

Exploration of the Heroes Monument Monument of Surabaya City Based on Ethnomathematics as a Learning Resource for Junior High School Geometry

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ABSTRACT

Mathematics is an abstract concept that is considered difficult and boring by students to learn. One study that links math and culture is called ethnomathematics. Learning with an ethnomathematics approach can explore more deeply between culture and mathematics. This research aims to explore the ethnomathematics contained in the Surabaya City hero monument monument and produce a book as a learning resource related to ethnomathematics at the hero monument monument. This type of research is descriptive qualitative with data sources obtained from observations, interviews, literature and documentation related to the Surabaya City hero monument monument. The results showed that the mathematical concepts contained in the Surabaya City hero monument monument include design activities and junior high school level geometry. Design activities include identifying building models that have mathematical aesthetics and junior high school level geometry in the area of the hero monument monument including isosceles triangle, square, trapezoid, and circle. Furthermore, the building space includes a pentagonal prism, rectangular pyramid, cone and tube.

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1. Introduction

The development of science and technology is advancing from year to year. As the young generation of Indonesia, understanding and preserving local culture needs to be done. Given that culture has a positive impact ranging from character, habits, behavior so that it has a great influence in everyday life. Technological

advances are gradually eroding local culture, increasingly sophisticated tools make it easier for humans to carry out work so that traditional culture or habits are considered ancient and finally abandoned. As a result, ethics and character in society will decrease due to the influence of technology. In the current era of globalization and technological advances, the threat to the destruction of the local cultural order is increasingly real if not balanced with cultural preservation (Setyaningrum, 2018). According to Taylor, culture has a complex nature that includes knowledge, beliefs, customs, morals, arts, laws and all the abilities and habits acquired by a person as a member of society. (Prayogi & Danial, 2016). Culture has a very strong relationship with education in structuring life. That way as the next generation of the nation, cultural preservation can be done through education.

Education as a protector of culture while culture as a philosophy of education, because in essence education has an important role in shaping cultured humans (Zahroh, 2020). The results of observations and interviews conducted by researchers to several teachers at all levels of Bojonegoro schools, there are still few who apply culture-based learning, one of which is mathematics. This is because teachers are already motivated by existing books, learning videos, besides that teachers are also required to meet target achievements according to lesson plans so that time is limited if students do culture-based learning. Cultural preservation in education can be done through math lessons. Mathematics lessons are still considered difficult to understand so that many students avoid mathematics. In reality, current mathematics learning still uses traditional learning that is still teacher-centered so that students do not have the opportunity to develop new ideas, creativity and problem solving. In the end, students only understand concepts without knowing and understanding their meaning (Shoffa, 2016). According to research conducted by Masykur and Fathani in (Hidajat, et al., 2019) stated that the mastery of students in the field of mathematics at all levels of education is still 34%. Even though math lessons can be learned and understood through various ways such as traditional games, exploration of a custom and culture, problem solving and others. Basically, mathematics is not only limited to formulas that are written and then problems that are done through sheets of paper, but actually it is embedded in the human mind and then processed and practiced through the human senses in real activities in everyday life.

The city of Surabaya has a wide variety of cultures and historical buildings. Cultural arts include ludruk, kidungan, remo dance. The historical buildings in Surabaya city include majapahit hotel, red bridge, internatio building, tugu pahlawan monument, siola building, grahadi building, and kalisosok prison. Tugu Pahlawan monument is a famous icon of Surabaya city. Set against the backdrop of the history of the struggle to defend Indonesia's independence in the city of Surabaya. The hero monument was built as a form of remembrance of the events that occurred (Halim & M.Arch, 2013). This monument was built in order to give the highest honor to all the soldiers who had fallen in the great encounter to fight the tribal soldiers who were hitchhiking by NICA. At that time wanted to occupy the Surabaya area on November 10, 1945. This monument as a promise of building culture with strategically located because it is in the center of Surabaya City.

Mathematics is referred to as knowledge that is universal and is the basis of

science and technology (Fitria Utami, et al., 2020). Mathematics has a role in advancing the human mindset in solving problems that occur in life so that it can be said that mathematics is a very important science. Thus math is very embedded in everyday life and human activities, such as work, at home, and culture. However, sometimes they do not realize that they have done mathematical activities both in economic and social terms. This happens because mathematics develops through the thinking process. It takes a way to link math and culture in everyday life called ethnomathematics.

