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Tracing Geometry in Bagan Boats: An Ethnomathematical Exploration of Traditional Fishing Gear in the Coastal Community of Barru

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ABSTRACT

This study aims to explore the geometric elements found in the traditional fishing gear known as the bagan boat, used by the coastal community of Barru, from an ethnomathematical perspective. This study is based on the view that mathematics is not only present in formal forms in the classroom but is also embedded in cultural practices and community life activities. This research employed an exploratory qualitative approach with an ethnomathematical perspective. Data were collected through observation, interviews, documentation, and field notes on the shape, structure, size, frame arrangement, ropes, poles, nets, and other components of the bagang. The results of the study show that the structure of the bagan boat contains various geometric concepts, including parallel lines, perpendicular lines, intersecting lines, angles, triangles, rectangles, symmetry, area, perimeter, diagonals, proportional measurements, scale, and similarity. These findings indicate that the coastal fishing community of Barru has indirectly applied mathematical knowledge in designing, constructing, and using the bagang based on empirical experience and local wisdom. The bagang does not only function as a fishing tool but also represents cultural intelligence that contains mathematical, technical, social, and ecological values. Therefore, the findings of this study have the potential to be integrated into mathematics learning, particularly in geometry, as a contextual learning resource that is closely related to students' lives and can foster appreciation for local culture

INTRODUCTION

Human activities in everyday life are closely related to mathematics. Mathematics is not always present in the form of symbols, formulas, or formal procedures as learned in school (Hardiani, 2019; Slamet et al., 2020). In society, mathematical activities often emerge implicitly through various practices, such as measuring, estimating, comparing, arranging, determining shapes, and designing tools to meet daily needs. Such mathematical knowledge may not be directly referred to as "mathematics" by the community, but it is clearly reflected in cultural practices and traditional technologies that develop within their daily lives. From an ethnomathematical perspective, mathematics is understood as knowledge that grows and develops within the cultural context and life practices of a particular community. D'Ambrosio (2006) emphasized that mathematics should be understood as part of human activity that develops within specific social, historical, and cultural contexts; therefore, its application is always related to people's experiences, needs, and ways of solving problems in everyday life.

Several previous studies have shown that traditional fishing gear contains various mathematical concepts that can be examined through an ethnomathematical approach. Fresnski et al. (2026), for example, examined the design of traditional boats and fishing gear used by the Bengkulu community and found that they contain various mathematical concepts applied in daily life. These concepts are reflected in the shapes, measurements, patterns, and arrangements of tools that have been produced by fishing communities from generation to generation. In traditional boats, mathematical concepts can be identified in the form of measurement, size comparison, symmetry, angles, curved lines, and three-dimensional shapes, which function to maintain balance and facilitate the movement of the boat at sea. This is in line with the study by Kadek et al. (2023), which found that ethnomathematical elements in the design of *bubu* are related to geometry topics, including plane figures such as circles, triangles, and hexagons, as well as cylinders, parallel lines, and tessellation. In the process of making *bubu*, non-standard units of measurement, such as *lengkat*, were also found. In addition, the determination of the time for setting and retrieving the *bubu* involved the concept of number multiples. All of these mathematical concepts can be connected to school mathematics.

Ethnomathematical studies are important because they reveal that mathematical knowledge does not exclusively belong to a formal discipline, but is also embedded in the cultural practices of society. From this perspective, mathematics is understood as part of lived experience shaped by everyday activities and local cultural contexts. According to Bishop, through the concept of mathematical enculturation, mathematics cannot be separated from cultural activities such as counting, measuring, constructing patterns, designing, and locating objects in space. These activities, which naturally emerge in the social life of communities, serve as an important basis for identifying mathematical elements contained in local cultural practices (Bishop, 1988; Khalimah et al., 2025; Ratna et al., 2026). Within this framework, ethnomathematics does not merely position culture as an object of study, but also as a source of knowledge that demonstrates the relationship between community ways of thinking and mathematical concepts, there by opening opportunities to enrich the mathematics curriculum through a cultural perspective (Ratna et al., 2026).

