Ethnomathematics: Exploring the activities of culture festival

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Abstract. This research is an exploratory study to show the correlation between mathematics and culture. These studies have the purpose of exploring culture at cultural festival activities that contain mathematical concepts. This study uses ethnographic methods. Data collection techniques use principles in ethnography such as observation, interviews, documentation, and field notes with original ethnographic descriptions. The result shows that in the activities of the culture festival have the concepts of mathematics, such as transformation geometry, cone wall area, cone nets, Pythagorean theorem, and circumference of the circle.

1. Introduction
Mathematics is a necessary branch of knowledge required for students moreover needed by everyone in daily activities to develop the ability of logical, systematic, critical thinking of students, and to support their learning success in the future [1-3]. Other than that, mathematics also has relationships with everyday activities and mathematics has a relationship with culture and can be learned in a fun way [4-5]. In mathematics learning, students still experience difficulties with abstract knowledge, so they need an approach that directs the concept to something more concrete with the hope that it can be applied in everyday life [6]. In line with this, the concept of mathematics should be linked to problems in daily life [7-8]. The teacher to the student does not just transfer mathematics, but it is actively engaged in by students to reinvent the mathematical concepts in their way [9].

Ethnomathematics is conceptually designed as mathematics that is practiced, used or combined in cultural practices in society [10-13]. Furthermore, the idea of ethnomathematics arises as a broader view of the relationship between mathematics and the real world [14]. In line with this, ethnomathematics relates to mathematical concepts that can be integrated into mathematics teaching and learning activities both at the elementary and secondary levels [15]. So it can be interpreted that ethnomathematics is cultural integration in learning mathematics or in other words mathematics which has cultural elements. The culture adopted depends on where and to whom mathematics is taught. With the assumption that ethnomathematics has the potential to increase student involvement and interest in learning mathematics [16].

Mathematics learning can be carried out outside the classroom so that students can introduce and connect mathematics to local wisdom and make mathematics learning fun, meaningful, and better understand the contextual concepts in mathematics [4]. The cultural aspects contribute to introducing mathematics as part of everyday life, developing essential connection skills, and deepening mathematical understanding Adam [17]. According to Clarkson [18], culture can be understood as a pattern of meaning, built historically and transmitted socially, embodied in symbols and language,
where humans communicate, perpetuate and develop their knowledge and understanding of life. The culture is essential is embedded in students early on [19]. On the other hand, the cultivation of cultural values is necessary to support the development of national character, because with the understanding and application of individual cultural values capable of filtering the influence of globalization which is now clearly seen its negative impact [20].

2. Methods
The method used in this study is exploratory that is to find and to know a phenomenon or event (concept or problem) with conducting an assessment of the symptoms [21]. Furthermore, in the process using an ethnographic approach that is an empirical and theoretical approach that is, aiming to get a description and a thorough analysis of culture based on field research. How people organize their culture in mind and then use in life. Ethnographic tasks to finds and describe the organization of the mind [22]. The procedure of research conducted adopting ethnographic approach by Spradley [22], includes the following steps: establish informants, conducting interviews with informants, making notes ethnographic, ask questions descriptive, analyzing the results of ethnographic interviews, create a domain analysis, asking questions of structural, conduct taxonomic analysis, and writing ethnography.

3. Result and Discussion
The results showed that Ethnomathematics found in the activities of the culture festival in Gunungkidul, Indonesia. Ethnomathematics in activities of culture festival can be seen from the process of making butterfly costume, puppet costume, traditional game tool Egrang, batik Caping, and Gunungan.

3.1. The application of geometry transformation in making butterfly costume
This butterfly costume is displayed in the cultural festival in Tepus sub-district, Indonesia. This butterfly costume symbolizes the condition of the Tepus community. The butterfly has gone through various phases of life that have led them to become beautiful figures as they are today [23]. If seen from history, the Tepus community has gone through various phases like a butterfly. Tepus village is famous for its difficult water source villages. However, at this time slowly the village government continues to improve itself so that it can always reach the "butterfly" phase and achieve a glorious and prosperous condition. Furthermore, to making butterfly costume, students can apply geometry transformations that explain in Figure 1 which describes the application of geometry transformation in making the butterfly costume, to making this costume can the applied reflection of two ornaments using y-axis in the Cartesian coordinate system.