Ethnomathematics contains multicultural mathematical ideas consisting of symbols, traditional cultural values, traditions and procedures that have the aim of helping people in learning mathematics (Safina & Budiarto, 2022). Mathematics that was born and developed from a cultural value in society is then used as a learning resource or teaching method. The existence of ethnomathematics can facilitate the process of learning mathematics so that it is easy to understand. The beginning of ethnomathematics was introduced by D'Ambrosio in 1977, a mathematics teacher from Brazil. In (Ekowati, et al., 2017) D'Ambrosio states that *Ethnomathematics* is the study of mathematics that pays attention to cultural considerations where mathematics arises by understanding the reasoning and mathematical systems they use. Ethnomathematics learns from culture, understanding the use of concepts and practices contained in culture.

In connection with this, this research problem is focused on analyzing the various forms of geometry at the junior high school level in various buildings in the Tugu Pahlawan Monument Surabaya City. This is done to enrich mathematics learning materials, especially in junior high school level geometry materials, and students can understand contextual problems to be closer to the surrounding environment. Geometry is a branch of mathematics that was born for centuries from the real conditions of the daily life of a group in society. Geometry studies the relationship between points, lines, and planes so that it can be formulated into various notions, namely flat buildings, flat-sided spaces, and curved-sided spaces. Various types of geometry can be found in the Surabaya City Heroes Monument building. The building also involves the concept of symmetrical strength and beauty. Based on the above description of the relationship between culture and mathematics, this study aims to explore ethnomathematics on the monument to the Surabaya city heroes.

2. Method

Based on the background and objectives of the research that has been described, this research is classified as descriptive qualitative with an ethnographic approach. The definition of ethnography comes from the words "ethno" meaning nation and "graphy" meaning to describe. It can be said that ethnography aims to describe culture as a whole, both material in the form of artifacts and abstract in the form of experiences or beliefs. With this the ethnographic approach is a method that identifies, describes, and explains various human characteristics that are general to specific (Ramdiani, 2014). The ethnographic approach is carried out to describe the state of a phenomenon or event systematically in accordance with reality. Through this study, researchers tried to reveal how ethnomathematics is contained in the Surabaya city hero monument monument through exploration as a mathematics learning resource in junior high school geometry material.

This research was conducted at Tugu Pahlawan Monument, Surabaya City. Data collection techniques in this study used observation methods, interviews with research instruments in the form of observation sheets and interview sheets. The observation method was carried out by researchers at the location of the hero monument and the interview method was carried out by researchers to resource persons, namely educational guidance staff, conservation and curatorial of the Surabaya City hero monument.

This research began with the step of examining and determining the problems that became the focus of the research then continued with the making of observation sheets and interviews. Both instruments were validated by two validators, namely a lecturer in mathematics education at Muhammadiyah University of Surabaya and a teacher at MTs Muhammadiyah Banjaranyar Baureno Bojonegoro. Next, data collection was carried out by conducting observations and interviews with sources. The data obtained will be analyzed using the triangulation method, namely source triangulation and method triangulation.

3. Results and Discussion

The research that has been carried out has succeeded in identifying various forms of ethnomathematics at the research location, namely the Surabaya City Heroes Monument. The following will present descriptively the results of observations and interviews regarding ethnomathematics at the Surabaya City Heroes Monument. The parts that contain ethnomathematics are the colonade gate, the hero monument, and the November 10 museum.

a. Symbol of the Flame of Struggle

The symbol of the flame of struggle is a collection of images of the trident, chakra, stambha, and padmamula weapons framed in a gunung formation. The term trident means a weapon often used by Arjuna in puppetry with the meaning of power, strength, and destruction in evil. The term chakra in Sanskrit means circle. In the context of religious spirituality, chakra refers to the energy center in the human body which in life has an influence on physical, emotional and spiritual well-being. The term stambha in Sanskrit means pillar or pole. The stambha symbol is used to symbolize stability, strength and grandeur. The term Padma means the place of the seed as the origin of man which gives birth to resources, strength, and courage.

