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THE STUDY OF ETHNOMATHEMATIC OBJECTS IN THE DIENG TEMPLE WONOSOBO, CENTRAL JAVA

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Abstract

The development of science and technology which is based on mathematics must be balanced with human resources who are sensitive to changing times without leaving the national identity achieved through learning in schools. Exploration of Dieng Temple objects as historical artifacts in Wonosobo can produce knowledge about the structure and architecture of Dieng Temple which can be used as a source of contextual learning. The purpose of this study was to determine the ethnomatematic object contained in the Dieng temple. The research method used is qualitative research. Data collection methods are observation and interviews with 1 archaeologist and 2 local cultural observers. The results of this study indicate that there are ethnomatematic objects that can be applied in mathematics learning in historical buildings, one of which is Dieng Temple. A well-observed indicator is the activity of generalizing the number sequence pattern and the object configuration sequence pattern.
Keywords: ethnomatematics; dieng_temple; mathematics_learning

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INTRODUCTION

Mathematical science is the basis for technological development and contributes to various disciplines, so that mathematics learning is given at every level of education. Permendikbud 103rd of 2014 states that learning is a process of interaction between students and between students and educators as well as learning resources in the learning environment. Furthermore, Marisa (2014) stated that learning resources are in the form of writing, pictures, photos, sources, natural objects and cultural objects. The use of learning resources that are appropriate to the context will make it easier for students to learn mathematics. On the other hand, mathematics covers abstract ideas in the form of symbols, so the basic concepts of mathematics must be understood before manipulating these symbols

(Susanto, 2013). So that learning mathematics requires understanding, not just memorizing it verbally and in memory.

The importance of mastering the understanding of mathematics is not in line with the relatively low mathematical abilities of students. The results of a survey by the International Association for the Evaluation of Educational Achievement (IEA) which measures the development of mathematics and natural sciences in the 2015 Trend in International Mathematics and Science Study (TIMSS) put Indonesia in 45th place out of 50 countries in mathematics, which means the bottom position (Elsa Susanti, 2017). The cause of the low mathematics achievement is presumably because the current mathematics learning is not contextual. Minister of Education and Culture Regulation No. 68/2013 supports an innovative and contextual learning process. So it is hoped that learning will be more interactive, fun, motivating, and have a multidicipline pattern (Mukhni, 2014).

The role of mathematics is interesting to study in various aspects, one of which is culture. D'Ambrosio in 1985 pioneered learning that bridges between culture and mathematics education called ethnomatematics. Marsigit (2016) argues that ethnomatematics is a science used to understand how mathematics is adapted from culture. D'Ambrosio (2006) states that ethno-mathematics complements the efforts of teachers and students in formal schools in providing relevant contextual meanings.

Learning is a relatively permanent change in behavior, knowledge, and thinking skills that arise through experience which is influenced by several factors, including environmental factors including technology and culture (Pardimin, 2018). Culture determines the way students perceive things, including math problems. When a material is so far from their cultural schema, of course the material is difficult to understand. Wahyuni (2013) states that an approach is needed in mathematics learning that is able to connect mathematics with their culture. By applying ethno-mathematics as a learning approach it will be very possible for the material to be studied to be related to their culture so that the

understanding of a material by students becomes easier because the material is directly related to their culture which is their daily activity in society.

Therefore, ethnomatematics can be used in the mathematics learning process as a bridge to link abstract mathematics with local culture, so that it can be accepted more easily by students. The purpose of this study was to determine the ethnomatematic objects contained in the Dieng temple and their relevance to the context of school mathematics. The application of the results of the exploration of the surrounding culture in mathematics learning is expected to make students not only know and understand their culture better, but also make students understand that mathematical concepts are not far from their daily lives.

METHOD

The research method used is qualitative research, in order to obtain valid data regarding the Dieng temple area, the main informants were selected, namely 1 Dieng temple archaeologist and 2 local cultural observers who are members of the Indonesian Tour Guides Association (HPI) Wonosobo. The data in this study are ethnomatematic findings on the structure and architecture of the Dieng temple obtained from library data, oral data and ethnographic records. Library data is obtained by conducting literature studies, oral data is obtained from interviews with local archaeologists and cultural observers, ethnographic records are writings made during observation and interview activities.