![Figure 1. The application of reflection in making the butterfly costume](image-url)
3.2. The application of geometry transformation in making puppet costume

Puppet costumes are displayed in a cultural festival in Tepus sub-district. This costume symbolizes that the Tepus people still preserve puppet art. Puppet is the essence of Javanese culture inherited from generation to generation, not just a spectacle and guidance on how humans must behave in their lives, but also an order that must be dititeni kanti titis (which is an orderly natural law that must be known and addressed wisely) to go to kasunyatan and reach true life [24]. Furthermore, to making attribute puppet costume, students can apply geometry transformations that explain in Figure 2.

![Figure 2](image1.png)

**Figure 2.** The application of reflection and dilatation in making puppet costume

Figure 2 describes the application of geometry transformation in making puppet costume, to making this costume can the applied reflection of several ornaments using $y$-axis in Cartesian coordinate system. It also can to applied dilatation of an ornament using $x$-axis in Cartesian coordinate system, so can get the motif that has the same form but have different size.

3.3. The application of Pythagorean theorem in the making traditional game tool Egrang

The philosophy of the game Egrang according to Suffah [25] to is a pair of bamboo that is stepped on, likened to the environment in which we stand. With Egrang we learn to control ourselves, we need skills, maintain balance and confidence when we pull it. Skills in life are required to practice creativity so that growth cannot easily fall. Even if we fall, we can rise again.

![Figure 3](image2.png)

**Figure 3.** The application of Pythagorean theorem in the making traditional game tool Egrang
Furthermore, to make traditional game tool Egrang, students can apply Pythagorean theorem that explains in Figure 3. It describes the application of Pythagorean theorem in making traditional game tool Egrang, to making this traditional game tool can the applied formula $a^2 + b^2 = c^2$.

3.4. The application of cone wall area and cone nets in making batik Caping

This batik Caping is displayed in a cultural festival in the sub-district of Tepus. This Caping Batik symbolizes the majority of Tepus people who work as Farmers. The batik used to decorate Caping is a famous form of culture in Yogyakarta. Didik [26] explained that Yogyakarta batik not only has a beautiful motif but contains philosophy, full of deep meaning and there are prayers and hope inside.

![Figure 4](image1.png)

**Figure 4.** The application of cone nets in making batik Caping

Figure 4 describes the application of cone nets in making batik Caping. Then, to calculate the amount of batik paper needed, it can apply the cone wall area concept. The formula can be written:

$$\text{Cone wall area} = \pi rs \times n$$

with $n = \text{amount of batik Caping}$

3.5. The application of circumference of the circle in making Gunungan

Gunungan is displayed in a cultural festival in the sub-district of Tepus. This Gunungan symbolizes that the Tepus community still preserves Javanese traditions. The philosophy of the Gunungan according to Kuncoro [27] is a form of gratitude from the Sultan to its people with of various types of plants such as vegetables, fruits, etc. which are arranged like cones. Furthermore, to make the skeleton of the Gunungan, students can apply the circumference concept of the circle that explains in Figure 5.
Figure 5. The application of circumference of the circle in making Gunungan

Figure 5 describes the application of circumference concept of the circle in making Gunungan. In the process of making the skeleton of the Gunungan, starting from making a ring of bamboo with the longest diameter installed at the bottom, then making a ring of bamboo with a shorter diameter and mounted above the previous circle by giving a distance ± 4 inches, and so on until the top of Gunungan.

4. Conclusion
Ethnomathematics activity on the culture festival is very diverse. The starting from making butterfly costume, puppet costume, batik Caping, traditional game Egrang, and Gunungan. The result shows that in the activities of the culture festival have the concepts of mathematics, such as transformation geometry, cone wall area, cone nets, Pythagorean theorem, and circumference of the circle. The result would be the context in design the learning trajectory by using etnomathematics as the starting point on learning process in realistic mathematics education approach for the future research.

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