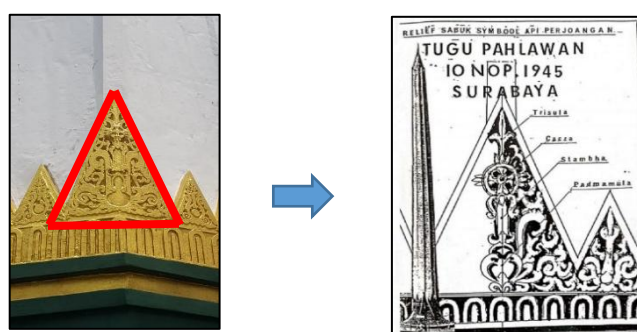


Figure 1. The symbol of the flame of struggle

The four weapons are arranged to form a symbol of fire as a symbol of struggle. The symbol of the blazing fire at the bottom of the hero monument

gives the meaning of the spirit of the Surabaya youth never going out in defending independence. The blaze symbol forms a triangular pattern because the nature of fire tends to spread radially and form regular angles.

When a fire burns fuel such as wood or other materials, the heat and gas generated will rise upwards to form a tapered flame. As this tapered flame moves upwards, the heat generated makes the surrounding air rise. The combination of the rising air and the continuous supply of oxygen to the fire creates a regular flow of air, resulting in certain patterns in the flame. One pattern that often forms is a triangular pattern. This occurs because the heat and rising air flow form three clearly defined sides of a triangle. These sides meet at the fire point, which is the source of the heat.

The shape of the flame symbol has 2 equal sides, 2 equal angles, and 1 axis of symmetry. From the picture, it can be seen that the symbol of the flame of struggle contains the concept of a triangular flat building.

b. Metal Proclamation Text Sheets

Sheet metal is a thin sheet made of metal, such as steel, aluminum, copper, or other metals. Sheet metal is often used in industry and construction for a variety of applications, including the manufacture of building materials, vehicles, industrial equipment, and more. Sheet metal has a fairly high strength and durability, while remaining flexible and moldable according to requirements. This allows sheet metal to be bent, cut, or given shape in a variety of ways to meet specific design and application requirements. Sheet metal is often used as a base material for the construction of various components and structures, as well as a material for manufacturing panels, protective sheets, or decorative surfaces. The flexibility and easy-to-work-with properties of sheet metal make it a popular choice in the manufacturing and construction industries.



Figure 2. Metal Proclamation Text Sheet

The sheet metal containing the proclamation text forms a square pattern. This is done to obtain visual clarity of the content of the proclamation text itself so that it is easily highlighted by the eyes of visitors, because the existence of the proclinator statue is located at the southern gate of the entrance to the monument area of the Surabaya City hero monument. Figure 2 has a flat, square element. A square is a geometric shape that is symmetrical and easily recognizable, so the use of a square in the representation of the proclamation text can help convey the message more clearly and stand out. The flat square pattern formed is evident from the four parallel sides of the sheet metal with corners that form right angles.

c. Museum 10 November

The Museum 10 November was established to support the data and literacy center of the history of the 10 November battle as well as the surviving relics. The Museum 10 November is placed between the railroad embankment and the hero monument; it is considered that it is closer and represents the events of the battle against the invaders. The Museum 10 November which is conceptualized as "Sinking" is a tribute to history, this is done to save and protect cultural heritage. Furthermore, the concept of submerging the museum is done to protect the environment, this concept means not disturbing the scenery and natural characteristics that exist at ground level. By submerging the museum, it can directly integrate with the surrounding environment and still maintain the beauty of nature. Furthermore, the concept of submerging the museum is symbolism or unique experience, because with this concept it will attract visitors because it is unique and interesting. In addition, it can involve traveling to buildings that are located below the surface, which creates a sense of mystery or wonder. The concept of submerging the museum is done so that its existence is more monumental and undisturbed. Although the placement of the museum floor is submerged it has a strong symbolic meaning. Given that the period of struggle has passed and is past. However, this does not mean that the struggle has sunk.



Figure 3. Museum 10 November

The 10 November Museum has non-parallel and parallel sides; this illustrates strength and stability as the two parallel sides provide good support and balance. Furthermore, the November 10 museum has a less common shape compared to other museums. So that the shape of the on-Museum 10 November shows diversity and creativity. Figure 3 on Museum 10 November looks to have a flat element, namely the Trapezoid. The Museum 10 November building is interesting and unique, because its shape is not too symmetrical with different angles and can provide an interesting and striking aesthetic appeal. Furthermore, the emphasis on angles and lines, the Museum 10 November has sharp angles and strong lines.

d. Chakra

The chakra is one of the ornaments found on the hero monument at the bottom arranged on the symbol of the flame of struggle. The chakra is used as a melee weapon, and is often dropped or thrown at the enemy. It can be thrown with great speed and precision, and has cutting and piercing capabilities. The chakra is a very effective weapon in combat, mainly due to its speed and cutting ability.

