.

Tape is a processed food made from glutinous rice that is closely related to the lives of local villagers. *Tawaran tape* is a typical tape from Tawaran village. *Tawaran tape* has become the icon and identity of the village in the Kenduruan sub-district. This is because the tape offered has a variety of uniqueness, from the manufacturing process to the local beliefs thick with myths. To maintain the existence of the *Tawaran tape*, a *Grebeg Tape Tawaran* festival is held every year.

The culture of the *Grebeg Tape Tawaran* festival can be utilized as a mathematics learning resource for students, especially for elementary school students. Teachers must still utilize the *Grebeg Tape Tawaran* Festival as a mathematics learning resource. This research will explore the mathematical concepts in the *Grebeg Tape Tawaran* festival. By exploring the mathematical concepts in the *Grebeg Tape Tawaran* festival, students will more easily understand the connection between mathematical concepts and daily life and increase their motivation. In addition, students will recognize local wisdom or culture in their area.

## Materials and Methods

This research uses descriptive qualitative research with field research or the natural environment as a direct data source. Field research reveals the social and cultural life of the community in the field. (Pinnock, 2020). The qualitative approach is a research procedure that produces descriptive data, speech, or writing, and observable behavior of the people (subjects) themselves. The research aims to explore information about the forms of ethnomathematics at the *Grebeg Tape Festival* offered in the Kenduruan sub-district, Tuban district, East Java province. The forms of ethnomathematics include the identification of geometry concepts and number concepts. The research subjects were residents of Tawaran village, Kenduruan sub-district, Tuban Regency. Data sources are verbal from interviews or written through document analysis or survey responses. The data collection instrument is the researcher himself. The data collection techniques used were observation, interviews, documentation, and field notes to obtain ethnographic descriptions. (Habibi & Prahmana, 2022). Researchers use data triangulation, combining observation, interview, and documentation techniques. Qualitative data analysis techniques in this study refer to Miles and Huberman. (Miles, Huberman, & Saldana, 2014), namely analyzing observation and interview data through data collection activities, data reduction, data presentation, and verification with triangulation to test the validity and credibility of the data.

## Results and Discussion

### Results

#### *Grebeg Tape Tawaran* Festival

The *Grebeg Tape Tawaran* festival begins with parading the gunungan tape from the border monument of Blora and Tuban regencies to the field of Tawaran village. The procession

was accompanied by a parade performance from the residents, a lion dance, and a TaSoWan dance performance (Ploso Tawaran Dance). After the procession and cultural rituals are completed, the gunungan tape is distributed to the people present with the aim that the community members get the blessing of a sweet life, like the sweetness of the Tawaran tape.

### **The Process of Making Tawaran Tape**

Tawaran Tape is a tape made from glutinous rice that is packaged in a unique way using palasa leaves or plosio leaves. There is a myth about the process of making tawaran tape, which has a distinctive sweet taste and is undoubtedly better than tape made in other regions. Residents believe that to make delicious tape, they must use water from one of the seven springs in Tawaran Village, namely Sendang Unggul, Sendang Duren, Sendang Nggolo, Sendang Jati Gede, Sendang Gonto, Sendang Sabruk, and Sendang Tawaran. In addition, there is also a myth that develops in the community that women who are menstruating should not make tape because it can cause the tape produced to be red. The expertise of the people of Tawaran Village in making sweet tape has been passed down from generation to generation as an ancestral heritage.

The main ingredient in making Tawaran tape is glutinous rice, plus other ingredients such as yeast and katuk leaves, which are used as natural coloring for the tape. At the same time, the wrapper of the tape is plosio leaf. Making tape begins with washing glutinous rice until it is clean. Glutinous rice is then steamed until half-cooked. The next step is to water the glutinous rice with water from the katuk leaves so that it is green. After being colored, the glutinous rice is steamed again until cooked. After cooling, the tape dough is sprinkled with yeast and wrapped using plosos leaves.

The tape, ready for consumption, was stored for two nights. Ahead of the Grebeg Tape Festival, Tawaran villagers work together to make as many as 10,000 tapes, which are then collected at the Village Hall to be arranged in the form of a cone shape (gunungan). All residents voluntarily contribute labor and costs to the success of the festival because tape is an icon, identity, and pride for Tawaran villagers.

