ETHNOMATHEMATICS: EXPLORATION OF SEWU TEMPLE IN KLATEN

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ABSTRACT

The purpose of this study is to observe and describe a culture that surrounds the community as a whole related to Sewu Temple in a certain period based on fieldwork, then look for mathematical aspects of Sewu Temple in history, manufacturing processes, and mathematical concepts. The results of this study are presented in a qualitative form with an ethnographic approach that describes the history of Sewu Temple. The sources obtained are based on the results of interviews, observations, and documentation, using an interview guide, the results of documentation, and observations as a tool to obtain data sources. The temple building has several flat geometries, including triangles, squares, trapezoids, and rectangles. Then there is spatial geometry in the form of cubes, blocks, tubes, and square pyramids, which are concepts from the mathematics of geometric material. The results of this study are in the form of geometry material found in junior high schools related to mathematics learning activities. In this study, it is expected to be able to become material from learning and become a reference for future research studies related to culture and mathematics.

1. INTRODUCTION

ulture can be defined as a living guide to be developed and become a possession of a group of people, which will be passed on to successors in the next generation. Belief systems, customs, political policies, language, clothing, building construction, and art become difficult components of the formation of culture or culture. Culture is inherited from generation to generation and contains the integrity of the meaning of social values and norms, science, and the completeness of social, religious, and other forms. Society has its peculiarities, including all scientific explanations and beauty [1]. The explanation Rosa and Orey 2011 say that learning in schools, such as mathematics material, is learning that is completely unrelated to culture in general. Learning only involves facts, concepts, and materials. Thus, mathematics is considered far from the reality of everyday life because it is considered a perfect science with objective truth [8].

According to education and culture can be interpreted as two things that are interrelated with each other [17]. Indirectly a culture can be an aspect that is able to help the implementation of teaching programs. Therefore, efforts to improve education can be made by developing culture. This can be done by maintaining and preserving the existing culture, which is commonly known as ethnomathematics, for example, with the temples scattered in the archipelago indirectly.

Groups of workers, fishermen, farmers, children from certain groups of society, and professional classes are examples of certain cultural communities that carry out mathematical activities called ethnomathematics [2], [5]. Thus, mathematics can be explained as an integrated cultural element in the life of society as a whole, both when and wherever it is located [6], [7].

Speaking of temples, one of which is the Sewu Temple which is located in Klaten, Central Java. The Manjusrighra inscription or better known as Sewu Temple, is a temple that is estimated to have been built during the Syailendra dynasty of the reign of the Ancient Mataram Kingdom. Prambanan Temple is adjacent to Sewu Temple in the Prambanan Temple area. nlike the Hindu-style Prambanan Temple, Sewu Temple is focused on Buddhist worship, this can be distinguished by the absence of a yoni phallus in Sewu Temple. The name Sewu in Javanese means a thousand, which indicates that the temple is contained in a very large number of temples, although, in fact, it does not reach a thousand. To be precise, the Sewu Temple series consists of two hundred and forty-nine temples, one main temple, eight flanking temples or intermediate temples, and two hundred and forty ancillary temples surrounding the temple. Arranged in symmetrical order, the temple stands on top of the main temple in the center or center, then is surrounded by four flanking temples and ancillary temples [9].

Ethnomathematics has a definition by the community or a certain cultural group that has special ways of carrying out activities that contain the abstraction process in it from real expertise with mathematics or vice versa in everyday life [4]. These activities are in the form of groups, counting, measuring, counting, arranging buildings or tools, forming patterns, deciding locations, explaining, acting, and so on [11].

Providing a formulation of the results of an effort can be interpreted as a goal after carrying out a learning experience. So that it can be interpreted that education or education is an effort that is carried out with full awareness and uses systematics to achieve a better life than before. Simply put, education is a learning effort that is carried out for students to be able to know, understand, and make individuals who are able to think critically. Mathematics is one way to attract students to think critically because, in mathematics, there are activities related to form, problem-solving, and thinking logically, which aims to be able to understand the world by developing critical thinking.

