EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 2, 2025. 865-876
DOI: https://doi.org/10.24127/emteka.v6i1.7802

e-ISSN 2746-5594
p-ISSN 2746-5608

EXPLORATION OF ETHNOMATHEMATICS AND GEOMETRY ON TOURISM ARTIFACTS OF LEANG-LEANG PREHISTORIC PARK, MAROS REGENCY, SOUTH SULAWESI

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Received 15 June 2025; Received in revised form 25 August 2025; Accepted 30 September 2025

ABSTRAK
This study focuses on the exploration of mathematical concepts and cultural values in the Leang-Leang prehistoric park tourism which is still well preserved until now. The purpose of this study is to explore and understand the mathematical concepts of geometry contained in the artifacts of the Leang-Leang prehistoric park tourism located in Bantimurung District, Maros Regency, South Sulawesi. The research method used is qualitative research with an ethnographic approach. The stages of this research begin with conducting a study, compiling instruments, collecting data through observation, and interviews. Data collection techniques in this study are observation, interviews, and documentation. The main instrument in this study is the researcher himself, while the tools used are observation guidelines, interview guidelines, and documentation. The results of the study show that there are various geometric shapes, such as ocher, sus celembis, Maros arrowheads, depictions of human fossils at that time, adze and ike stones, bracelets and currency, and fossils. The mathematical concept applied to this tour is the concept of flat shapes, such as squares, rectangles, triangles, isosceles triangles, circles, and ellipses.
Keywords: ethnomathematics; exploration; mathematical concepts; prehistoric tourism

ABSTRACT
Penelitian ini berfokus pada eksplorasi konsep matematika dan nilai budaya pada wisata taman prasejarah Leang-Leang yang hingga kini masih terjaga kelestariannya. Tujuan penelitian ini adalah untuk mengeksplorasi dan memahami konsep matematika geometri yang terdapat pada artefak wisata taman prasejarah Leang-Leang yang terletak di Kecamatan Bantimurung, Kabupaten Maros, Sulawesi Selatan. Metode penelitian yang digunakan adalah penelitian kualitatif dengan pendekatan etnografi. Tahapan penelitian ini diawali dengan melakukan kajian, menyusun instrumen, mengumpulkan data melalui observasi, dan wawancara. Teknik pengumpulan data dalam penelitian ini adalah observasi, wawancara, dan dokumentasi. Instrumen utama dalam penelitian ini adalah peneliti sendiri, sedangkan alat yang digunakan adalah pedoman observasi, pedoman wawancara, dan dokumentasi. Hasil penelitian menunjukkan bahwa terdapat berbagai bentuk geometri, seperti oker, sus celembis, mata panah maros, penggambaran fosil manusia pada masa itu, batu adze dan ike, gelang dan mata uang, serta fosil. Konsep matematika yang diterapkan pada wisata ini adalah konsep bangun datar, seperti persegi, persegi panjang, segitiga, segitiga sama kaki, lingkaran, dan elips.
Kata Kunci: *eksplorasi; etnomatematika; konsep matematika ; wisata prasejarah*

Introduction

e-ISSN 2746-5594
p-ISSN 2746-5608

Mathematics is a science that can be connected to humans, because every science requires mathematics which functions as a basis for many other fields. (Fitriyah & Syafi'i, 2022). Mathematics is a symbolic concept that develops and grows through cultural and environmental actions and skills. Existing mathematical knowledge can be enhanced with the concept of ethnomathematics. (Destrianti, 2019). According to Djafar et al (2024) is essential to acquire mathematical literacy skills. To justify situations involving numeracy, graphing, and geometry and to communicate mathematically, students must be able to estimate, evaluate data, and even solve realistic problems. Connecting the study of mathematics to real-world situations, local cultures, or ethnomathematics is an engaging and innovative way to engage students in the subject (Simbolon, 2020).

