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Ethnomathematics: Geometry Exploration in Pura's Architecture of Taman Nasional Alas Purwo

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ABSTRACT. Mathematics has a fairly close relationship with culture. History shows that mathematics emerged as a product of a culture based on human social activities. Integrating mathematics with culture will have an impact on more effective and meaningful learning, especially in Geometry learning which is closely related to everyday life. Alas Purwo National Park is one of the historical heritage sites located in Banyuwangi. This study aims to describe the results of ethnomathematical exploration on historical buildings in Alas Purwo National Park, namely Pura Luhur Giri Salaka. This study uses the method of observation, documentation, and interviews with research instruments in the form of observation sheets and interview guidelines. The results of the study indicate that the architecture of Pura Luhur Giri Salaka reflects some Geometry properties. Gapura building reflects some geometry shape and space such as triangle, rectangle, prism, and pyramid. Besides that, some of Geometry transformation also could be seen building. The rotation and dilation properties can be seen in the bale kulkul building. The translational and reflection properties about y-axis can be seen in the gate of Pura. Furthermore, the results of this study can be used as the source for the development of learning materials in geometry.

INTRODUCTION

Mathematics has a fairly close relationship with culture. History shows that mathematics emerged as a cultural product based on human social activities. Culture and mathematics are two things that develop in tandem, there are still many students who often find it difficult and view mathematics as a science that is difficult to learn, meanwhile mathematical concepts, especially in learning geometry which has a very close relationship with everyday life.

One thing that can bridge between culture and mathematics education is ethnomathematics. Ethnomathematics is a learning strategy that explores how to understand, clarify, process, and apply mathematical ideas, concepts, and practices that can be applied to activities. Ethnomathematics uses many mathematical ideas that are related to all mathematical activities. The purpose of ethnomathematics is to develop mathematical knowledge in various sectors in different ways such as measuring, calculating, classifying, designing, determining locations, and others [1]. Ethnomathematics presents mathematical concepts of the school curriculum in a way in which these concepts are related to the students' cultural and daily experiences, thereby enhancing their abilities to elaborate meaningful connections and deepening their understanding of mathematics [2].

The combination of mathematics and culture has apparently existed in the midst of people's lives, where people themselves have unconsciously applied mathematical concepts, especially in the field of geometry in culture. There are several ethnomathematical studies that have been carried out on various cultures in Indonesia. Exploration of ethnomathematics in the several motifs of Yogyakarta batik that contains philosophy, deep cultural values, and mathematics concepts, especially geometry transform subject [3]. In addition, the *bouffant* community has been

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practicing mathematics in everyday life, visible from the shape and the model of the building the which has the pattern, angle, building space, angle, triangle, square, cylinder, prism and circle [4]. This can be seen in the *sasak* architecture has different construction and ornamentation designs to present a functioning and beautiful building. In addition, ethnomathematics is also found in Sundanese, especially in estimating, measuring, and making patterns appearing in the activities in term of *kibik* (a unit for measuring volume), *bata* (a unit for measuring surface area), and path *pihuntuan* (a model of cane work) and in mathematical modeling [5-6].

By linking mathematics and culture, learning will be more effective and meaningful [7], especially in geometry learning which is closely related to everyday life. Integrating culture in geometry learning gives a new experience for students [8]. The implementation of an ethnomathematical perspective in the school mathematics curriculum helps to develop students' intellectual, social, emotional, and political learning by using their own unique cultural referents to impart their knowledge, skills, and attitudes [2].

Taman Nasional Alas Purwo is one of the historical heritage sites located in Banyuwangi. There is a lot of biotic, abiotic, tourism, and cultural potential in it. Pura Luhur Giri Salaka is one of the temples with a culture that is still inherent in the Taman Nasional Alas Purwo area. This temple was built to be used as a place of worship for Hindus which quite a lot has ethnomathematical elements. This study aims to describe ethnomathematical exploration on historical buildings in Pura Luhur Giri Salaka.