The problem that will arise if the anticipation in this exploration is not carried out is that the understanding of Sewu Temple as a cultural heritage will be abandoned. The influence of only a few temples that are often visited and famous makes other temples more to explore again. Many things will be obtained when learning about Sewu Temple, especially those related to the process of studying mathematics. Thus, there is a need for ethnographic studies related to Sewu Temple. Therefore, this study aims to describe and then implement ethnomathematics in Sewu Temple for the study of mathematics.

2. RESEARCH METHODS

The types of research used in this study were exploratory and ethnographic. Explorative research is research that evaluates in detail and thoroughly by understanding the symptoms and phenomena that occur

so that the results of this research become the impact of the thoughts, knowledge, and ideas of researchers in processing the information obtained. This study uses a procedure to describe, examine, and explain elements such as language patterns, behaviors, and beliefs of a cultural group that, from time to time, always develop, which is very in line with the ethnographic approach. The purpose of ethnographic research is to observe and describe the culture that surrounds the community as a whole related to Sewu Temple in a certain period based on in-depth fieldwork. Researchers chose to use this approach and type of research because the research carried out related to Sewu Temple based on observations of the culture and the surrounding environment required explanations in pictures and words as well as data processing [13]. The subjects of this research are resource persons or historians, guards of Sewu Temple located in Bener Hamlet, Bugisan Village, Prambanan, Klaten. The criteria for selecting subjects in data collection are people who have a better understanding of the shape and history of Sewu Temple to be studied using ethnomathematics in mathematics [13].

In the process of collecting data, the researchers themselves used it as a research instrument. Data collection in this study was carried out by literature study, observation, documentation, and interviews. The cultural aspects contained in Sewu Temple can be known by using interviews and literature studies. Mathematical aspects of Sewu Temple can be known through observation. All data obtained will be supported using documentation. The Miles and Huberman method in the form of data reduction (data reduction), data presentation (data display), as well as drawing conclusions and verification (conclusion drawing and verification) became a reference for data analysis in this study.

Ervinawatitwo stages, the first describes the data during the field and after data collection. Regarding data analysis in the field, it includes data collection of provisions used as a limiter for the scope of the study, then arranges steps to collect data on the things being analyzed and explores library sources that are compatible with the research. The study of data after all data has been collected includes combining data obtained from interviews, observations, and documentation [13].

3. RESULTS AND DISCUSSION

3.1. History of Sewu Temple

The establishment of Sewu Temple is a home for Manjusri. Manjusri himself is a teacher for bodhisattvas (the embodiment of buddhas who experience spiritual enlightenment and are ready to reach nirvana). Possessing a high position, Manjusri is depicted as a figure carrying a sword in his right hand and a script in his left which symbolizes the war against ignorance and deep wisdom. The embodiment of Sewu Temple is a form of people's love for their king. This is implied in the Manjusri Grha inscription. As a royal temple, the Candi Sewu complex began to be built during the reign of Rakai Panangkaran, who was thought to have died shortly before the temple was inaugurated. It is stated in the inscription that all the people worked together to build, and rejoiced when this temple was officially established, in 792 AD.

Had been left behind because of a natural disaster that caused Sewu Temple to be buried as a result of its eruption, then researchers searched again for restoration, and in 1992 the main temple was able to return. Stand up straight. Due to the incomplete construction of the building, temple restoration took a long time to build a temple. To produce a complete temple, it is necessary to group the temple stones, even the temple stones must be arranged according to their place, because if the stones are not arranged in the right place, they will not be able to stand as a temple. In the results of the interview, the informant said that the temple stones were not only located around the location but had been found around residential areas. To determine that it is a temple stone, it is necessary to observe according to the procedure. To produce another temple, new stones are needed to fill the void in the construction so that it can stand tall and strong.

