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# Ethnomathematics in *Oko Mama* Woven Craft of the Amanuban Community: A Geometric Study

Prida N. L. Taneo[1*], Turmudi[2*], Elah Nurlaelah[3], Siti Fatimah[4]
[1,2,3,4] Department of Mathematics Education, Indonesian University of Education – Jawa Barat- Indonesia.
[1]pridataneo@upi.edu
[2*]turmudi@upi.edu
*Correspondence: correspondingauthor: turmudi@upi.edu

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***ABSTRACT***

Mathematics is often perceived as a challenging subject by students, necessitating innovative instructional approaches that enhance conceptual understanding and contextual relevance. The ethnomathematics approach presents a valuable strategy by linking mathematical ideas to cultural practices, thus fostering more meaningful learning. This study focuses on exploring mathematical concepts embedded in the *oko mama* plaiting craft tradition of the Amanuban community in South Central Timor. Through a qualitative design with an ethnographic method, the research involved direct engagement with three local artisans selected purposively based on their expertise. Data collection was conducted through semi-structured interviews, field observations, and documentation, followed by triangulation to ensure data validity. The analysis uncovered a variety of geometric concepts found in the artisans' practices. These include two-dimensional shapes such as squares, rectangles, parallelograms, rhombuses, triangles, trapezoids, and both regular and irregular hexagons and three-dimensional forms such as cubes, rectangular prisms, triangular prisms, and hexagonal prisms. Mathematical ideas involving perimeter, area, and volume also emerged through the measurement and structuring techniques used in plaiting. The study demonstrates that local cultural practices serve not only as expressions of heritage but also as rich sources of mathematical thinking. Findings highlight the potential of the *oko mama* craft to serve as a contextual learning resource for geometry education. This research contributes to the existing body of knowledge by offering a more comprehensive ethnomathematical analysis compared to earlier studies that focused narrowly on basic geometric forms and calculations.

**Keywords:** Amanuban, Ethnomathematics, Geometry, *Oko Mama*

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## Introduction

Education plays a vital role in preparing future generations to face evolving challenges. It is inseparable from culture, as the two are closely interwoven and mutually reinforcing. Without cultural grounding, education risks detaching learners from their identity Widyastuti (2021). Culture significantly influences many aspects of life, including the economy, religion, and education (Fouze & Amit, 2023). Thus, studying how mathematical ideas emerge from cultural contexts offers meaningful insights into the relationship between local practices and mathematical thinking. Education also functions as a systematic process to instill knowledge, values, and attitudes through various subjects, including mathematics (Wulandari & Isya, 2020).

Mathematics is fundamental across all levels of education. It fosters logical reasoning, patience, creativity, and problem-solving abilities (Yudha, 2019; Fauzan & Anshari, 2024), which are essential for real-life and professional settings (Kristia et al., 2021). Despite its importance, many students still perceive mathematics particularly geometry as difficult. The abstract nature of its symbols, formulas, and calculations contributes to this perception (Juliyanti et al., 2023; Sirait & Apriyani, 2020).

Geometry, in particular, presents challenges due to its formal deductive structure (Fouze & Amit, 2021). Therefore, contextual and engaging learning strategies are necessary. Integrating culture into mathematics instruction helps make abstract concepts more relatable and meaningful (Bonotto, 2007; Fouze & Amit, 2018). Culturally grounded activities support repetition, improve content retention, and boost learner confidence. Through culturally responsive teaching, students can engage with mathematical concepts embedded in local art and traditional artifacts (Pradhan, 2021).

Teaching mathematics without cultural context can hinder learning (Fouze & Amit, 2023; Gilmer, 1990). Lessons that reflect students' cultural environments make learning more relevant and impactful (Bustan et al., 2021). Ethnomathematics bridges mathematics and culture by exploring how communities conceptualize and apply mathematics in daily life (Brandt & Chernoff, 2014; Albanese & Perales, 2015; Barta & Shockey, 2006; Rawani & Fitra, 2022; Rosa & Shirley, 2016). It also includes the study of mathematical reasoning in societies without formal writing systems (Ascher & Ascher, 1997).