### **Ethnomathematics at the Grebeg Tape Tawaran Festival**

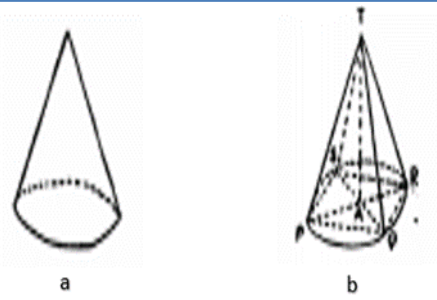
Gunungan is a term for crops arranged to resemble a mountain. Since Gunungan is a symbol of prosperity, its contents are usually crops or other typical snacks.



**Figure 1.**

Gunungan at the *Grebeg Tape Tawaran* Festival

Structurally, the shape of the gunungan tape resembles a cone. If abstracted, the shape of the gunungan will look like Figure 2



**Figure 2.**  
Structural Model of Gunungan Tape Tawaran

- a. Gunungan with a simple structure
- b. Gunungan with a complete structure

The shape of Gunungan b, when analyzed in depth, has the following meaning:

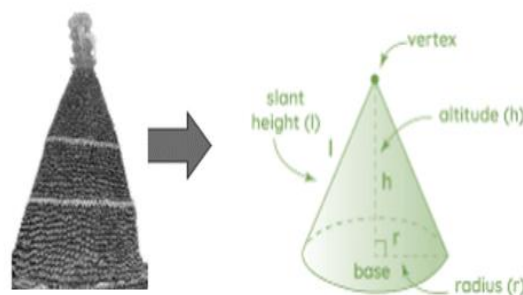
- Point T, at the top of the Gunungan, is a symbol of the existence of God.
- The circular base is a symbol of the world where humans live
- Point P, Point Q, Point R, and Point S are symbols of humans in the world
- Point A is a symbol of religion passed down by God to humans
- The TA line is a symbol of the relationship between humans and God.
- Line PQ, Line QR, Line RS, and Line SP a horizontal line that describes the relationship between humans and fellow humans
- The T.P., T.Q., T.R., and T.S. lines are human steps guided by God.

### Discussion

With the exploration of ethnomathematics at the Grebeg tape festival, it is hoped that it can help students explore the concept of learning mathematics. From the gunungan, many mathematical concepts are found in building materials, geometry, measurement, arithmetic rows, and series. Here are some examples of ethnomathematics exploration found at the *Grebeg Tape Tawaran* cultural festival activities:

### Introduction to Spatial Buildings

The gunungan shape resembles a conical space, so students can be introduced to the elements of the cone, as explained in Figure 3

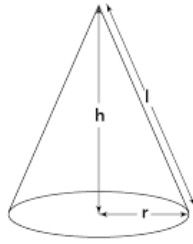


**Figure 3.**  
Concept of Conical Spaces in the Shape of Gunungan

The elements of the cone include:

- Radius
- Height
- slant height

## 1. Calculating the Radius and Slant Height of the Cone



**Figure 4.** The concept of measuring a cone with a tape measure

After recognizing the elements of a cone, the next lesson is to measure the cone-shaped *gunungan* by finding the radius and the cone slant height. Usually, the height of a *gunungan* is 2 meters, while its diameter is 1 meter. So, it can be known that the radius of the mountain is 0.5 meters, which is obtained from:

$$r = \frac{d}{2}$$

$$r = \frac{1}{2}$$

While looking for a cone's slant height, you can use the following formula:

$$l = \sqrt{r^2 + h^2}$$

If it is known that  $r = 0.5$  meters and  $h = 2$  meters, then the size of the cone's slant height is:

$$l = \sqrt{0,5^2 + 2^2}$$

$$l = \sqrt{0,25 + 4}$$

$$l = \sqrt{4,25}$$

$$l = 2,06$$

## 2. Calculating the Volume and Surface Area of a Cone

The formulas for the volume and surface area of a cone are:

a. Volume of cone

$$V = \frac{1}{3} \times \pi \times r^2 \times h$$

b. Surface area of a cone

$$s_a = \pi \times r \times (r + l)$$

### Problem Example:

A conical tape mountain has a height of 2 m and a radius of 0.5 m. Calculate the volume and surface area of the tape cone.