3.2. The form of Sewu

Temple Kaki Sewu Temple is divided into three parts, namely the lower framing, the foot body, and the upper framing. On the body of the foot of Sewu Temple, there is a relief with the Purnakalasa motif, which means a flower vase. The flower vase symbolizes fertility and abundant life force from Central Java Cultural Heritage Preservation Center, 2017.

The mathematical concept of Sewu Temple is shown by a building that uses stone in the form of flat shapes and shapes. Most of the temple buildings use stone in the form of square and rectangular flat shapes, although none of them are the same size because the stones used in ancient times were really natural stones of different sizes. To make it easier, the stone is formed into a rectangle. In essence, Sewu Temple is a

decorative temple that is used only as a place of worship, although it is known that it was originally built for Manjusri.

Sewu Temple only has one main temple with the largest size among other temples. The Sewu Temple building, when drawn or viewed from above, will form a square and rectangular shape from the rows of temples (see picture 1). It looks like a square shape, but in the third and fourth rows, it is a rectangular shape. This row of temples is called the Perwara Temple, which surrounds the Main Temple. In addition to the main temple and ancillary temples, there is an Apit temple which is located between the two rows of ancillary temples. The Apit temple has the second largest size after the main temple. The arrangement of the ancillary temples is the first and second rows facing the main temple, while the third row faces the main temple. The position of the Apit Temple faces each other because each row there are two shapes, so for the entire Apit Temple, there are eight buildings finally, which are arranged in the Sewu Temple complex, namely Arca, with the name Drawapala. The Drawapala statue is in the same position as the Apit Temple, only that it is placed at each temple gate because Sewu Temple has four gates.
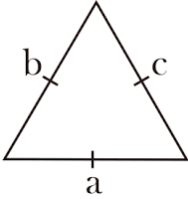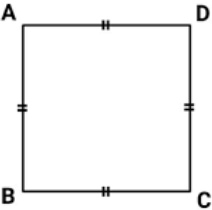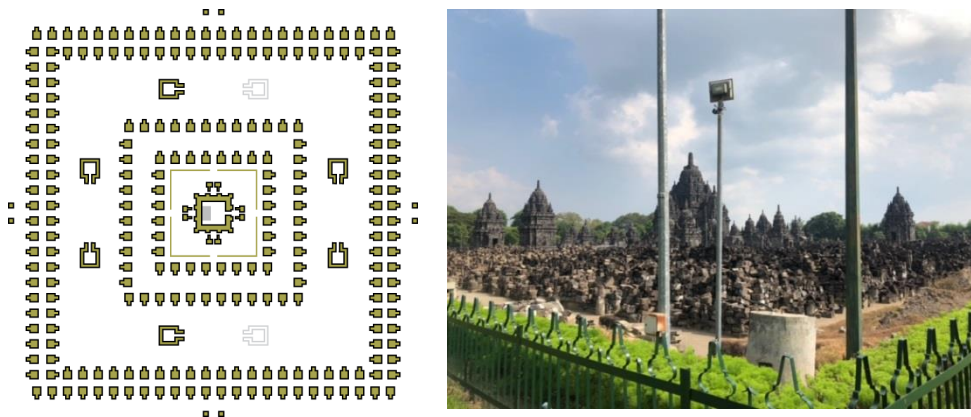

**Figure 1.** Sewu Temple floor plan

3.3.   Ethnomathematics and Math Concept

Seeing Sewu Temple has no reliefs or stories left behind; the researchers found several flat shapes on parts of the temple. The shapes are in the form of triangles, squares, rectangles, trapezoids, and pentagons. Then we also find some mathematical elements such as blocks, cubes, tubes, and pyramids in the space. The ethnomathematics of Sewu Temple related to mathematical concepts will be presented in (**Table 1**) below.

