

Ethnomathematical Exploration of the Tutup Ari Ornament at Padangsidimpuan City Park: Plane Geometry Concepts and Their Potential as a Contextual Learning Resource

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ABSTRACT

This study explores plane geometry concepts represented in the Tutup Ari ornament at Padangsidimpuan City Park and examines its potential as a contextual mathematics learning resource. A qualitative descriptive-exploratory design was employed within an ethnomathematics framework. Data were collected through direct observation, photographic documentation, and a literature review on ethnomathematics, Angkola-Mandailing decorative traditions, and contextual mathematics learning. Analysis involved segmenting visual elements, superimposing geometric guide lines, identifying geometric properties, classifying shapes, and interpreting their relationship with local decorative motifs. The findings identified six principal geometric concepts: triangles in Bindu Matogu/Ador-ador Duri-duri, rhombi in Suncang Duri/Raga-raga, trapezoids and parallelograms in Singgor, rectangles in Silindung, and circles in Mataniari. The patterns also demonstrate repetition, parallelism, regularity, and visual symmetry. The novelty of this study lies in using a publicly accessible replica of Tutup Ari as a learning context that supports observation, measurement, representation, and geometric reasoning. Padangsidimpuan City Park therefore has potential as an open-air learning laboratory connecting school mathematics with local culture. However, this study was limited to visual exploration and did not assess instructional effectiveness among students.



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INTRODUCTION

School mathematics is often perceived as a collection of symbols, definitions, and procedures detached from students' everyday experiences. This perception becomes problematic when students can recall formulas but struggle to explain why a particular shape has certain properties or how geometric concepts are manifested in their surroundings. (Khasanah, N., Kusmayadi, T. A., & Nurhasanah, 2021) showed that difficulties in understanding abstract mathematical objects can affect students' problem-solving abilities. In geometry, this problem becomes evident when instruction relies primarily on idealized textbook figures, even though shapes, patterns, symmetry, and measurement are readily observable in buildings, crafts, and cultural ornaments in students' immediate environments. Mathematics learning therefore requires contexts that are not merely visually engaging but also socially and culturally meaningful to learners.

Ethnomathematics provides a framework for understanding mathematics as knowledge embedded in cultural practices. (Prahmana, R. C. I., & D'Ambrosio, 2020) conceptualized ethnomathematics as the study of how cultural groups develop, use, and interpret mathematical ideas in their everyday activities. In the Indonesian context, (Abdullah, 2017) demonstrated that Sundanese cultural practices can be examined from a mathematical perspective, while (Muhtadi, D., Sukirwan, Warsito, & Prahmana, 2017) identified estimation, measurement, and pattern-making as mathematical activities embedded in community practices. These findings affirm that mathematics does not emerge only after a cultural artifact is assigned a formal school-based label; regularity, measurement, comparison, repetition, and the construction of forms have long been integral to cultural activity.

Integrating culture into mathematics instruction can also strengthen students' mathematical processes. (Fouze, A. Q., & Amit, 2018) found that incorporating ethnomathematical elements into instruction can support the development of mathematical thinking. In Indonesia, Prahmana and

D'Ambrosio (2020) showed that Yogyakarta batik patterns embody both geometry and cultural values, while (Septiana, W., Hikmah, N., Wulandari, N. P., & Prayitno, 2023) identified ethnomathematical concepts in Sukarara woven-fabric motifs and discussed their implications for learning. Other studies have similarly demonstrated the educational potential of cultural artifacts, including Tembe Nggoli (Az-Zahra, R., Azkiya, A., Ningtiyas, E., Haerani, S. M., & Farhan, 2024), Palembang songket (Musodiqoh & Kusno, 2025), the Patola Ratu motif in East Sumba ikat weaving (Luda, H. A., & Nuhamara, 2026), and Batak cultural practices represented through lappet, ulos, and marsitekka (Siboro, G. A. F. P., Simanjuntak, I. C., Gultom, M., Simatupang, N. W., Hutasoit, R. D., Panjaitan, D., & Sesilia, 2025). Collectively, these studies point to an important trend: cultural objects can serve as meaningful contexts that bridge formal mathematics and concrete experience.