### Answer:

a. Volume of cone

$$V = \frac{1}{3} \times \pi \times r^2 \times h$$

$$V = \frac{1}{3} \times 3,14 \times 0,5^2 \times 2$$

$$V = \frac{1}{3} \times 3,14 \times 0,25 \times 2$$

$$V = \frac{1}{3} \times 1,57$$

$$V = 0,52 \text{ m}^3$$

b. Surface area of the cone

$$s_a = 3,14 \times 0,5 \times (0,5 + 2,06)$$

$$s_a = 3,14 \times 0,5 \times 2,56$$

$$s_a = 4,0192 \text{ m}^2$$

### 3. Arithmetic Rows and Sequences

Upon further observation, there is an arithmetic row and sequence pattern in the arrangement of the tapes in the gunungan. Of the total 10,000 tapes used in the gunungan, according to Mr. Mohammad Arief, S.H., as the Head of Tawaran Village, there are about 50 rows of tapes arranged from bottom to top. To directly count the number of tapes in each row is very difficult. However, using the arithmetic sequence formula, you can easily calculate the number of tapes in each row. The formula used is:

$$n = \frac{1}{2} n(a + un) \text{ and}$$

$$n = a + (n - 1)b$$

#### Problem Example:

Suppose the difference between each row of tape arranged on the gunungan is 8, the number of tapes needed at the top of the first row is 4, and the number of tape rows from top to bottom is 50.

- How many tapes are needed to fill the 50th row?
- What is the total number of tapes needed to fill the gunungan?

#### Answer:

- $$U_{50} = a + (n - 1) b$$

$$U_{50} = 4 + (50 - 1) 8$$

$$U_{50} = 4 + (49 \times 8)$$

$$U_{50} = 4 + 392$$

$$U_{50} = 396$$
- $$S_n = \frac{1}{2} n (a + U_n)$$

$$S_n = \frac{1}{2} 50 (4 + 396)$$

$$S_n = 25 \times 400$$

$$S_n = 10.000$$

### Ethnomathematics in the Tape-Making Process

Based on the results of interviews and observations of the tape-making process with Mrs. Nur Fita Esti, in outline, making tape goes through several stages: preparation, washing, cooking, coloring, cooling, fermentation, and packaging. Mathematical concepts were found in some of the tape-making processes.

#### 1. Preparation Stage

In the preparation stage, some of the materials needed in making tape include:

- 1 kg glutinous rice
- 1 tape of yeast
- 15 katuk leaves
- 50 Ploso leaves
- 600 ml water

In the preparation stage of tape making, a good command of the concept of comparison is required. The ingredients mentioned above can produce 40 large-size or 50 small-size tapes. If more or less tape is needed, just increase or decrease the amount of ingredients by using the concept of value comparison.

**Problem Example:**

The amount of glutinous rice needed to make 50 small tapes is 1 kg. How many kilograms of glutinous rice are needed to make 120 small-sized tapes?

**Answer:**

The formula used is:

$$\frac{a1}{a2} = \frac{b1}{b2}$$

For example

a = number of tapes

b = glutinous rice

Then, it can be calculated as:

$$\frac{a1}{a2} = \frac{b1}{b2}$$

$$\frac{50}{120} = \frac{1}{x}$$

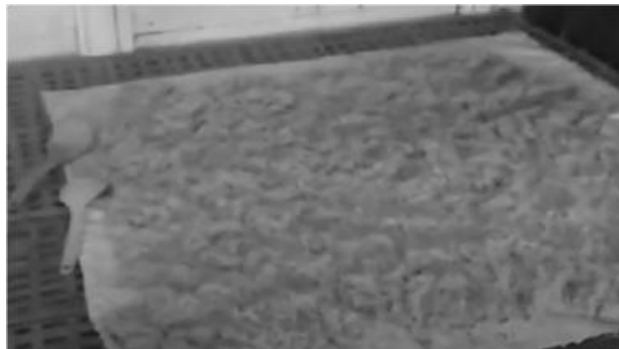
$$50x = 120 \times 1$$

$$x = \frac{120}{50}$$

$$x = 2,4 \text{ kg}$$

**2. Washing, Cooking, Coloring, and Cooling Stage.**

In the washing stage, glutinous rice is washed using running water, and after cleaning it, it is soaked for 30 minutes. Then, the glutinous rice is drained and steamed for 15 minutes. After becoming Karon (half-cooked), it is watered using juice from katuk leaves. After it is green, the Karon is steamed for 30 minutes until cooked. The tape dough is then cooled for approximately two hours.