Table 1. Ethnomathematics and Implementation in Learning

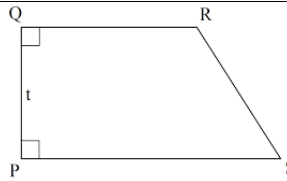| No.	Ethnomathematics	Math Concept
1.		An equilateral triangle is a shape where all sides are the same length. AB = BC = CA Can be called an equilateral triangle with the proof that sides are equal, all angles are equal.
2.		A square is a quadrilateral with all four sides the same length. AB = BC = CD = DA Can be called a square by the proof that all sides are equal, all four angles are equal.
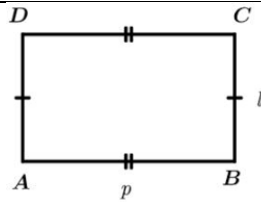
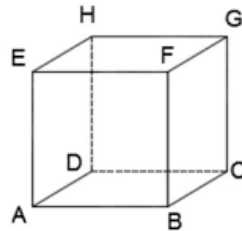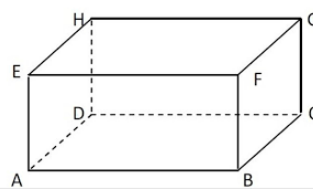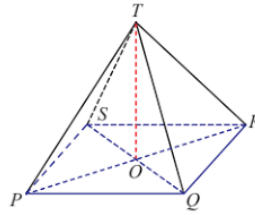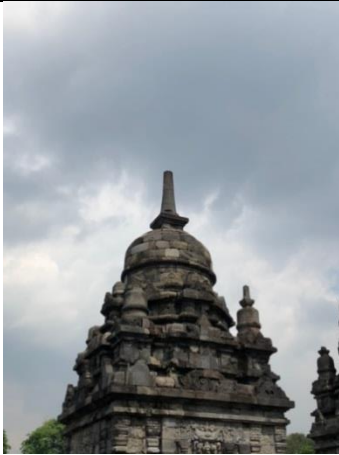| 3. | | | A rectangle is a flat shape that has four sides with both pairs of sides the same length.
AB = CD = p
BC = DA = l
It is called a rectangle if all four angles are equal and the opposite sides are the same length. |
4.			A trapezoid is a quadrilateral with two dimensions, the two sides of which are parallel but not the same length. Can be called a trapezoid if it has a pair of parallel sides but not the same length, all angles are different, and the lengths of the sides are not necessarily the same.
5.			A cube is a geometric shape composed of six squares in three dimensions, so that all sides are the same length. ABCD=BCFG=ADEH=CDGH=EFGH=ABEF Can be called a cube if it has an arrangement of six squares built into space.
6.			A beam is a geometric shape which is formed from three pairs of squares or rectangles that become three dimensions. ABCD = EFGH ABFE = DCGH BCGF = ADHE It is called a cube when it has three pairs of built rectangles.
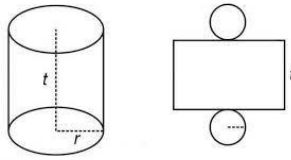
| 7. | | | The tube is a geometric shape formed by two circles (base and lid), then covered with a rectangle that surrounds the circle to make it three-dimensional. Length = circumference = $2\pi r$ Width = tube height = t can be called a tube if the lid and base form a circle |
| 8. | | | A regular square pyramid is a spatial geometry composed of a rectangular base with a triangle as the upright side which then becomes three-dimensional. QRT = upright side PQRS = rectangle OT = t |

Sewu temple has an arrangement of two pairs of squares and two pairs of rectangles (see picture 1). In the first row, there are 28 Perwara Temples, 44 Perwara Temples in the second row, then in the third row, 80 Perwara Temples are arranged, and in the fourth row, 88 Perwara Temples are arranged. This results in a mathematical concept of comparison with a value of 28:44:80:88, which, if all values are divided by 4 then the comparison value becomes 7:11:20:22. This cannot be categorized into a regular comparison pattern because it does not reach a simpler comparison value. Without realizing it, every number in the temple area has an even number. By using the square concept in each building, the Sewu Temples are neatly arranged.