Ethnomathematics provides a transformative perspective in education, emphasizing values of cultural dignity and social justice (Rosa & Shirley, 2016; D'Ambrosio, 2004). It enhances students' engagement and improves their problem-solving abilities (Ogunkunle & George, 2015; Rawani & Fitra, 2021). This approach enriches mathematics education by combining intellectual rigor with cultural identity and empathy.

Indonesia's cultural diversity offers rich educational potential. One such cultural tradition is the Amanuban community's woven craft in South Central Timor. A notable artifact is the *oko mama*, a traditional container used in social and ceremonial contexts. Its geometric characteristics such as cubes and rectangular prisms make it a promising resource for teaching geometry. Several studies have explored ethnomathematical aspects of traditional weaving practices (Kristiamita et al.., 2023; Samal et al., 2023; Yanti et al., 2021), while others have focused on mathematical structures in woven patterns (Tarigan & Rakhmawati, 2024; Kurniawan & Aldino, 2024). Some have analyzed specific cultural practices in particular communities (Ispita et al., 2023; Laurens et al., 2021).

However, research specifically addressing *oko mama* (Kamengon et al., 2020; Maluk et al., 2022; Lopo et al., 2024) has not yet explored its mathematical aspects in depth. Although Beti et al. (2021) made an initial effort, their study focused only on basic measurements and angles. To date, no study has thoroughly investigated the broader range of geometric and transformational concepts inherent in the *oko mama*'s structure and motifs. This study seeks to address that gap by analyzing mathematical reasoning embedded in both the construction and decorative designs of *oko mama*. It aims to reveal how traditional artisans intuitively apply mathematical principles, contributing valuable insights to ethnomathematics and its integration into mathematics education.

## Method

This study employs a qualitative approach with an ethnographic method, aiming to identify, describe, and interpret mathematical ideas embedded in cultural practices within the Amanuban community in South Central Timor. The research focuses specifically on the traditional craft of *oko mama*, examining how mathematical thinking especially related to geometry manifests in everyday artisan practices. Data collection was conducted through three primary techniques: observation, interviews, and documentation. Observations focused on the artisans' crafting processes, including the techniques used, patterns produced, material measurement, and decision-making involved in motif arrangement. Field notes and photographs were taken in natural settings while the artisans were actively working, capturing how mathematical reasoning emerged organically in practice.

Interviews were carried out semi-structurally and conducted face-to-face in the local language, guided by a flexible protocol that allowed follow-up questions to explore emerging insights. These interviews delved into the artisans' interpretations, skills, problem-solving approaches, and cultural values reflected in their work. Documentation involved visual and textual records of finished products, tools, raw materials, and workspaces, collected through field notes, photos, and audio recordings. This triangulated approach helped enrich the data and ensure reliability across sources. The primary participants were three local artisans selected through purposive sampling. Each artisan came from a different sub-region within the Amanuban area and was recognized by their community for expertise in crafting *oko mama*. Their distinct backgrounds, varied experience levels, and stylistic preferences provided a diverse and insightful data set.

Data analysis followed an interactive and cyclical process consisting of data condensation, data display, and conclusion drawing and verification. The analytical phase began concurrently with data collection and continued through to the final reporting. Through systematic coding, categorization, and interpretation of emerging themes, mathematical ideas particularly those involving geometric reasoning and cultural measurement practices were identified from the artisans' practices and the structural features of the *oko mama* craft

## Results and Discussion

This ethnomathematical study investigates how mathematical thinking is embedded in the cultural practices of the Amanuban community in South Central Timor, particularly through the tradition of chewing betel and areca nut. This practice, found in both urban and rural areas, is a vital symbol of respect, hospitality, and friendship. In every social interaction, the offering of *sirih pinang* (betel nut and areca leaf) precedes any formal or informal engagement. These items are presented in a specific container, emphasizing their cultural significance. The container, known as *oko mama*, is more than a vessel it reflects the community's values of respect and honor. Presenting *sirih pinang* without it is seen as disrespectful.