From a curricular perspective, plane figures are particularly suitable for ethnomathematical exploration because their properties can be observed directly in visual objects. Students can identify sides, angles, parallelism, diagonals, symmetry, perimeter, and area through tangible forms. (Rahayu, N. S., & Afriansyah, 2021) reported persistent misconceptions among junior secondary students regarding quadrilaterals, indicating the importance of strengthening conceptual understanding through multiple representations. (Puspitarani, 2025), for example, integrated the cultural context of the Yogyakarta Palace into primary-school instruction on the area of a rhombus. Cultural exploration, therefore, need not stop at the activity of merely "finding shapes"; it can be extended to concept formation, measurement, modeling, and mathematical reasoning.

A culturally relevant context in South Tapanuli is the Angkola-Mandailing tradition. One of the most prominent visual elements in Bagas Godang architecture is Tutup Ari, the triangular section at the front of the roof that is decorated with distinctive colored motifs. Rahayu (2024) examined ethnomathematical elements in the Tutup Ari of the South Tapanuli Regent's Office and demonstrated the presence of mathematical representations within its structure. (Rhamayanti, Y., Harahap, H. H., & Lubis, 2022) likewise highlighted the existence of mathematical language and representations within the Batak community of South Tapanuli. These findings provide a foundation for viewing local ornaments as representations of mathematical knowledge as well as cultural symbols.

Urban development has resulted in Tutup Ari being encountered not only on traditional buildings or government offices but also as a replicated feature in public spaces. One example is located at Padangsidimpuan City Square Park on Teuku Umar Street, which, according to the research documentation, was inaugurated on February 1, 2024. The Tutup Ari replica functions as a landmark that can be viewed and approached by the public on a daily basis. This public-space setting is educationally important because it is more openly accessible than objects located within institutional spaces. In principle, students can directly observe the shapes, conduct simple measurements, photograph patterns, produce sketches, and discuss cultural meanings at the site.

Although ethnomathematics research has grown rapidly in Indonesia, two gaps still warrant further attention. First, many studies remain limited to inventories of mathematical forms found in cultural artifacts. Such inventories are important as an initial stage, but their pedagogical contribution becomes stronger when findings are explicitly connected to learning activities that students can undertake. Second, previous research on Tutup Ari focused on an object attached to a government building (Rahayu, 2024), whereas the characteristics of a Tutup Ari replica in a city park as an inclusive public space have received insufficient attention. This gap creates an opportunity to interpret the same cultural object not merely as a visual artifact but also as a geometry-learning context embedded in the urban environment.

Accordingly, the novelty of this study does not rest solely on a difference in location. The contribution is structured at two analytical levels. The first identifies and explains the geometric properties visible in each Tutup Ari motif. The second connects these findings to potential contextual learning activities through Realistic Mathematics Education (RME) and outdoor learning. (Yonathan, A. B., & Seleky, 2023) demonstrated the relevance of realistic mathematics approaches for optimizing students' conceptual understanding. In the present study, the reality used as a starting point is not an artificially constructed situation but a cultural object that is physically present in a public space and familiar to the local community.

Based on this rationale, the study aimed to: (1) identify the plane geometry concepts represented in the Tutup Ari ornament at Padangsidimpuan City Park; (2) analyze visual regularities, including repetition, parallelism, and symmetry, that support geometric classification; and (3) formulate the

potential use of the object as a contextual mathematics learning resource. The study did not test students' learning outcomes; therefore, the term "potential" is used deliberately to ensure that the claims remain aligned with the available evidence.