Barru Regency is one of the coastal areas in South Sulawesi that has a strong connection with marine and fisheries activities. Barru Regency is located on the western coast of South Sulawesi Province, approximately 102 km north of Makassar City. It covers an area of 174.72 km² and is situated between the coordinates of 4°47'35" South Latitude and 119°49'16" East Longitude. Administratively, Barru Regency consists of seven districts and 54 villages/sub-districts (Basuki, 2021; Fijwal et al., 2021; Hasmawati et al., 2021; Alam et al., 2025).

One of the fishing gears commonly known in the life of coastal fishermen is the *bagan boat*. The boat lift-net fishing gear, known as *bagan boat* , is a rectangular fishing device with equal length and width. The construction of this fishing gear consists of nets, bamboo, iron pipes, ropes, lamps, and a motorized boat (Nurlindah et al., 2017; Ilhamdi, 2018; Fijwal et al., 2021; Alpiani, 2019; Khusnul et al., 2021).


Source: Fishing Methods; Vessels and Logistics

Source: Arifin &dkk

Figure 1. Introduction

From a geometric perspective, the *bagan boat* is an interesting cultural object to study. Its structure consists of poles, frames, ropes, nets, platforms, and supporting components arranged in a particular configuration. These components reflect various geometric concepts, such as lines, angles, parallelism, perpendicularity, plane figures, solid figures, symmetry, patterns, proportional relationships, and spatial relationships between fields. The supporting poles demonstrate vertical and horizontal relationships, the main frame shows a particular plane pattern, while the arrangement of nets and ropes reflects geometric regularity designed according to the functional needs of the fishing gear

The presence of geometric elements in the bagan boat indicates that coastal communities possess practical intelligence in designing fishing gear. This intelligence emerges from empirical experience rather than solely from formal theory. Fishermen and bagan boat nmakers determine the size of the frame, the position of the poles, the area of the net, the strength of the ropes, and the balance of the structure based on inherited knowledge, observations of the sea, and the needs of the fishing process. This shows that mathematical concepts can exist within cultural practices, even though they are not always expressed using academic mathematical terminology.

Studies on traditional fishing gear, particularly the bagan boat, as an object of ethnomathematics have also begun to develop. Research on the bagan boat as a traditional fishing tool shows that this equipment has a particular construction that can be analyzed in terms of its shape, dimensions, frame, and function. Other studies have even indicated that the traditional bagan boat fishing gear can be used to understand geometric concepts through its internal structure. These findings strengthen the idea that traditional fishing gear has potential as an object of culture-based mathematical study.

Nevertheless, ethnomathematical studies that specifically examine the bagan boat used by the coastal community of Barru remain limited. So far, the *bagan* has been more frequently studied from the perspectives of fisheries, catch productivity, fishing technology, and the socio-economic systems of fishermen. The geometric aspects embedded in the structure of the *bagan* have not been widely explored as part of the local knowledge of the coastal community in Sumpang Binangae, Barru District, Barru Regency. In fact, the shape, dimensions, arrangement, and construction patterns of the *bagan* reveal mathematical concepts that are interesting to explore

The mathematical concepts embedded in the traditional bagan boat fishing gear represent an interesting aspect to explore, particularly from an ethnomathematical perspective. To date, studies that specifically examine ethnomathematical values in bagan boat fishing gear remain limited; therefore, this study is important for identifying the mathematical elements found in the form, structure, dimensions, patterns, and working mechanisms of the *bagan*. These ethnomathematical values indicate

that the cultural practices of coastal communities not only serve economic and social functions but also contain mathematical knowledge that naturally develops in everyday life (Sulaiman, 2019; Putri et al., 2024; Khotimah, 2025). The cultural elements of the *bagan* can be connected to mathematical concepts, particularly in geometry, such as plane figures, angles, lines, symmetry, patterns, and relationships among the components of the fishing gear construction. Thus, ethnomathematics in the *bagan* has the potential to be integrated into mathematics learning as a contextual approach that links learning materials with students' local culture. Based on this explanation, this study aims to identify the ethnomathematical values embedded in the traditional *bagan* fishing gear and to analyze its potential integration into mathematics learning.

Based on the explanation above, the article entitled "Geometric Traces in *Bagan*: An Ethnomathematical Exploration of Traditional Fishing Gear Used by the Coastal Community of Barru" is important to conduct. This study seeks to reveal the geometric elements embedded in the *bagan* and to explain how the local knowledge of the Barru coastal community is reflected in the design and use of this fishing gear. Through this study, the *bagan* is understood not only as a traditional fishing tool but also as a representation of the cultural intelligence of coastal communities, encompassing mathematical, technical, social, and ecological values.