Ethnomathematics in mathematics education is a new field of study that has great potential because it can innovate teaching materials with the aim of introducing Indonesian culture to students.(Alfiya & Rohmah, 2024) The term "ethnomathematics" was originally used by D'Ambrossio. He himself was a Brazilian mathematician. The word ethnomathematics, which consists of three syllables ethno, mathema, and tics, is the origin of the term ethnomathematics. An identifiable cultural group, such as an ethnic group in a country or a class of people's occupations, which includes language and daily life, is denoted by the prefix ethno. While tics refers to the art of engineering, mathema refers to the explanation, understanding, and manipulation of real objects, especially through calculation, measurement, classification, ordering, and modeling of environmental patterns.(Pathuddin & Raehana, 2019). Ethno is defined as all the elements that form a person's cultural identity, such as language, codes, jargon, values and beliefs, food and clothing, and environmental customs. (Dr. Lalu Muhammad Fauzi, 2022).

Ethnomathematics is a form of mathematics that is influenced or based on culture. (Mulyani & Natalliasari, 2020). This creates opportunities in mathematics education to use local contexts and to enhance critical reasoning and student interest by rediscovering the mathematics needed. in the student culture that exists in their environment to gain benefits from it (Prahmana et al., 2021). One of the mathematical concepts that is close to everyday life is the concept of geometry. (Andriliani et al., 2022). Geometry is a branch of mathematics that was born centuries ago from the real conditions of daily life of a group in society. Geometry studies the relationship between points, lines, and planes. From these three elements, various definitions of flat shapes can be formulated, such as rectangles, triangles, isosceles triangles, circles and ellipses. (Medyasari et al., 2019). In mathematics education, ethnomathematics is a very promising new field of study because it can be used to innovate teaching materials with the aim of educating students about Indonesian culture. (Diniyati et al., 2022). The ethnomathematics aspect includes concepts, symbols, beliefs, and so on. Mathematical concepts seen in everyday life have an impact on formal mathematics education in schools. (Nursyeli & Puspitasari, 2021). Ethnomathematics is important because in every culture there are mathematical elements that can be used by teachers as a learning medium for students (Sari et al., 2021).

Ethnomathematics means mathematics applied by certain groups of people, including urban and local communities, indigenous communities, groups of working

e-ISSN 2746-5594
p-ISSN 2746-5608

class children from certain social classes, and so on.(Fitriyana & Mariana, 2022). According to Izah & Malasari (2021) Ethnomathematics in mathematics education will provide a new perspective that mathematics learning is not limited to one culture. Ethnomathematics also investigates mathematics through travel and interaction with ethnomathematics subjects, namely local tourism. It can also be interpreted that mathematical concepts can be explored and found in culture, thus further clarifying that there is a relationship between mathematics and culture. The ability to think and act from an individual depends on his ability to interact or communicate with his socio-cultural conditions (Ichsyantianawati & Kartika, 2023).

Cultural diversity is preserved so that it continues to grow and is not easily forgotten, as many people are currently embracing new religions that originate abroad in order to counterbalance Indonesian culture (Putri Yolanda, 2024). The application developed contains elements of local Lampung culture which motivates students to love local culture and preserve local Lampung culture (Sugiharti et al., 2025). Tourist destinations that incorporate mathematical ideas in a particular culture are the subject of ethnomathematics. Tourist objects are everything in a tourist destination that attracts visitors (Adolph, 2023). As is the case, the researcher's research conducted at the Leang-leang Prehistoric Park tourism located in Bantimurung District, Maros Regency, South Sulawesi. South Sulawesi Province is one of the areas that has a variety of tourism potential, including one of them in the Maros Regency area. Based on its geographical strategy, Maros Regency has a very strategic location so that it is possible to develop various tourist villages (Rusnaeni, 2021). Researchers link the concept of geometry with ethnomathematics in the prehistoric tourism artifacts of Leang-leang Maros Park. Geometry content is one of the areas of mathematics education that has a strong relationship with culture and ethnomathematics.