Table 1. Position of the present study within related ethnomathematics research

Study	Object/context	Primary focus	Contribution	Position relative to the present study
Abdullah (2017)	Sundanese culture	Ethnomathematical perspective	Shows that mathematics is embedded in cultural practices	Conceptual foundation for ethnomathematics
Muhtadi et al. (2017)	Sundanese cultural activities	Estimation, measurement, and patterns	Identifies mathematical activities embedded in community practices	Affirms that analysis can move from forms toward mathematical activities
Prahmana & D'Ambrosio (2020)	Yogyakarta batik	Geometry and values	Connects geometric patterns with cultural values	Provides a reference for linking visual representations and cultural context
Septiana et al. (2023)	Sukarara weaving	Motifs and learning implications	Demonstrates the potential of motifs as learning contexts	Strengthens the pedagogical orientation of the exploratory findings
Rahayu (2024)	Tutup Ari at the South Tapanuli Regent's Office	Identification of ethnomathematical elements in Tutup Ari	Establishes Tutup Ari as a relevant ethnomathematical object	Closest prior object; differs in site characteristics and orientation of use
Present study	Tutup Ari replica in a city park	Plane geometry + potential learning activities	Interprets public space as an accessible context for geometry learning	Shifts novelty from location alone toward accessibility and the design of a learning context

METHODS

This study employed a qualitative approach with a descriptive-exploratory design within an ethnomathematics framework. The design was selected because the study did not seek to quantify the frequency of motif occurrence or test the effectiveness of an instructional model, but rather to understand mathematical concepts represented in a cultural object and to interpret their possible use in learning. An ethnographic perspective was applied in a limited manner to the interpretation of the cultural artifact and its context, rather than as a full ethnography requiring prolonged immersion in the community. This distinction is important to ensure that the method corresponds to the data actually available. Mahendra et al. (2024) explain that ethnography in qualitative research is oriented toward understanding practices and meanings within cultural contexts; in this study, that context was specifically focused on the visual artifact of Tutup Ari.

The study was conducted at Padangsidempuan City Square Park on Teuku Umar Street. The primary object was a replica of the Angkola-Mandailing Tutup Ari structure that serves as one of the park's landmarks. The unit of analysis was not the park as a whole but the visual elements of the Tutup Ari ornament that displayed boundaries, sides, angles, parallel lines, curves, repetition, or arrangements of forms that could be classified as plane geometry concepts. By specifying the unit of analysis in this way, identification was not based merely on superficial resemblance but was directed toward features that could be explained mathematically.

The data consisted of three types of sources. First, primary visual data were obtained through direct observation of the Tutup Ari structure. Second, photographic documentation captured both the landmark as a whole and individual motif sections. Third, published sources were used to examine motif terminology, cultural meanings, ethnomathematical concepts, and their relevance to mathematics learning. The study did not involve interviews or student testing. Consequently, interpretations of the philosophical meanings of motifs were limited to information available in the literature, while instructional implications were framed as pedagogical potential rather than evidence of effectiveness.

Data were collected through visual observation and photographic documentation. Observation focused on the position of each motif from the upper section to the base, the regularity of the arrangement, the boundaries of forms, the orientation of sides, and relationships among shapes. Photographs enabled repeated analysis after the field observation. During analysis, the images were segmented into several motif sections, and geometric guide lines were superimposed to emphasize their geometric boundaries. This technique is consistent with ethnomathematical exploration practices that use visual representations to identify shapes, patterns, and geometric relationships in cultural artifacts (Az-Zahra et al., 2024; Musodiqoh & Kusno, 2025).

Data analysis was conducted through five operational stages. The first was visual reduction, in which sections of photographs showing the clearest motif boundaries were selected. The second was segmentation, whereby individual motif units were separated to prevent one shape from being visually conflated with surrounding patterns. The third stage involved identifying geometric properties based on visual characteristics, such as the number of sides, the presence of pairs of parallel sides, diagonal structure, or closed curves. The fourth stage classified the forms into plane geometry concepts and mapped them onto local motif terminology. The fifth stage involved pedagogical interpretation by linking the identified concepts to potential learning activities such as identifying properties, estimating dimensions, measuring, reconstructing figures, calculating model-based perimeter and area, and explaining symmetry. This procedure allowed the analysis to move from visual description toward a more structured mathematical interpretation.

The credibility of the interpretations was maintained through cross-checking among direct observation, photographic documentation, and published sources. When a motif name or cultural meaning could not be supported by the available literature, no further interpretation was made. Likewise, the study did not assume that every form in the ornament constituted an ideal Euclidean figure. Some forms are decorative representations that approximate the properties of particular geometric shapes. Classification was therefore based on dominant visible characteristics and used as a bridge to school mathematics concepts rather than as the result of precise architectural measurement.