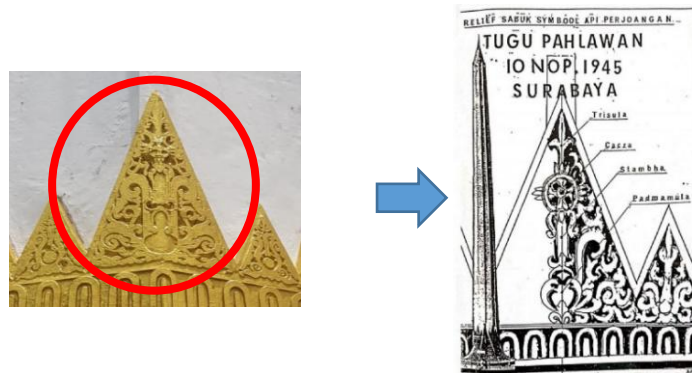


Figure 4. Chakra

A disc can be identified with a circular flat shape because it is a circular disk. A circle is a type of flat that has all points around it equidistant from its center. A disc has edges that are circular and symmetrical, with a center that is the center point of the circle. The diameter of a disc is the distance that crosses the center and connects two points on its edge. The radius of a chakra is the distance from the center to its edges, and the perimeter of a chakra is the curved length of its arc. Another flat shape related to a chakra is a concentric circle. Concentric circles are a series of circles with the same center but different radii. Some chakras can have designs with concentric circles that give them an interesting and artistic look.

e. Heroes Monument Torch

The torch of the hero monument is built around the hero monument which stands towering upwards. There are 10 torches surrounding the hero monument, which has a very philosophical meaning. As the number 10 symbolizes the battle that occurred on November 10, 1945. The torch means that the fire of the Indonesian people's struggle on November 10, 194 will remain for all time. The torch is only lit every November 10 hero ceremony with the intention of providing momentary light at the time of holy reflection which reminds the seconds of the battle against the colonizers.



Figure 5. Torch Base of the Hero Monument

The torch pedestal of the hero monument has a unique shape and is not commonly found in traditional architecture. This shape may contain symbolic meaning or represent the unique identity of the building. This philosophy can reflect the desire to create a distinctive impression and distinguish the building from others. Furthermore, it has mathematically defined proportions. Each corner and side has a proportional relationship that can give a sense of harmony and visual aesthetics.

The base of the hero monument torch has five sides that are connected to form a certain pattern. Furthermore, it has two pairs of parallel sides that are opposite sides, then the two opposite sides of the base are always parallel. The visual pedestal of the torch also shows symmetry and consistency in its shape. A line of symmetry can be drawn in the center of the base to divide it into two symmetrical parts. Furthermore, the base of the torch hero monument is also combined with the sides that connect it, a three-dimensional space is formed.

f. Museum Roof

The roof of the museum has a function as an aesthetic element of the outer envelope of the roof of the November 10 museum building. Functionally, the roof of the museum is used as a place for utility lights that emit red color, so that the roof of the museum gives the impression of a pile of embers that are "smoldering" not just lit. The lights are turned on only during the day, while during the day the pyramid elements together appear as a compound triangle. The rectangular pyramid shape that is "smoldering" at night also symbolizes the spirit of Surabaya's *arek-arek* during the struggle. It is hoped that the embers will remain burning in the chests of the nation's next generation of youth.

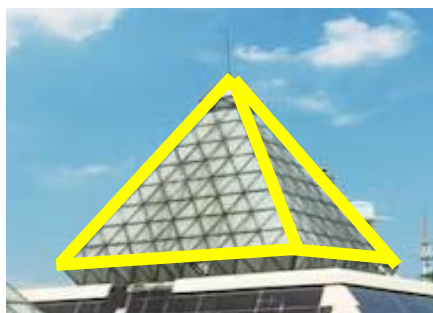


Figure 6. Museum roof

The roof of the museum has a high and prominent structure which can create a strong and impressive visual impression, giving the building a sense of grandeur and greatness. It then narrows upwards, creating a visual convergence. This directs the observer's gaze to the top of the building or the focal point at the top. In addition, the philosophy of narrowing upwards can be used to attract attention and emphasize the important points or features of the building. The roof shape of the museum shows stability and balance. The wider base at the bottom provides a strong foundation, while the sides that tend to narrow upwards create a sense of visual balance.