According to Shirley, currently ethnomathematics is the main focus in the learning process and mathematics teaching methods that emerge and develop rapidly in society in accordance with existing local cultures (Kholisa, 2021). Furthermore, Ethnomathematics can be applied as a form of approach to provide an understanding that mathematics is actually adapted from a culture that exists in society (Kurino & Rahman, 2022). Ethnomathematics studies explore and identify mathematical concepts contained in cultural heritage, as a form of local wisdom that can be linked to mathematics learning in schools (Hidayati et al., 2025). Ethnomathematics studies the relationship between culture and the application of mathematics contained in that culture (Latifah Fitriana Rahmah, 2022).

Several studies have been conducted on the exploration of ethnomathematics in tourism, and the results of these studies show that there are mathematical concepts in tourism that have been studied by researchers, such as: Nurazizah & Nuryami (2024) entitled "Ethnomathematics Exploration on Papuma Jember Beach Tourism", shows that there is a mathematical concept on Papuma Jember Beach tourism. The mathematical concept applied to this tourism is the concept of spatial figures. The spatial figure concepts applied are cones, pentagonal prisms, cylinders and blocks. Furthermore, the research Simbolon (2020) entitled "Ethnomathematics at Taman Wisata Iman Sitinjo and Its Relation to Mathematics Learning in Schools", shows that there is a mathematical concept applied to this tour, namely the concept of flat shapes. The flat shape concepts applied are triangles,

e-ISSN 2746-5594
p-ISSN 2746-5608

rectangles, circles and octagons. This tour also provides knowledge of the relationship between ethnomathematics and mathematics learning in schools.

Research on ethnomathematics has grown rapidly in recent decades. Several previous studies have shown that various cultures around the world apply mathematical concepts in their daily lives, which are reflected in art, architecture, and traditional skills. Research on ethnomathematics in Indonesia, especially those focusing on the application of geometry in cultural artifacts, already exists, but is still limited and focuses more on artifacts from certain regions that are better known in ethnographic and cultural contexts. In addition to providing information for the local community, this research also plays a fairly important role in learning in schools(Afifah et al., 2020). Thus, "Ethnomathematics Exploration of Geometry in the Leang-Leang Prehistoric Park Tourism Artifacts, Maros Regency, South Sulawesi", is the title given by the researcher for this research.

Previous relevant research has focused more on cultural and historical aspects, but has not investigated in depth the relationship between the geometry found in these artifacts and the mathematical concepts taught in formal education, as explained in the context of ethnomathematics. Artifacts in the Leang-Leang Prehistoric Park, which contain various geometric shapes such as squares, rectangles, triangles, and circles, have not been widely explored in ethnomathematics literature for applications in mathematics learning in schools. Therefore, in order to make mathematics learning more enjoyable, one way is to develop culture-based mathematics learning (Salsabila & Soebagyo, 2023).

Research Methods

The type of research used in this study is qualitative research with an ethnographic approach. The ethnographic approach is used to understand the geometric concept contained in the Leang-Leang Prehistoric Park tourist artifacts. According to Citriadin (2020) Qualitative research is a phenomenon or event that occurs in a particular social situation. According to Ummah (2019) Ethnography is the writing or reporting of an ethnic group or other culture by an anthropologist based on months or years of fieldwork. The main tools used in this research are the researcher as planner, data collection tools, and data analysis tools.

The data collection techniques in this study are: 1) Observation, the researcher has conducted research on the form of artifacts, geometric patterns that appear, and the relationship between artifacts and cultural aspects that support the concept of ethnomathematics. 2) Interview, the researcher has conducted an interview with one of the managers of the Leang-Leang Prehistoric Park who has a deep understanding of the tour. 3) Documentation, the researcher uses images to provide information about the artifacts in question. The data analysis technique used is technical triangulation, namely interviews with the tourism manager regarding several artifacts to ensure the validity of the data information obtained related to the geometric concept in several artifacts of the Leang-leang Prehistoric Park, Maros Regency. Technical triangulation is carried out to strengthen or compare the results found during the interview to ensure that the data collected is more comprehensive and can reduce bias that could arise from using only one method.