In presenting the findings, formulas for perimeter and area are included as curricular extensions of the identified plane figures. These formulas do not represent calculations based on the physical dimensions of the Tutup Ari because the study did not conduct detailed architectural measurements. This distinction prevents readers from inferring that the landmark's area or perimeter was empirically calculated. Instead, the formulas are positioned as follow-up concepts that teachers may use when developing learning activities that progress from a real object to a mathematical model.

RESULTS AND DISCUSSION

Visual Characteristics of Tutup Ari as an Ethnomathematical Object

The observations showed that the Tutup Ari replica at Padangsidempuan City Park has a predominantly triangular structure filled with several horizontal bands of decorative motifs. The patterns are arranged in tiers from the top toward the base. Red, black, white, and yellow function as visual elements that accentuate motif boundaries. From a mathematical perspective, colored lines and field boundaries help create perceptions of sides, angles, parallel lines, and repetition. Thus, the ethnomathematical significance of the object lies not only in the outer shape of Tutup Ari but, more importantly, in the way smaller motif units are organized into a regular visual structure.

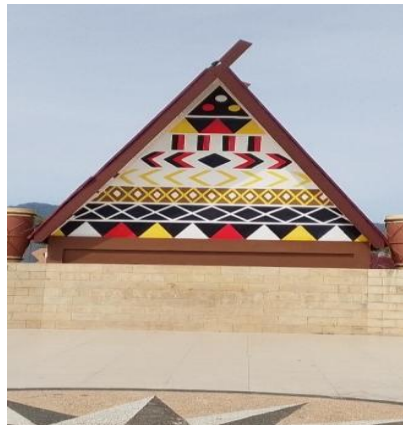


Figure 1.

Replica of the Tutup Ari ornament at Padangsidempuan City Park (research documentation)

This regularity is important because ethnomathematics should not be reduced to identifying a "shape that resembles a triangle" or a "shape that resembles a rhombus." Researchers also need to consider how a form is produced through repetition, parallelism, or reflection. (Samosir, H. Z., Tampubolon, F. C., Adsari, J. D., Sihotang, M. A., Agustina, W., & Gea, 2025) showed that cultural artifacts may embody mathematical concepts through the processes and structures by which they are produced, while Siboro et al. (2025) demonstrated the breadth of mathematical concepts embedded in Batak cultural artifacts and practices. In Tutup Ari, motif units appear to be arranged in repeated horizontal bands, making the relationships among shapes as mathematically important as the individual shapes themselves.

Identification of Plane Geometry Concepts

Based on image segmentation and the identification of visual characteristics, six principal plane geometry concepts were identified. Table 2 presents the relationship among the geometric concepts, curricular formulas, local decorative motifs, and visual segments of the object. The term "formula" in the table refers to a curricular extension that may be used in instruction, rather than to measurements of the physical landmark.

Table 2. Identification of plane geometry concepts in the Tutup Ari ornament

N o.	Geometric concept	Curricular formula	Decorative motif	Visual object
1	Triangle	$P = a + b + c$; $A = \frac{1}{2}bh$	Bindu Matogu / Ador-ador Duri-duri	
2	Rhombus	$P = 4s$; $A = \frac{1}{2}d_1d_2$	Suncang Duri / Raga-raga	
3	Trapezoid	$P = a+b+c+d$; $A = \frac{1}{2}(a+b)h$	Singgor	
4	Parallelogram	$P = 2(a+b)$; $A = bh$	Singgor	
5	Rectangle	$P = 2(l+w)$; $A = lw$	Silindung	
6	Circle	$C = 2\pi r$; $A = \pi r^2$	Mataniari	

Triangles in Bindu Matogu/Ador-ador Duri-duri

The lower section of the ornament displays a sequence of motifs visually bounded by three sides and forming an apex. Because the photographic documentation does not provide precise side measurements, this study uses the general term "triangle" and does not impose an equilateral classification. Pedagogically, this non-idealized form can itself become a productive discussion point: students can measure the three sides on a scaled photograph or sketch and then determine whether the figure is closer to an equilateral, isosceles, or scalene triangle. Such an activity encourages students to apply property-based definitions rather than relying solely on visual appearance.