METHODOLOGY

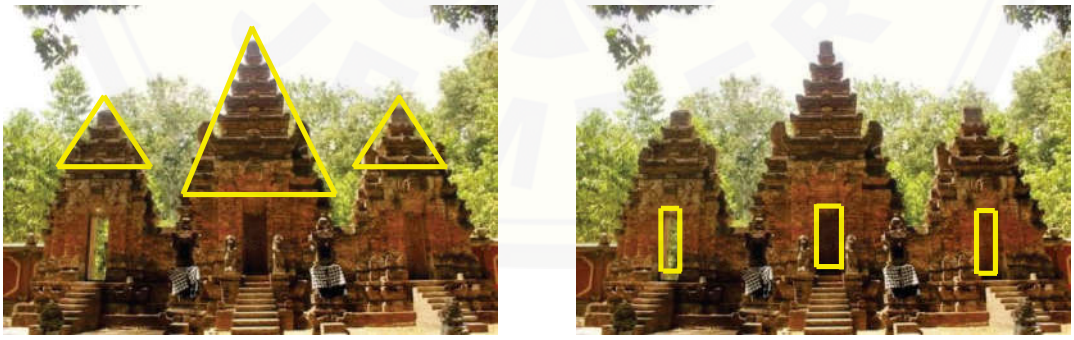
This research is qualitative research with an ethnographic approach. Qualitative research will examine and study the meaning of individuals or groups about the problems that are the focus of research [9]. This study uses descriptive type because it aims to describe the exploration of ethnomathematics in the architecture of Pura Luhur Giri Salaka. This study also uses ethnographic approach. Ethnography is a design of inquiry coming from anthropology and sociology in which the researcher studies the shared patterns of behaviors, language, and actions of an intact cultural group in a natural setting over a prolonged period of time [9]. Ethnography learns about broad culture-sharing behavior of individuals or groups. involve a detailed description of the setting or individuals, followed by analysis of the data for themes or issues. Data collection involves observation, documentation, and interviews.

RESULT AND DISCUSSION

Based on the results of exploration, observation, documentation and interviews, Pura Luhur Giri Salaka has some ethnomathematical elements. The mathematical element found in the temple that is related to geometry shape and space also transformation in geometry. The ethnomathematics exploration of Pura Luhur Giri Salaka describes below.

Geometry Shapes and Space in Pura Luhur Giri Salaka Building

The Pura Luhur Giri Salaka building reflect geometry shape and space. The ethnomathematics exploration in pura buildings are shown in the following figure.



(a) (b)

FIGURE1. Geometry shape in Pura Luhur Giri Salaka

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Figure 1 shows that the top of the temple when viewed from the front represents a triangular shape. The gate when viewed from the front, it represents a rectangular shape. From that exploration, Pura Luhur Giri Salaka represent the ethnomathematics especially the geometry shape. The Pura Luhur Giri Salaka building also adapts geometry space that are shown in the following figure.

FIGURE 2. Geometry space in Pura Luhur Giri Salaka

Figure 2 shows that the top of the temple represents the shape of a rectangular pyramid. In addition, the ladder section represents the shape of a right triangular prism. From that exploration, Pura Luhur Giri Salaka represent the ethnomathematics especially the geometry space.

Geometry Transformation in Pura Luhur Giri Salaka Building

Pura Luhur Giri Salaka also represents the properties of geometry transformation. Geometry transformations are also commonly described as a transfer of geometric objects in the form of points, lines, shapes, SPACE on the plane [10]. The properties of geometry transformation include reflection, translation, dilation and rotation.

Reflection in this geometry transformation is one type of transformation that reflects an object against a certain line/mirror. Reflection is defined as the transfer of each point by using the mirror properties of a plane mirror [11]. the image produced by mirroring gets the same shape and size, the distance of the image from the mirror will be similar to the distance of the original object to the mirror, and the resulting image will face the original object. The reflection on the Y axis can be seen in the entrance gate building as shown in the following figure.

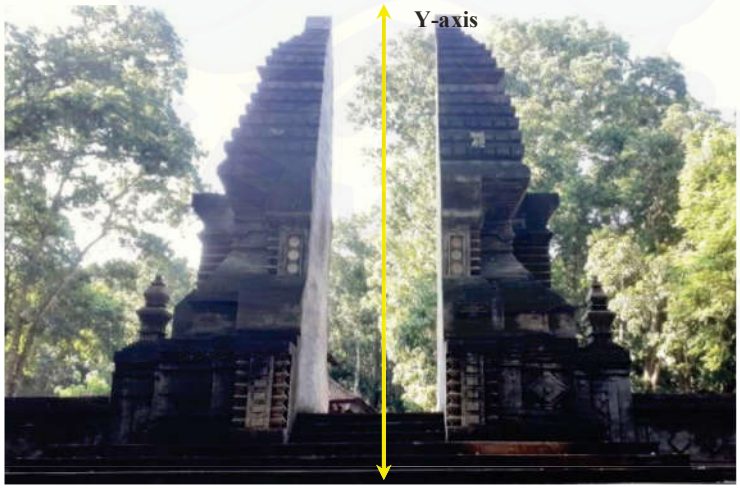

FIGURE 3. Reflection property in entrance gate

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Figure 3 shows the left side of the gate building is a reflection by y axis of the right side of the gate building. The next property of transformation is translation. Translation is a type of geometric transformation where a shape undergoes a shift but does not change the shape of the translated shape because each translated point experiences the same shift [12]. Translation is also referred to as a transformation that moves an object in the form of a straight line in the direction of a certain distance. The entrance gate to Pura Luhur Giri Salaka also represents the concept of translation as shown in the following figure.