Some of the pictures that the researcher took are of abandoned temple stones (see picture 2), but every stone around the temple has an important meaning for the temple for the restoration process. The stone that has not been arranged into a temple is a stone that is still in the process of placing, because it is not permissible to place temple stones carelessly. The Sewu Temple area has just renovated 24 temples including the main temple, or only one-sixth of the total existing temples, so there are still many temple stones lying around the Sewu Temple area.

Figure 2. Sewu Temple stone

At the time of the interview, the source said that the temple stone could not be left anywhere. the sources concluded that the ancients used cube-shaped stones or blocks to make it easier to arrange. there are

several other shaped stones whose function is to make the temple more beautiful. Because the temple is a place of worship so it requires stones that are sturdy and easy to arrange and lock so that they can last as long as possible standing. for details can be seen in **Figure 3**.

Figure 3. Temple arrangement

In the arrangement of the temple to become a relief, of course, the method used was using stone blocks carved according to the beliefs of the temple at that time to become reliefs mounted on the temple walls. this can be seen in **Figure 4**. this already illustrates that the ancients could think that the making of temples with reliefs arranged on the walls could stand firmly.

Research conducted on Sewu Temple resulted that it turns out that philosophy and mathematical concepts make a phenomenal magnificent building. The beautiful, structured, and unique Sewu Temple building certainly cannot be separated from the existing mathematical concepts. Having a moral and philosophical message in the structure of the temple building that describes the teachings, culture, and reality that cannot be abandoned [15] during the construction period. This relationship inspires an orchestra in the mathematics of life so that the whole concept is united in ethnomathematics.

This study shows the results that there are several mathematical concepts that can be learned from Sewu Temple which is located in Bener Hamlet, Bugisan Village, Prambanan District, Klaten Regency, Central Java, including the concepts of flat shape, spatial structure, and comparison. This proves that the context of Sewu Temple or heritage buildings can be a source of mathematics learning for teachers and students, so that learning becomes interesting. Research related to ethnomathematics for example [8], [12] dan, [16] using multiple real-world contexts, has been reported to make learning motivation more meaningful for study.

The use of the Sewu Temple context has an advantage in learning mathematics, namely that learning becomes interesting for study. In addition, the context used can also be used as a means for teachers to make it fun and for students to learn about past civilizations, so it is hoped that a sense of pride will grow as well as a sense of responsibility to maintain and care for this ancestral heritage. Among them are previous studies, namely research that has revealed that ethnomathematical studies can be used as motivation as a learning tool to make study more interesting.

The results of this study can be used as learning media as well as implementation for students and teachers. The introduction of culture and education makes people understand better and will protect the ancestral heritage, especially since it has become a world heritage **[14]**, **[10]** dan, **[12]**.

4. CONCLUSIONS

The conclusions that can be drawn based on the results and discussion that have been explained are as follows: (1) Sewu Temple is a temple that embodies the people's love for Manjusri. Manjusri himself is a teacher for bodhisattvas. Then Sewu Temple was used as a means of worship only. Sewu Temple is a Hindu temple, so there are no reliefs or stories on the temple walls. It is known that Sewu Temple was discovered by local people after being buried by volcanic ash from the eruption of the surrounding mountain, because the shape of the temple was not intact, it was rebuilt or restored and the Main Temple was successfully established in 1992. (2) Sewu Temple has several mathematical aspects in geometry material. Wake up like triangles, squares, rectangles, and trapezoids to get flat, then in the wake of space there are cubes, blocks, tubes, and square pyramids. Not only geometric shapes, another aspect is that there are comparisons. (3) The community's mathematical thinking process about how to make Sewu Temple. The form of placement of the temple produces a rectangular shape using various forms of stone that can become a solid building. (4) Some of the things found in Sewu Temple can be used as a source of learning mathematics for study.

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