Rhombi in Suncang Duri/Raga-raga

In one of the motif bands, repeated four-sided figures appear in an orientation resembling a "diamond." Mathematically, however, a rhombus is not defined by its tilted orientation but by the equality of its four side lengths. Because the present study is based on visual evidence, these figures are classified as dominant representations of rhombi. In classroom learning, the distinction between "looking like a diamond" and satisfying the mathematical definition of a rhombus can be used to strengthen students' understanding of geometric properties. (Rahayu, N. S., & Afriansyah, 2021) showed that misconceptions about quadrilaterals remain a persistent issue; therefore, motif-based contexts can be used to challenge students' visual assumptions.

Trapezoids in Singgor

Trapezoidal forms appear in sections containing one pair of sides oriented in parallel and two other non-parallel sides. Within the ornament, several units are formed through the intersection of oblique lines with horizontal boundaries. This configuration shows that a cultural pattern can generate a geometric concept through combinations of lines rather than through an isolated, explicitly drawn figure. Students may be asked to trace pairs of parallel sides in the photograph, compare the definition of a trapezoid used in their textbook, and examine whether all units satisfy the same criteria. In this way, the cultural object becomes a context for mathematical argumentation.

Parallelograms in Singgor

The Singgor band also produces four-sided figures with two pairs of opposite sides that appear parallel. The repetition of these oblique shapes provides a visual illustration of translation and regularity. Although this study focuses on plane figures, the arrangement of parallelograms also creates an opportunity to introduce geometric transformations: students can select one motif unit, draw a translation vector to the next unit, and explain how the pattern is generated. Cultural patterns with regular repetition have similarly been used in other ethnomathematics studies as bridges to transformation and symmetry concepts (Prahmana & D'Ambrosio, 2020; Septiana et al., 2023).

Rectangles in Silindung

In certain sections, vertically oriented fields are bounded by two pairs of opposite lines, forming repeated rectangular representations. Although the rectangle is relatively easy to recognize, the motif can be extended to discussions of length-to-width ratios, perimeter, area, and scale. Teachers may ask students to photograph the motif, establish a measurement unit on the image, and compare the length-to-width ratios of different units. Such activities shift learning from merely naming figures toward processes of measurement and modeling.

Circles in Mataniari

The Mataniari motif displays circular fields. In contrast to the polygons found in other sections, circles allow students to compare the properties of a shape with no straight sides or vertices. Contextually, students can measure the diameter on a photograph or directly from the object where appropriate, estimate circumference, and discuss the relationship between diameter and radius. The presence of circles within a structure dominated by straight lines also creates a strong visual contrast and makes them particularly suitable for classification activities based on defining properties.

Regularity, Repetition, and Symmetry as Mathematical Structures

If the analysis stopped at naming six plane figures, the mathematical richness of Tutup Ari would be reduced to a list of shapes. The observations instead show that these figures are arranged in repeated patterns. Sequences of triangles, rhombi, and parallelograms form horizontally repetitive units. This repetition creates visual rhythm and provides an intuitive entry point into patterns, sequences, and transformations. In ethnomathematics research, pattern-making has been recognized as an important form of mathematical practice (Muhtadi, D., Sukirwan, Warsito, & Prahmana, 2017).

Parallelism is also a dominant structural feature. In parallelograms and trapezoids, pairs of parallel lines provide the basis for classification; in rectangles, two pairs of parallel sides create a stronger sense of regularity. Students can test parallelism using a ruler or dynamic geometry software after taking photographs of the object. Such activities connect field observation with verification or proof in the classroom. Outdoor learning can therefore function as an exploratory phase that precedes the formalization of mathematical concepts, rather than as an isolated learning experience.