METHODS

Type of Research

This study employed an exploratory qualitative research design with an ethnomathematical approach. A qualitative design was selected because this study aims to explore and describe in depth the geometric elements embedded in the traditional *bagan* fishing gear used by the coastal community of Barru. The ethnomathematical approach was used to reveal the relationship between mathematical concepts, particularly geometry, and the cultural practices and local knowledge of fishing communities in designing, constructing, and using the *bagan*

Research Location

This study was conducted in the coastal area of Barru Regency, South Sulawesi. The location was selected because Barru Regency is one of the coastal regions whose communities are engaged in fisheries activities and are still familiar with the use of traditional fishing gear, including the bagan. The research site was focused on areas where fishermen use or construct bagan, allowing the researchers to obtain data relevant to the objectives of the study.

Research Subjects and Object

The subjects of this study were coastal community members who had knowledge and experience related to *bagan* fishing gear. The research subjects included fishermen who use *bagan*, *bagan* makers, *bagan* owners, and coastal community figures who understand the function, form, dimensions, and construction process of the bagan boat.

The object of this study was the traditional *bagan* fishing gear used by the coastal community of Barru. The object was observed in terms of its form, structure, dimensions, patterns, frame arrangement, nets, ropes, supporting poles, and other components that indicate the presence of geometric elements.

Research Instruments

The main instrument in this study was the researcher. The researcher served as the data collector, observer, interviewer, note-taker, and interpreter of the data obtained in the field. In qualitative research based on ethnomathematics, the researcher needs to be directly involved in order to understand the form, function, dimensions, arrangement, and cultural meanings embedded in the bagan boat fishing gear.

In addition to the researcher as the main instrument, this study also employed several supporting instruments, including observation guidelines, interview guidelines, documentation sheets, and geometric concept identification sheets. These supporting instruments were used to ensure that the data obtained were more focused, systematic, and aligned with the focus of the study.

Data Collection Techniques

The data collection techniques in this study were carried out through observation, interviews, documentation, and field notes. These four techniques were used to obtain in-depth data regarding the form, structure, dimensions, function, and geometric elements found in the traditional bagan boat fishing gear used by the coastal community of Barru.

1. **Observation**

Observation was conducted by directly

examining the physical form and structure of the bagan boat fishing gear. The observation focused on parts of the bagan boat related to geometric concepts, such as the main frame, supporting poles, binding ropes, nets, platform, and the arrangement among its components. Through observation, the researchers were able to identify elements such as lines, angles, plane figures, solid figures, parallelism, perpendicularity, symmetry, patterns, dimensions, and proportions.

2. **Interviews**
   Interviews were conducted with informants who had knowledge and experience related to the bagan boat, such as fishermen who use bagan boat, bagan boat makers, bagan boat owners, and coastal community figures. The interviews aimed to obtain information about the names of the parts of the bagan boat, the function of each component, the construction process, the method of determining dimensions, the reasons for selecting certain forms, and the local knowledge used in designing and operating the *bagan*.
3. **Documentation**
   Documentation was carried out to obtain visual and supporting data related to the bagan boat fishing gear. The documentation included photographs of the overall form of the bagan boat, photographs of its components, structural sketches, dimensional notes, as well as interview recordings or transcripts. This documentation was used to strengthen the data obtained from observations and interviews.
4. **Field Notes**
   Field notes were used to record important information found during the research process. These notes included the condition of the research location, the activities of coastal communities, the process of using the bagan boat, and other findings that were not directly captured through photographs or interviews.

Data Analysis Techniques

The data analysis technique used in this study was qualitative descriptive analysis. Data obtained through observation, interviews, documentation, and field notes were analyzed through the stages of data reduction, data presentation, conclusion drawing, and verification. Data reduction was carried out by selecting data relevant to the focus of the study, namely the components of the bagan boat that contain geometric elements. The analyzed data included the shape of the frame, the position of the poles, the direction of the ropes, the pattern of the nets, the platform area, the dimensions among components, and the function of each part of the bagan boat. The reduced data were then presented in the form of descriptive narratives, identification tables, photographs, and sketches. At this stage, the components of the bagan boat were classified into geometric concepts, such as lines, angles, plane figures, solid figures, parallelism, perpendicularity, symmetry, patterns, measurement, and proportional relationships. Finally, the researchers drew conclusions regarding the geometric elements found in the bagan boat and the ethnomathematical meanings embedded within it.