The museum roof has a square base and sides that narrow to the peak. Furthermore, the sides of the museum roof at the top meet at one point which is the peak. The museum roof also has a square base and shows symmetry and

consistency in its shape, this can be seen when the square base and sides narrow consistently towards the peak.

g. Top of the Heroes Monument

The building model of the hero monument resembles upside-down nails that have a deep meaning and philosophy. The philosophy of the inverted nails on the hero monument means that the courage of the Surabaya *arek-arek* in fighting the invaders to defend Indonesia's independence. In addition, the existence of this hero monument is to remind us of the services and sacrifices of the heroes of Indonesian independence on November 10, 1945 until the end of time. At the top of the monument or the tip of the cone-shaped nail is equipped with red lights and lightning rods so that it looks at the tip of the hero monument there is an antenna. The diameter at the top (the tip of the nail) is 1.3 meters.



Figure 7. Peaks of the Hero's Monument

The peak of the hero monument is in the shape of a curved-sided space. The meaning of the peak of the monument narrowing towards the top is often associated with a spiritual journey or elevation. The peak of the hero monument can symbolize the goal or perfection achieved through a spiritual journey or quest for knowledge. This is in line with the events of the November 10 battle. The journey against the invaders at that time was intended to defend Indonesian independence in the city of Surabaya. Furthermore, the conical top of the monument is interpreted as focus and emphasis, as well as the philosophy of the inverted tip of the nail means emphasis that the spirit of the Surabaya youth on November 10 was very fiery and unstoppable because of their desire for independence. The top of the hero monument symbolizes stability, then there are many natural symbols such as mountains, trees, pyramids which provide deep meaning and connect the building with cultural heritage.

The peak of the hero monument has a shape that resembles a tapered tip, the surface of the peak of the monument narrows to a point which is the peak. Furthermore, the top of the monument has a very sharp angle, this sharp angle shows that the top of the monument tapers sharply to a single point. When the top of the monument is combined with the stem part of the monument, a three-dimensional space is formed.

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4. Conclusions

Based on the results of the exploration carried out by researchers at one of the historical places in Surabaya City, namely the hero monument monument, it can be concluded that ethnomathematics is a science that combines the concept of mathematics with culture. The ethnomathematics studied by researchers is about what mathematical concepts exist in the Surabaya City hero monument monument area.

Based on the history of the establishment of the hero monument, it stems from the great battle that took place in the city of Surabaya, especially in the Kenpeitai building, the former headquarters of the Japanese colonizers. The incident occurred when the youth of Surabaya City had a great and strong desire to liberate Indonesia, especially in the city of Surabaya, which at that time was still controlled by Japan. In this event, many fighters died and on November 10, 1945, it was named National Heroes' Day. After seeing the ruins of the kenpeitai building destroyed, President Soekarno gave an idea to Doel Arnowo as the mayor of Surabaya City to erect a building that could be used as a reminder of the battle in Surabaya. Finally, the Heroes Monument was established as a historical place to commemorate the fighters who had died at that time.

Ethnomathematics at the hero monument is created from the building model around the monument area. The results of the study found that there is a mathematical concept of identifying. Identifying activities can be found in several buildings that are related to junior high school level geometry such as flat shapes, flat side spaces and curved side spaces. Junior high school level geometry found by researchers as follows, flat shapes are isosceles triangle, square, trapezoid, and circle. Furthermore, the concept of flat-sided space is a pentagonal prism and a rectangular pyramid. Then the concept of curved-sided space, namely cones and tubes.

By exploring the monument of Surabaya's hero's monument, researchers can find mathematical concepts around the monument area. So, it can be concluded that mathematics is so close to culture because mathematics can be learned through culture according to the area in the environment. The relationship between mathematics and culture is called ethnomathematics, so ethnomathematics can be used as an innovative learning resource for teachers.

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