Symmetry is visible in the overall structure of Tutup Ari and in several motif arrangements. However, the study does not claim that all motifs exhibit perfect symmetry because the photographic documentation is affected by perspective, camera angle, and decorative characteristics. In instruction, this condition can be used to discuss the distinction between ideal symmetry and visual resemblance. Students can propose an axis of symmetry, reflect selected sections, and then evaluate the resulting correspondence. This process is consistent with learning approaches that encourage students to construct concepts through activity and representation rather than passively receiving definitions.

Cultural Meaning and Interpretive Caution

The Tutup Ari ornament is not merely a collection of geometric fields devoid of cultural context. The literature used in this study associates Bindu Matogu with the Dalihan Na Tolu social structure, Suncang Duri with adherence to customary norms, Singgor with flexibility in social relationships and deliberation, Silindung with the unity of a huta, and Mataniari with firmness and collective determination. Rhamayanti et al. (2022) emphasized the presence of mathematical language in the Batak community of South Tapanuli, while Rahayu (2024) specifically positioned Tutup Ari as an ethnomathematical object. These connections indicate that learning activities based on the ornament may simultaneously foster two forms of literacy: mathematical literacy and cultural literacy.

This article, however, deliberately limits its cultural claims. No interviews with customary leaders or craftspeople were conducted; therefore, the philosophical meanings of the motifs were not reconstructed from primary field data. Cultural meanings are presented only to the extent that they are supported by sources cited in the manuscript. This limitation strengthens methodological integrity: visual exploration can explain what is observable in an object, but it should not substitute for community voices when a study seeks to interpret symbolic meanings in depth. Future research could incorporate interviews with cultural practitioners to enrich this dimension.

Potential of Tutup Ari as a Contextual Learning Resource

The primary pedagogical value of the Tutup Ari replica in the city park lies in its accessibility. The object is situated in a public space that is, in principle, easier to access than cultural artifacts located in private or institutional settings. Within Realistic Mathematics Education, contexts that are close to students' experiences can function as starting points for the progressive formalization of mathematical concepts. Yonathan and Seleky (2023) showed that realistic mathematics approaches are relevant to optimizing conceptual understanding. In the case of Tutup Ari, this context is available as a tangible visual object that can be directly observed.

Its learning potential can be organized into three phases. The first phase is field exploration, during which students observe, photograph, mark geometric forms, and estimate dimensions. The second phase is classroom mathematization, in which students reconstruct the object, test properties of sides and angles, calculate dimensions using data or scale, and compare results across groups. The third

phase is cultural reflection, in which students connect the patterns they studied with local terminology and discuss why a cultural artifact can function as a source of knowledge. This three-phase model was not tested empirically in the present study but was formulated directly from the characteristics of the object and the exploratory findings.

This approach also helps prevent culture from being used merely as classroom decoration. If motifs are simply inserted into exercises without meaningful interpretive activity, cultural elements risk becoming superficial embellishments. Instead, students should be encouraged to observe the object, question its structure, and connect mathematical properties to visual evidence. (Az-Zahra, R., Azkiya, A., Ningtiyas, E., Haerani, S. M., & Farhan, 2024) and (Puspitarani, 2025) showed that cultural contexts can be positioned as learning resources that stimulate mathematical activity. In the case of Tutup Ari, this potential is further strengthened by the presence of a physical object that can be accessed within the urban environment.

For teachers, the findings can serve as a basis for developing ethnomathematics-based student worksheets. A worksheet may begin with an image of the entire Tutup Ari, followed by tasks that ask students to mark geometric figures, record their properties, select one motif for measurement, and formulate their own mathematical questions. At more advanced levels, the patterns can be extended to topics such as transformations, coordinates, ratios, and modeling. Thus, a single cultural artifact may support different levels of mathematical depth, provided that the learning objectives are clearly formulated.