RESULTS AND DISCUSSION

1. Research Findings

General Overview of bagan boat as a Traditional Fishing Gear of the Barru Coastal Community

Bagan boat is one of the traditional fishing gears used by coastal communities. In fisheries literature, the term most commonly used is *bagan* (Sadi et al., 2020; Patanngari et al., 2021; Ismail, 2021; Agustina, 2022; Sahrul, 2023). Among the coastal community of Barru, *bagan* functions not only as a means of economic production but also as part of the local knowledge of fishermen. Barru Regency itself is known as a coastal area with fisheries activities, including the use of boat lift-net fishing gear in Barru waters. The form, arrangement, and working mechanism of the bagan boat indicate that fishing communities possess technical skills in designing fishing gear that is strong, balanced, and suitable for marine conditions.

Based on observations of the general form of the bagan boat, this fishing gear consists of several main components, namely the main frame, supporting poles, binding ropes, nets, platform, and lamps used as fishing aids. Each component has a specific function and is arranged systematically. This regularity in form and arrangement indicates the presence of geometric elements in the construction of the bagan boat. The symmetrical position of the poles and direction of the nets, the proportional length and distance among components, and the

orderly rope-binding patterns show that fishermen have internalized geometric concepts through everyday practices, even without formal calculations.

Thus, the bagan boat functions not only as fishing gear but also as a medium of ethnomathematical knowledge, in which geometric traces can be identified in every element of its construction. This confirms that the construction of traditional bagan boat represents a form of mathematical enculturation, in which the coastal community of Barru naturally integrates experience, environmental observation, and geometric principles to produce fishing gear that is effective and sustainable.

2. Geometric Concepts in Traditional Bagan Boat Fishing Gear

Source: Agustina, 2022

Figure 2. Bagan Boat

Based on the image of the bagan boat fishing gear, there are several geometric concepts that are highly interesting to explore in mathematics learning

Table 1. Geometric Concepts in Traditional Bagan Boat Fishing Gear

Bagan boat	Geometric Concept	Explanation
The main frame of the bagan boat extending to the left and right	Rectangle / quadrilateral	The frame of the bagan boat forms a flat plane resembling a rectangle as a place for installing the net.
Supporting poles and frame crossbars	Parallel lines and perpendicular lines	Several frame rods are arranged parallel to one another, while other crossbars intersect to form right angle
Ropes from the top of the pole to the end of the frame	Triangle	The supporting ropes form a triangular pattern that functions to maintain the balance and strength of the bagan boat structure.
The intersection of poles, ropes, and frame	Angles	In this section, acute angles, obtuse angles, and right angles can be observed
Arrangement of bamboo/pipes on the frame	Patterns and regularity	The frame of the bagan boat is arranged regularly, forming repeated geometric patterns
Net installed under the frame	Area and perimeter of plane figures	The net can be associated with the concept of calculating the area of a

		rectangle and the perimeter of the fishing area
The left and right sides of the bagan	Symmetry	The structure of the bagan boat appears to have a balanced shape between the left and right sides relative to the position of the boat or the central part.
Pulling ropes and main pole	Diagonals and oblique lines	The ropes connecting the pole to the frame form oblique or diagonal lines in the structure of the bagan boat
Proportional measurements of poles, ropes, and frame	Similarity and scale	The dimensions of the components of the bagan boat can be analyzed through comparisons of length, width, and height

Findings from Interviews with Fishermen

Based on the results of interviews with fishermen from the coastal community of Barru, it was found that the bagan boat is one of the traditional fishing gears that has been used from generation to generation. The fishermen explained that the construction of a bagan boat is not carried out randomly, but through careful consideration of its shape, size, material strength, frame balance, and net position so that the tool can be used effectively at sea.In the construction process, fishermen usually determine the length and width of the frame, the height of the poles, the size of the net, and the length of the supporting ropes based on experience and field needs. Although the fishermen do not refer to these activities as mathematical concepts, the activities they perform indicate the presence of mathematical elements, such as measuring, estimating, comparing sizes, determining shapes, and arranging structures in an orderly manner.This can be seen in the bagan frame, which forms a plane resembling a rectangle; the arrangement of rods, which shows parallel and intersecting lines; the supporting ropes, which form triangular patterns; and the balance between the left and right sides of the bagan, which indicates the concept of symmetry.