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Results and Discussion

Leang-leang Prehistoric Park is one of the most popular tourist destinations in Maros Regency, South Sulawesi. As the name implies, this location offers educational opportunities and information about the way of life of ancient people in the past. At this location, visitors can observe various signs of ancient human growth that have reached a significant age. Examples include handprint paintings on cave walls, pictures of deer pigs, and many fossils and artifacts. However, there are several other discoveries indoors, while in order to maintain the various fossils and ancient artifacts found. Visiting the Leang-leang prehistoric park can serve as a means to foster a sense of togetherness among family members and children. In addition to being a tourist attraction, this location can also teach children about the customs of the ancient community. Leang-leang Prehistoric Park is located in Leang-Leang Village, Bantimurung District, Maros Regency. It is not far from the Bantimurung National Park area, Maros. This tourist attraction is located in the Bantimurung-Bulusaraung National Park area, in the Leang-Leang Prehistoric cluster, located in Leang-Leang Village, Bantimurung District, Maros Regency. It is located in the Bantimurung National Park area, Maros. This tour is located in the Bantimurung-Bulusaraung National Park area, in the Maros-Pangkep karst mountain range, which is the largest karst area in the world after Guangzhou, China. In simple English, the word "leang-leang" means "cave". This is the word liang which means "hole". There are many unique and fascinating prehistoric archaeological sites of ancient humans in this location. According to archaeologists, the caves found here were first discovered by humans between 3,000–8,000 years ago. It is said that there are around 40 cave locations in this area. Several Images Of Artifacts At The Leang-Leang Maros Prehistoric Park are as follows Figure 1:

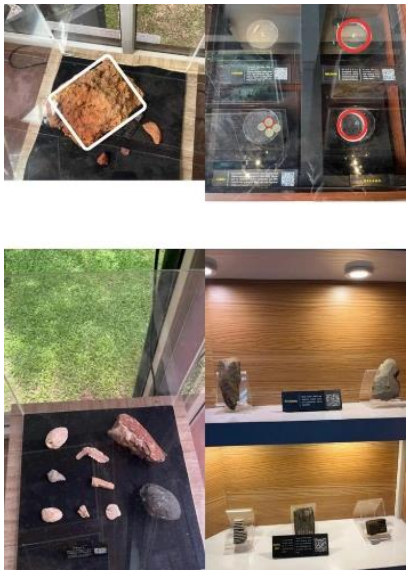

Figure 1, Several Images Of Artifacts At The Leang-Leang Maros Prehistoric Park

In addition to consisting of historical caves, the Leang-Leang Maros Prehistoric Park also consists of a large and beautiful park. Visitors can enjoy the stunning views of the surrounding landscape with several karst formations of all shapes and sizes.

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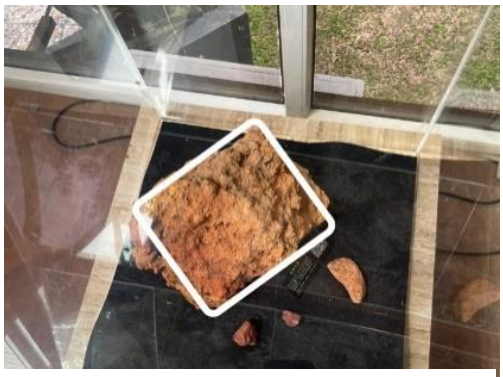
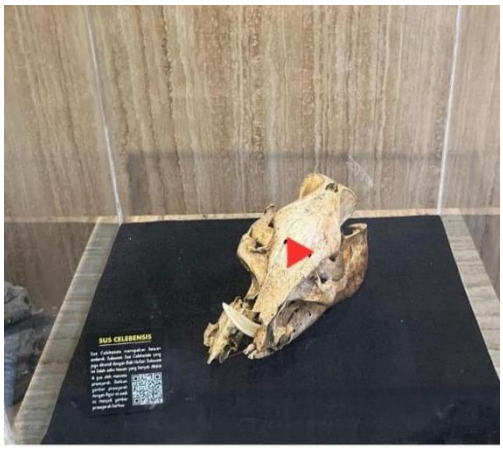
p-ISSN 2746-5608

The park facilities are explained in detail with each path that visitors can use to explore this area. In addition, there is a gazebo that can be used to enjoy the natural atmosphere peacefully. The beautiful natural scenery makes this location a favorite for taking pictures. Not many people choose this Leang-leang location for pre-wedding photos. The karst cliffs, which consist of solid towering in the sky, are photographed and the results are beautiful and beautiful. Very good for sharing and promoting on social media.