Table 3. Example mapping of findings onto learning activities

Stage	Student activity	Mathematical concept	Learning product	Teacher notes
Observation	Identify and mark shapes in photographs/the object	Classification of plane figures	Annotated photograph or sketch	Emphasize property-based reasoning rather than visual resemblance
Measurement	Measure sides, diameters, or heights on a scaled sketch/photograph	Length, perimeter, area, and ratio	Table of measurements and calculations	Distinguish model measurements from actual physical dimensions
Representation	Reconstruct one motif unit	Parallelism, angles, and diagonals	Geometric construction	Use manual tools or geometry software
Pattern	Identify the repeating unit	Translation, symmetry, and regularity	Description of the pattern rule	Guide students to explain the rule verbally and symbolically
Reflection	Connect motif terminology with mathematical concepts	Mathematics-culture connections	Reflective notes	Avoid cultural claims that are not supported by adequate sources

Comparison with Previous Studies and Scientific Contribution

The findings are consistent with the broader trend in Indonesian ethnomathematics research that identifies geometric concepts in cultural artifacts. Prahmana and D'Ambrosio (2020) reported relationships between batik patterns and geometry, Septiana et al. (2023) identified mathematical concepts in Sukarara weaving, and (Musodiqoh, U. A., & Kusno, 2025) explored Palembang songket. These similarities demonstrate that cultural patterns constitute rich sources of geometric representation.

The distinctive feature of Tutup Ari is that it is an architectural ornament replicated as an urban landmark, placing it at the intersection of traditional culture and cultural transformation within contemporary public space.

When compared directly with Rahayu (2024), this study does not claim to have discovered an entirely new object. Tutup Ari had already been established as a relevant ethnomathematical object. The contribution of the present article lies in shifting the analytical focus from "where Tutup Ari is found" to "how the characteristics of public space alter its educational potential." This novelty is more substantive than a mere change of location because it concerns accessibility, opportunities for direct observation, and the design of learning activities. In other words, an already recognized cultural object can generate a new contribution when examined through a different pedagogical lens.

A second contribution is the explicit distinction between empirical findings and pedagogical recommendations. The empirical findings concern the presence and arrangement of geometric representations in the object. By contrast, RME activities, outdoor learning, and student worksheets are implications derived from those findings rather than outcomes of a classroom experiment. This distinction is important to avoid overstating that the use of Tutup Ari "improves" learning outcomes in the absence of testing data. The article therefore states that the object has the potential to serve as a learning resource and provides operational directions for subsequent development studies or classroom experiments.

This study has several limitations. First, the primary data are visual; therefore, the classification of shapes is not supported by precise architectural measurements. Second, the study did not involve customary leaders or craftspeople, so the philosophical meanings of the motifs are presented only to the extent that they are supported by the literature. Third, the study did not develop or test student worksheets or other instructional materials with students. Fourth, the angle from which photographs were taken may affect perceptions of shape and symmetry. These limitations do not diminish the exploratory value of the study, but they define the boundaries of its claims. Future research may incorporate more precise field measurements, cultural interviews, the development of student worksheets, and tests of instructional effectiveness to examine how the Tutup Ari context influences students' understanding of geometry.

CONCLUSION

The ethnomathematical exploration of the Tutup Ari replica at Padangsidempuan City Park shows that the object represents plane geometry concepts through triangles, rhombi, trapezoids, parallelograms, rectangles, and circles. These representations occur in the Bindu Matogu/Ador-ador Duri-duri, Suncang Duri/Raga-raga, Singgor, Silindung, and Mataniari motifs. The mathematical value of the object lies not only in individual figures but also in repetition, parallelism, regularity, and visual symmetry, which connect the cultural artifact with school mathematics. Compared with previous research on Tutup Ari in a government-building context, the contribution of this study lies in interpreting the replica in a public space as an accessible learning context. The city park has the potential to function as an open-air laboratory in which students observe, measure, represent, and reason about geometry through a cultural object embedded in their everyday environment. However, the study did not test instructional effectiveness and did not conduct cultural interviews; accordingly, the pedagogical implications are presented as potential rather than as evidence of improved learning outcomes.

Future research should develop Tutup Ari-based student worksheets and evaluate them at appropriate educational levels through either design-based/development research or classroom experiments. More precise field measurements could enrich activities involving scale, perimeter, area, and transformation. In addition, the involvement of customary leaders or cultural practitioners is needed to deepen the interpretation of individual motifs so that the integration of mathematics and culture extends beyond visual resemblance and appropriately acknowledges the local knowledge underlying the ornament.

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