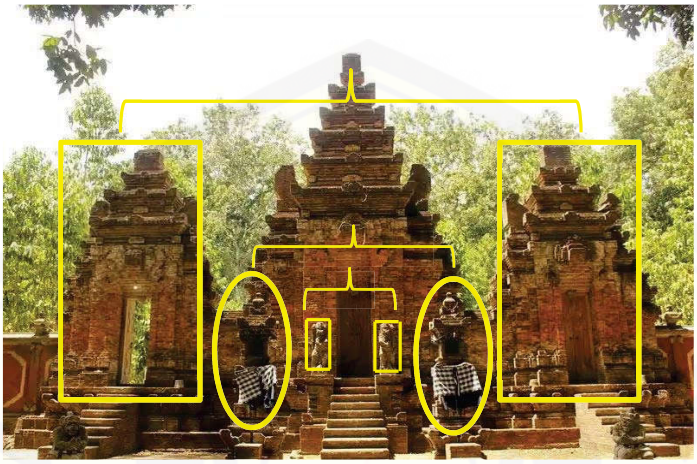
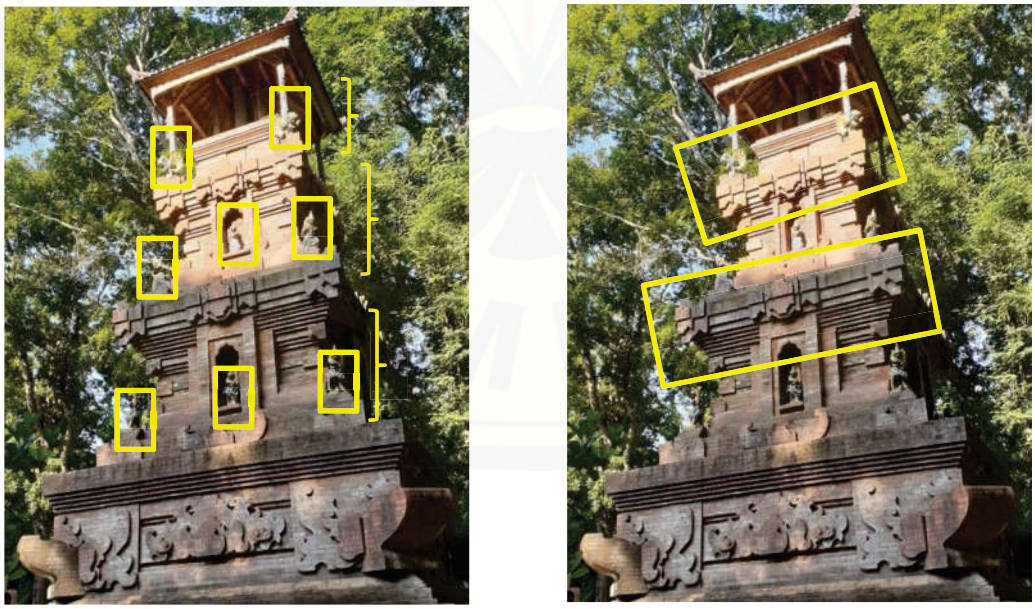


FIGURE 4. Translation property in entrance gate

Figure 4 shows that there are three elements in the building that show translation. These elements include two pairs of statues and the entrance gate. The elements on the left if shifted a few units to the right will produce elements on the right. The next transformation property is rotation and dilatation. Rotation is a transformation which rotates each point of its coordinates to a fixed center of rotation with a certain turning angle and the intended direction [11]. The rotation about a fixed point is known as the center of rotation. Dilation is a transformation that changes the size of an object by zooming in or out with a certain scale factor denoted by k [11]. The rotation and dilatation property in Pura Luhur Giri Salaka area can be found in Bale Kulkul as shown in the following figure.



(a) (b)

FIGURE 5. Rotation and dilatation property in Bale Kulkul

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Figure 5 (a) indicates that the statues on the third floor of Bale Kulkul is rotated 90^0. The statues on the first and second floor of Bale Kulkul are rotated 45^0. Figure 5 (b) shows the dilatation property on the Bale Kulkul. The architecture of the buildings marked in yellow indicates the dilatation where the shapes are similar but have different sizes. The first one has a larger size than the second one so that both are applications of the concept of dilation. The exploration result of ethnomathematics can be used as an innovative learning. The students would get new experience and new chance in learning mathematics. It could make the students challenge themselves, satisfy their potential and explore their learning process [8].

CONCLUSION

Mathematics has a fairly close relationship with culture. Mathematics in a culture is called ethnomathematics. The exploration of Pura Luhur Giri Salaka architecture as one of the historical heritage in Taman Nasional Alas Purwo result some ethnomathematics, especially geometry properties. Entrance gate building reflects some geometry shape and space such as triangle, rectangle, prism, and pyramid. Besides that, some of geometry transformation also could be seen in Pura Luhur Giri Salaka. Some properties of geometry transformation such as reflection, translation, dilation and rotation could be seen on the architecture of Pura Luhur Giri Salaka. Furthermore, this ethnomathematics-based learning can be used as an innovative learning that uses real mathematics learning resources with the aim of generating student interest in mathematics.

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