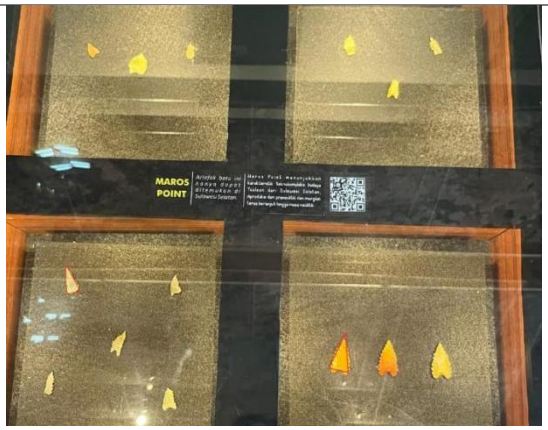
Leang-leang prehistoric park tourism in Maros Regency has become a favorite place among the community, both local people and foreign people who come to visit the tour. The number of visitors who come to visit the tour is because of the many interesting photo spots and the many vloggers who explore the caves in the tour. Then, the mathematical aspects that can be adapted from this study are explained in the following Table 1:

Table 1: Several artifacts forming geometry in the Leang-Leang Prehistoric Park, Maros Regency, South Sulawesi

No	Picture	Cultural Concept
1.	 Picture 2: Oker	Ochre, is a natural dye used by prehistoric humans for their wall paintings.
2.	 Picture 3, Sus Celembis	Sus Celembis, is an endemic animal of Sulawesi. Sus Celembis which is also known as the Sulawesi Wild Pig, is one of the animals that are often painted in caves by prehistoric humans. Even the prehistoric picture with this figure is currently the oldest prehistoric picture.

e-ISSN 2746-5594
p-ISSN 2746-5608

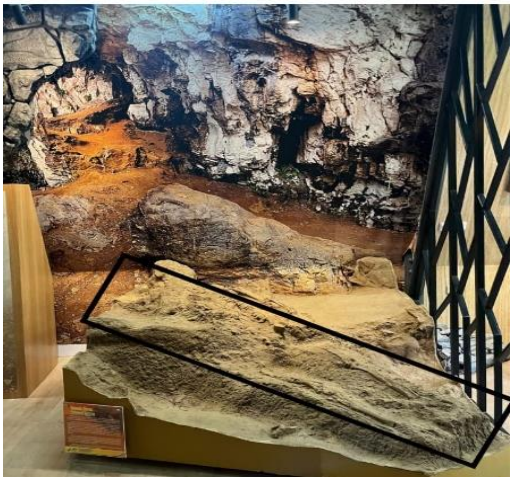
3.



Maros Point, is a stone artifact that is only found in South Sulawesi. Maros Point shows the characteristics of the Toalean culture technocomplex from South Sulawesi, produced from the preneolithic and possibly continuing the neolithic period..

Picture 4, Maros Point

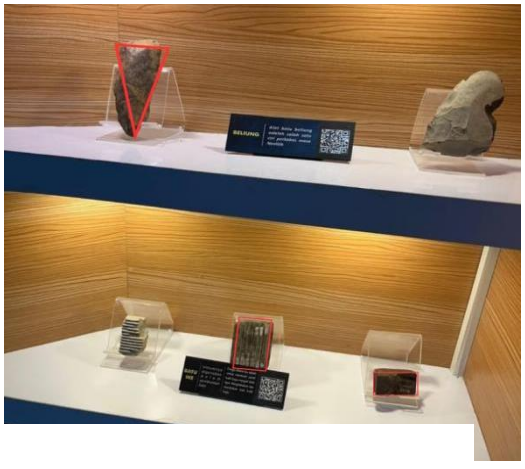
4.