The data collection method used was observation of the Dieng temple area and interviews with local cultural observers and the research instrument was the researcher himself (human instrument). In this case the researcher acts as a data collector, his role cannot be replaced as the main instrument and is supported by other instruments, namely: field notes, observation guidelines and interview guides.

Sugiyono in Chandra Sri (2016) states that to increase the validity of the research, it is obtained through various strategies, namely relatively long data collection, multi-method strategies in data collection and analysis (triangulation of

methods), detailed quotations of participant / source language, complete and detailed recording, note taking. mechanical data (audio recorders, videos, photos) and reviews by participants. The stages of the research method that will be carried out are as follows.

Figure 1. Research method

The preliminary survey stage was carried out by determining the topic, area and research subject. From the results of the preliminary survey, instruments were made, namely in the form of field notes, guidelines for outline observations and guidelines for large interview methods. The data collection stage was carried out by observing the Dieng Temple area and interviewing local cultural observers. The research was conducted to obtain data in accordance with the desired objectives. The data analysis stage is to collect all the data from the research results, then the data is arranged according to the focus of the problem study and the research objectives, namely to identify mathematical concepts in the Dieng Temple area. At the conclusion stage, the researcher draws conclusions on the results of data analysis which refers to the problem formulation.

RESULTS AND DISCUSSION

The results of field observations indicate that the Dieng temple area is located in the highlands which are included in the Wonosobo and Banjarnegara districts where mountain activities can be found in the presence of craters that emit sulfur gas and vapor. Dieng Temple is a Shiva Hindu temple that is marked by many statues of Hindu gods on the temple. One of them is the Shiva statue in various forms, one of which is the Shiva Trisirah Statue with 3 heads symbolizing creation, maintenance, and destruction that can only be found in Dieng. In addition, there was also an embodiment of Lord Shiva called

Nandisawahanamurti, which is a form of Lord Shiva riding a vehicle (vehicle) called Nandi (ox). The architectural style of the temple building is certainly an application of science, one of which is mathematics. Each part of the temple has a diverse architecture that can be related to learning mathematics. For example, at the bottom of the temple, there is a temple entrance gate on the right and left which is relevant to the subject of Geometry Transformation. The body part of the temple in the middle has a statue surrounded by a stone arrangement forming a frame relevant to the subject of Two-dimentional figure. The roof of the temple which is getting smaller at the top is relevant to the subject matter of Number Patterns and Object Configuration Sequences Patterns. In addition to parts of the temple, there is also the Wadihati Inscription which contains the determination of the land belonging to Sang Hadyan Juru Wadihati to be a sima (a group exempt from royal tax) so that it is designated for the hermitage of the Saiwa sect (Shiva worshipers) which can be used as ethnomatematic objects.

Following are excerpts of interviews with local cultural observers:

Q: "How did Dieng temple come from and how many temples are there in this Dieng area?"

A: "The origin of the word Dieng from Sanskrit is "Di" (means mountain) and Hyang (means God). So it can be concluded that Dieng means the mountain where the Gods reside. The Dieng temple area is divided into 3 groups. Namely the Arjuna, Gatutkaca and Bima groups. Daroi these three groups, only Bima Temple has an intact structure. Other temples have undergone restoration."

Q: "What is the architectural style of Dieng temple? Is there any similarity with the temple models in other areas?"

A: "The characteristics of the Dieng temple building are similar to temples in India which symbolize Mahameru with the characteristics consisting of 3 levels, namely the legs, body and roof of the temple."

The results of the interviews with the three informants concluded that the origin of the word Dieng from the Sanskrit language is "Di" which means place or mountain and "Hyang" means God. So that Dieng is the dwelling place of the gods with an altitude of 2000 m above sea level with an area of 1.8 x 0.8 km^2. The Dieng Temple complex is divided into several groups. The Arjuna temple group consists of five temple buildings, namely the Arjuna temple itself facing the Semar temple, then lined up there are Srikandi temples, Sembadra temples, and Puntadewa temple. Of the five temples, only Arjuna temple whose structure can still be observed well even though it has undergone restoration. Another group of temples is the Gatutakaca group which consists of five temples, including the Gatutkaca temple, Setyaki temple, Nakula and Sadewa temples, as well as the Gareng and Petruk temples. However, this temple group currently only leaves Gatutakaca temple. Apart from these two groups, there is the Bima temple which is the largest temple among the others and the most intact condition. The structure of the Dieng temple consists of three parts, namely the foot of the temple, the body of the temple, and the roof of the temple.