The interview results also show that fishermen understand the importance of balance in the construction of bagan boats. The left and right sides of the frame must be made balanced so that the bagan does not easily tilt or become damaged when used in the waters. In addition, the installation of supporting ropes must consider a certain inclination so that the frame remains strong and stable. Fishermen also estimate the size of the net based on the desired area of the fishing field. The wider the net used, the larger the fish-catching area; however, it must still be adjusted to the strength of the frame and the ability of the equipment to be lifted or lowered. These findings indicate that the practice of constructing and using bagan boats contains geometric concepts, such as plane figures, angles, triangles, parallel lines, symmetry, area, perimeter, and proportional measurements. Thus, the interview results strengthen the view that the bagan does not only function as a fishing gear, but also represents the local knowledge of the coastal community of Barru, which contains ethnomathematical values.

Discussion

1. Ethnomathematics in the Coastal Practices of Barru

Ethnomathematics in the coastal practices of Barru can be observed through the use of traditional fishing gear known as the bagan boat, which contains various geometric concepts. In its construction and use, fishing communities indirectly apply mathematical activities, such as measuring the length of the frame, estimating the size of the net, determining the height of the poles, installing supporting ropes, and maintaining the balance of the shape between the left and right sides of the bagang. The structure of the bagan boat demonstrates

geometric concepts such as parallel lines, intersecting lines, angles, triangles, rectangles, symmetry, area, perimeter, and proportional measurements. This indicates that the bagan is not only a fishing tool but also a form of local knowledge of the coastal community of Barru that contains mathematical values. Therefore, ethnomathematical exploration of the bagan boat is important to show that mathematics is present in community culture and can be used as a contextual, meaningful geometry learning resource that is closely related to students' daily lives.

2. Geometric Traces in the Structure of the Bagan

Geometric traces in the structure of the bagan boat can be observed through the shapes, arrangements, measurements, and relationships among its components that form the traditional fishing gear of the coastal community of Barru. The bagan boat is not constructed randomly; rather, it is designed by considering the balance, strength, and function of each component so that it can be used effectively in the waters. In the main frame, there is a plane shape resembling a rectangle or quadrilateral. This shape can be seen from the frame that extends to the left and right as the place where the net is installed. Mathematically, this part can be associated with the concepts of plane figures, length, width, perimeter, and area. The length and width of the frame greatly determine the area of the net used to catch fish. Therefore, fishermen have indirectly applied the concepts of measurement and area calculation in the practice of constructing bagan boats.

In addition to plane shapes, the structure of the bagan boat also demonstrates the concept of lines. The rods that make up the frame and are arranged horizontally indicate the concept of parallel lines, while rods that meet or cross each other indicate the concept of intersecting lines. In certain parts, the intersection between the main pole and the horizontal frame forms perpendicular lines, which can be associated with right angles.

The arrangement of these lines not only has mathematical significance but also serves a constructive function, namely strengthening the frame so that it does not easily deform when the net is lowered or when the bagan boat is exposed to water pressure and wind. This indicates that the orderly arrangement of the bagan boat frame contains geometric principles that are practically applied by the fishing community.

The most prominent geometric concept in the structure of the bagang is the triangle. The triangular pattern can be seen in the relationship between the main pole, the supporting ropes, and the ends of the bagan frame. The main pole serves as the vertical side, the horizontal frame as the base, and the supporting rope as the slanted side. This triangular shape plays an important role in maintaining the strength and stability of the equipment. In geometry, the triangle is known as a strong shape because it is able to distribute loads evenly. In the bagan boat, this principle can be seen when the supporting ropes are installed diagonally from the top of the pole to the ends of the frame to hold the load and maintain balance. Thus, fishermen indirectly apply the principle of triangular stability in their traditional construction

The structure of the bagan boat also contains the concept of angles. Angles can be found at the intersections between the poles, ropes, frame, and supporting crossbars. The ropes installed diagonally from the main pole to the ends of the frame, as well as the intersection between the vertical pole and the horizontal frame, form angles. The presence of these angles indicates that the construction of a bagan boat requires accuracy in positioning and inclination. If the angle at which the ropes are installed is not appropriate, the frame may become less balanced or less capable of supporting the load. Therefore, although fishermen do not formally use the term "angle," they still apply an understanding of

inclination and position in the process of constructing bagan boats.