The image of human fossils at that time, where there is a bone starting from:
1. Headbone (head bone)
2. Backbone (spine bone)
3. Pervis Bone (bone forming the pelvis)
4. Right Hand Bone (right hand bone)
5. Left hand Bone (left hand bone)
6. Left Leg Bone (left leg bone)
7. Right Leg Bone (right leg bone)

Picture 5, Picture of ancient humans at that time

5.

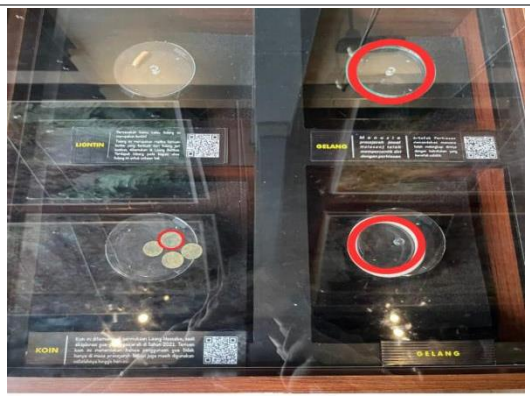
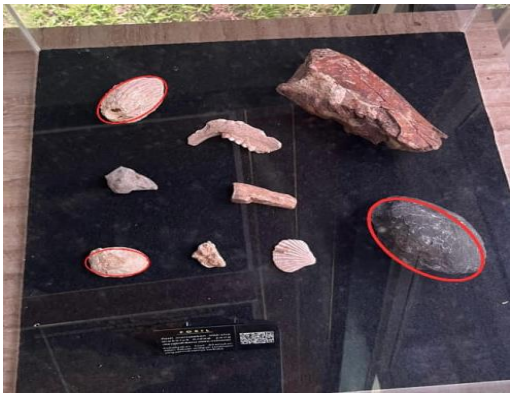


The pickaxe, a stone tool. A pickaxe, is one of the characteristic tools of the Neolithic period

Ike Stone, is a stone commonly used in making cloth. The main function of Ike is to make the bark fibers thinner. Smoothing and flattening the bark cloth.

Picture 6, Beliung and Batu Ike

e-ISSN 2746-5594
p-ISSN 2746-5608

6.	 Picture 7, Bracelet and Coin	Bracelets, are bracelets that are often used by prehistoric humans (early Holocene), humans at that time had beautified themselves with jewelry. This jewelry artifact indicates that humans have equipped themselves with aesthetic needs. Coins, found on the surface of Leang Massaloe, during the exploration of prehistoric caves in 2021, The discovery of these coins indicates that the use of caves was not only in prehistoric times but is still used afterward until today.
7.	 Picture 8, Fosil	Fossils are the remains of living things that have become rocks or minerals. Most fossils are found in sedimentary rocks that have open surfaces.

After describing the cultural concept contained in several artifacts located in the Leang-Leang Prehistoric Park, Maros Regency, South Sulawesi, the next step will be to describe the mathematical concept of flat shapes contained in the Leang-Leang Maros artifact images.

Rectangle

A square is a quadrilateral that has four sides of equal length and four right angles (Ratuanik & Filindity, 2021). In figure 2, the image of Ocher, which is a natural dye used by prehistoric humans has a flat shape, namely a square. The shape of Ocher when viewed from above resembles a square, where each side is the same length. Ocher has a unique shape and color, the shape of Ocher resembles a stone with rough edges, the color of Ocher also varies such as red, golden yellow and brownish. Therefore, to determine the Square formula is:

Square area $L = s \times s$

e-ISSN 2746-5594
p-ISSN 2746-5608

Period of square $k = 4 \times s$

Rectangle

A rectangle is a flat shape composed of four points that are in a line and connected to each other and the opposite sides are the same length. In pictures 4 and 6 there is an artifact in the form of a rectangle. In picture 4 there is a picture of a human fossil at that time, where there are several bones. In picture 6 there is a stone, namely the Ike Stone, which is a common stone used in making cloth. The main function of Ike is to make the bark fibers thinner. Smoothing and flattening the bark cloth. Therefore, to determine the rectangle formula is
Area of rectangle: $L = p \times l$
Perimeter of rectangle $k = 2(p + 1)$

Triangle

A triangle is a flat shape that is limited by three sides and has three corner points (Laukum et al., 2024). In figure 3, it is Sus Celembis, which is an endemic animal of Sulawesi. Sus Celembis, also known as the Sulawesi Wild Boar, is one of the animals that is often painted in caves by prehistoric humans. This Sus Celembis has a mark right at the top of the head that forms a triangle. Therefore, to determine the triangle formula is:
Triangle area formula: $\frac{1}{2}\ alas\ \times tall$
Circumference of triangle: $a\ + b + c$ a, b and c are the lengths pf the sides of the triangle, so the perimeter of the triangle $= 3 \times s$

Isosceles Triangle

An isosceles triangle is a triangle whose sides are equal. In the 6th picture, the adze, is a stone tool. The adze is one of the characteristics of Neolithic tools. This picture 6 has an isosceles triangle shape. Therefore, to determine the formula for an isosceles triangle is:
Triangle area formula: $\frac{1}{2}\ alas\ \times tall$
Circumference pf triangle: $2a\ + b$

Circle

A circle is the sum of all points in a plane derived from a fixed point called the circle. The distance of a point is known as the radius in a circle. In the 7th picture, the bracelet and the coin form a circle. Therefore, to determine the circle formula is:
The area of a circle is calculated using the formula: $A = \pi r^2$
The circumference of a circle is calculated using the formula $C = 2\pi r$

Ellipse

An ellipse is a set of points in a plane such that the sum of the distances from two fixed points (foci) to each point on the ellipse is constant. In the 8th picture, there is a fossil that forms an ellipse. Therefore, to determine the ellipse formula is:
the area of an ellipse can be calculated: $A = \pi ab$

e-ISSN 2746-5594
p-ISSN 2746-5608

circumference of ellipse: $C \approx 2\pi\sqrt{\frac{a^2+b^2}{2}}$

Based on the analysis that has been conducted, it can be concluded that the Leang-Leang Prehistoric Park is a cultural heritage site that stores artifacts containing mathematical concepts that need to be preserved. In the artifacts at the Leang-Leang Prehistoric Park, ethnomathematics has been found in the form of geometry concepts. The geometry concepts discovered in the artifacts at the park include flat shapes such as circles, triangles, ellipses, isosceles triangles, squares, and rectangles. Exploring the Leang-Leang Prehistoric Park can be used to recognize and delve into the historical and mathematical elements found in this tourist destination. These elements can serve as an alternative new learning resource in mathematics education. The artifacts at the Leang-Leang Prehistoric Park can be utilized as a tool for mathematics learning, providing a real understanding of geometry concepts.

Conclusion and Suggestions

Based on the results of data analysis and analysis that have been carried out by researchers, the following conclusions can be drawn: a) There are various types of artifacts found in the Leang-leang Prehistoric Park tourist artifacts, Maros Regency, including ocher, sus celembis, Maros points, depictions of current human fossils, adzes and ike stones, bracelets and coins, and fossils; b) The mathematical concept applied to the artifacts in the Maros Leang-leang artifacts is the concept of data construction. The data construction concepts used include ellipses, circles, triangles, isosceles triangles, squares, and rectangles. These findings confirm that the Leang-Leang prehistoric park tourist attraction not only functions as a tourist attraction but also as a means of contextual learning in accordance with the education curriculum and as a vehicle for preserving prehistoric tourism in Maros Regency. In order to maintain the sustainability of the Leang-Leang prehistoric park, it is recommended that further and in-depth research be carried out on the artifacts in the area. This study shows that mathematical concepts, especially geometry, are not only relevant in academic contexts but also have deep roots in local culture.

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