The architectural style of the Dieng temple is similar to the temples in India which symbolizes Mahameru which consists of 3 levels. The lower part of the temple base is called Bhurloka which is the underworld, the body of the temple is called Bhuwarloka which is the human world, and the roof of the temple is called Swarloka which is the world of the gods. On the roof of the entrance to each temple there is a Kala which is made of andesite rock depicting a creature with its eyes glaring downward, a large nose and a grinning mouth showing its fangs. Delivered by Syafii (2019) that the shape of Kala in Bima temple is much different from Kala in Arjuna because it looks simpler with a flat carving character. The composition between the elements also looks different, with the eyes and jaws quite far apart.

The results of the research data collection were collected, then arranged according to the focus of the study of mathematical ideas contained in the object

of the Dieng temple. The following are ethnomatematic objects found in the Dieng Temple area and their corresponding mathematical contexts.

Table 1. Ethnomatic objects in accordance with the context of mathematics.

No	Ethnomathematic Objects	Description	Relevant Mathematical Context
1	 	Temple Peak. This section is the top structure on the roof of the temple. The model of the roof of the temple, which has a higher and smaller, is called Wimana. The shape of the roof of the temple is said to be similar to the Bhubaneswar temple in North India which is the development of the temple in the shape of Shikhara (multi-storey tower).	Number sequence pattern and object configuration sequence pattern. (Class VIII)
2		Entrance gate at the temple entrance. There are on the right and left of the temple. In the Dieng temple architecture, the foundation is made higher because it was possible that the place was flooded in the past.	Transformation of geometry, section of reflection / reflection. (Class IX)

3		Kala. Depicting a creature with bulging eyes looking down, a large nose and grinning mouth revealing fangs. In the ear there is jewelry in the form of sumping. On the right and left, there are figures of small giants raising their hands baring their claws.	Transformation of geometry, section of reflection / reflection. (Class IX)
4		Antefix Antefix or cymbars are components of temple buildings that have a basic tumpal shape and contains tendrils. Usually the place in the corner of the roof is on the trim at each level of the roof	Two-dimentional figure, in section triangle. (Class VII)
5	 	Lingga Yoni. Made of andesite and divided into 3 parts. The Brahmabaga section is a cube with a height of 12.5 cm. The middle part, namely Wisnubaga, is in the form of a hexagon with a height of 13 cm, the upper part is called Rudrabaga in the form of a cylinder with a height of 11.5 cm. The union of the Lingga yoni is a meeting between a man and a woman that symbolizes fertility, so that a new life emerges (birth).	Geometry (Class IX)

6		One way of arranging stones in the Dieng temple architecture	Three-dimentional figure, in section cube. (Class IX)
7		Wadihati inscription This inscription contains the determination of the land of Sang Hadyan Juru Wadihati to become sima, so that the results can be used for the asceticism of the Saiwa sect (shiva worshipers). Sima is a perdikan exempt from royal taxes	Two-dimentional figure (Class VII)
8		Shiva Trisirah statue This depiction of Shiva with three heads is another form of the depiction of shiva Mahadewa which contains the Trimurti element.	Geometry Transformation. (Class IX)

Based on the table above, it can be seen that there are ethnomatematic objects in the parts of the Dieng temple that are relevant to the mathematical context. By analyzing the structure of the temple building, it can be concluded that the Dieng temple can be used as a contextual mathematics learning medium in schools through the ethnomatematic approach.

CONCLUSION

Ethnomatematics-based mathematics learning allows the implementation of mathematical concepts in a cultural context so that students together understand mathematics and culture in an area / tribe at once. Ethno-mathematical objects that can be used in mathematics learning are found in many areas, one of which is the Dieng Temple area. A well-observed indicator is the activity of generalizing the number sequence pattern and the object configuration sequence pattern. This activity requires mathematical connection skills to analyze patterns and relate them to problem-solving concepts or procedures in mathematics.

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