**Figure 4.**  
Tape Making Process

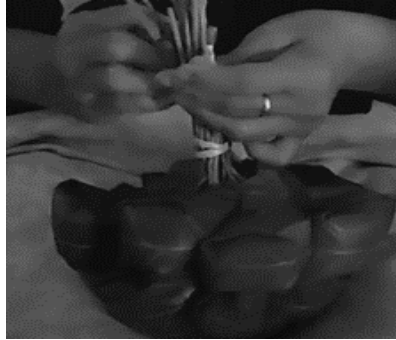
At this stage, it is necessary to calculate the right time so that the tape produced can be cooked perfectly. The mathematics materials at this stage include understanding and converting time units. The total time needed to make tape from the washing stage to the cooling stage is:

- Soak the glutinous rice for 30 minutes
- Steaming glutinous rice for 15 minutes
- Steaming after coloring for 30 minutes
- Cooling process 2 hours

The total time required to make the tape is = 30 minutes + 15 minutes + 30 minutes + 2 hours = 3 hours 15 minutes

### 3. Fermentation and Packaging Stage

At the division stage, the glutinous rice dough that has been cooked and cooled is then placed into a container and continued with the stage of adding yeast. The yeast used is just 1 grain for a ratio of 1 kg of glutinous rice. The yeast must first be dried in the sun and then mashed. After it is smooth, it is mixed into the glutinous rice mixture until evenly mixed. Next, the tape is wrapped using Ploso leaves. Three ploso leaves in one stalk and wrap one piece of tape.



**Figure 6.**

Ploso Leaves Used to Wrap Tape



**Figure 5.**

The Process of Wrapping the Tape Tawaran s

The math concepts used at this stage are multiplication and division. To wrap one piece of tape, three ploso leaves are needed, so if the number of tapes to be made is 50 tapes, then the number of tape leaves needed is  $50 \times 3 = 150$  pieces. The tape has been wrapped and then tied. One Bundle consists of 20 pieces of tape.

**Example:**

Ani bought eight bundles of tape to offer as souvenirs. If one Bundle contains 20 tapes, how many tapes did Ani buy?

**Answer:**

One Bundle contains 20 tapes

Eight bundles of tape = 160 pieces of tape, which is obtained from the following multiplication result:  $8 \times 20 = 160$

Ethnomathematics learning at the elementary school level can help students understand mathematical concepts more easily. Students at that stage are still in the learning process in the concrete operational stage, namely, learning is easier to understand if accompanied by or with the help of real objects that are fun for students (Rafiepour & Moradalizadeh, 2022). Previous research has shown that the use of

ethnomathematics to explain learning materials, especially for elementary school students, can improve students' understanding of mathematics through the application of ethnomathematics-based open learning, so that they can find interesting learning because it is related to culture. After all, it is related to the environment and daily lives of students (Murtafiah et al., 2024; Ulya & Rahayu, 2021). Linking mathematics learning with culture can have a positive impact on elementary school children's mathematics abilities in understanding mathematical concepts and encouraging students to make connections between knowledge and its application in everyday life (Pratiwi et al., 2020; Wati et al., 2021).

## Conclusion

Based on the description presented, the Grebeg Tape cultural festival activities offer ethnomathematics content. This ethnomathematics can be seen in the cone-shaped tape gunungan, which can facilitate students' learning of the elements of cone space, measuring and calculating the volume and surface area of the cone, and calculating the rows of the tape gunungan. In addition, the process of making the tape also contains elements of ethnomathematics, including the concept of comparison, time calculation, and multiplication and division of natural numbers. The ethnomathematics concepts in the *Grebeg Tape Tawaran* cultural festival activities and the tape-making process can be used as alternative learning resources for learning mathematics at school. This is because math learning is associated with daily activities and local cultural wisdom, which can make math learning more enjoyable and meaningful. This approach can also help students explore mathematical concepts more deeply to increase their understanding and motivation toward mathematics. In addition, by linking mathematics with local culture through the tape festival, the offer enriches the learning material and integrates cultural values into the educational process. Teachers also provide opportunities for students to apply mathematics in a real context, so students will find it easier to understand and remember mathematical concepts because they see and are directly involved in the learning process. Thus, integrating ethnomathematics into learning makes the subject matter more relevant and interesting and can help preserve local culture. This approach creates a holistic learning experience, where students learn about math and appreciate and understand the local culture.

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