In addition, the bagan boat also demonstrates the concepts of symmetry and balance. The left and right sides of the bagan are generally made balanced so that the equipment does not become unevenly weighted when used at sea. This balance can be seen from the length of the frame, the position of the ropes, and the arrangement of the net, which are made relatively similar on both sides. In geometry, this condition can be associated with the concept of symmetry, namely the correspondence of shape between one side and the other with respect to a central line. In the bagan boat, this central line can be imagined as being located along the position of the boat or the main pole. This concept of symmetry has a practical function, because an unbalanced bagan would be difficult to use, easily tilt, and be at risk of damage when exposed to waves or the weight of the net.

Other geometric traces can be seen in the concepts of proportion, scale, and similarity. In constructing a bagan boat, fishermen need to adjust the length of the frame, the height of the poles, the length of the ropes, and the area of the net. All of these measurements must be properly arranged so that the equipment can function effectively.If the pole is too short, the supporting ropes cannot support the frame optimally. Conversely, if the frame is too wide, the net will become too heavy and difficult to lift. Such considerations indicate the presence of proportional measurement and similarity concepts, because each part of the bagan must have a balanced dimensional relationship with the other parts.

Thus, the structure of the bagan boat contains various geometric concepts that can be explored in mathematics learning, such as plane figures, rectangles, triangles, parallel lines, perpendicular lines, intersecting lines, angles, symmetry, area, perimeter, proportion, scale, and similarity. These findings show that the bagan boat is not only a traditional fishing gear but also a form of local knowledge of the coastal community of Barru that contains mathematical values. Through an ethnomathematical study, the bagan can be used as a contextual learning resource that connects geometric concepts with the culture and real-life practices of coastal communities. Therefore, exploring geometric traces in the structure of the bagan is important to show that mathematics is not only found in textbooks but also lives within the cultural practices of society.

3. Implications

The implication of this study is that the geometric elements found in the bagan boat can be integrated into mathematics learning, particularly in geometry topics at school. The context of the bagan boat can help students understand mathematical concepts in a more concrete, contextual, and meaningful way, as it is closely related to daily life, especially for students living in coastal areas. In addition, the integration of ethnomathematics based on the bagan boat in learning can also foster students' appreciation of the local wisdom and cultural heritage of the coastal community of Barru.

This study is still limited to the exploration of geometric concepts in the structure of the bagan boat. Therefore, future research is recommended to develop teaching materials, student worksheets, modules, or mathematics learning media based on the ethnomathematics of the bagan boat, as well as to examine their effectiveness in improving students' understanding of geometric concepts. Further studies may also expand the research object to other traditional fishing gear so that the richness of mathematics embedded in coastal culture can be documented and more widely utilized in mathematics learning.

CONCLUSION

Based on the research findings, it can be concluded that the traditional fishing gear known as the bagan boat, used by the coastal community of Barru, contains various geometric concepts that are formed through cultural practices and the empirical experiences of fishermen. These geometric elements are reflected in the shape, structure, measurements, arrangement of the frame, poles, ropes, and nets of the bagan boat. The mathematical concepts identified include parallel lines, perpendicular lines, intersecting lines, angles, triangles, rectangles, symmetry, area, perimeter, diagonals, size

comparison, scale, and similarity. These findings indicate that fishermen have indirectly applied mathematical knowledge in designing, constructing, and using the *perahu bagan* so that the fishing gear has balance, strength, and functions that are appropriate to the needs of fishing activities.

This study confirms that the bagan boat does not merely function as a traditional fishing gear, but also represents the local knowledge of coastal communities, which contains mathematical, technical, social, and cultural values. From an ethnomathematical perspective, the practices of constructing and using the bagan boat demonstrate that mathematics is genuinely present in community life, although it is not always expressed through symbols, formulas, or formal terminology. Therefore, the bagan boat can be understood as a source of mathematical knowledge rooted in local culture that is relevant to be examined and developed in mathematics learning

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