The crafting of *oko mama* uses *polok* from lontar leaves, chosen for their ease of shaping and durability. These leaves are stretched and split based on their size, demonstrating an intuitive grasp of measurement and proportion. Each leaf contains two stalks *ket koti* (outer) and *ket nanaf* (inner) which are removed to extract usable blades. During the *pengelatan* phase, the blades are sliced using a sharp tool, with a unit called *heta* serving as a traditional guide for measurement. This process illustrates the use of informal but consistent mathematical reasoning, such as length estimation, symmetry, and proportionality.

The act of slicing lontar blades into uniform strips shows practical mathematical thinking in a cultural context. Although *heta* is not standardized, it works as a consistent reference unit informed by experience and intended function. Choosing the width of *heta* involves proportional reasoning and visual estimation, especially in crafting *oko mama*. This requires spatial awareness and uniformity, indicating how measurement, proportion, and geometry are naturally embedded in the weaving tradition. Once measured, the strips are ready for the weaving stage, using materials that reflect both cultural knowledge and mathematical precision.

**Figure 1.** *Slicing of Lontar Leaves by a Weaver*

The Amanuban community employs three primary woven craft techniques known as *pepa mese*, *pepa nua*, and *pepa tenu*. Among these, the crafting of *oko mama* predominantly utilizes the *pepa mese* technique, which is characterized by alternating each woven strand after every single leaf strip. While the *pepa nua* and *pepa tenu* techniques are also applied, their usage is relatively infrequent. The preference for *pepa mese* stems from its straightforward execution and its suitability for accommodating decorative motifs that are typically wrapped around the woven object, often concealing the underlying weave. The crafting process of *oko mama* generally begins by forming a square or rectangular base, which reflects the application of basic geometric principles such as symmetry, alignment, and measurement. A similar geometric approach is observed in the *pepa nua* technique, where artisans start with a quadrilateral layout, indicating culturally embedded mathematical reasoning in structuring woven forms. In contrast, the use of *pepa tenu* involves initiating the base in the shape of a hexagon, resulting in final forms resembling either regular or irregular hexagonal prisms. Various types, dimensions, and geometric structures of *oko mama* crafted by the Amanuban community are illustrated in Figure 2.


**Figure 2.** *Various Geometric Forms of Oko Mama*

Various forms of *oko mama*, including those not depicted in the illustrations, are analyzed based on their mathematical relevance, beginning with the base shape and the ornamental motifs applied. The most commonly encountered types used in both household settings and traditional ceremonies are shown in Figures 2a, 2b, and 2f, all featuring quadrilateral bases, typically squares or rectangles, as illustrated in Figure 3. Rather than merely identifying formal geometric attributes such as congruent sides, equal angles, or intersecting diagonals, this study highlights how these properties are intuitively practiced by artisans through their cultural techniques.

Interviews and field observations revealed that Amanuban artisans construct the base of *oko mama* by using an equal number of lontar leaf strips on each side. This method ensures the resulting form is balanced and structurally sound. They emphasized the importance of maintaining equal strip lengths and consistent corner angles to support the overall stability of the product. Based on these accounts and further visual examination, the base shown in Figure 3 can be interpreted mathematically as possessing the properties of a parallelogram, a square, and a rhombus characterized by equal side lengths, right angles, and diagonals that intersect symmetrically.

**Figure 3.** *Square-Shaped Base of Oko Mama and Its Sketch*

The base of the *oko mama*, which is woven using the *pepa mese* pattern, can also serve as an effective learning tool, especially in introducing the basic concepts of calculating the perimeter and area of a flat geometric shape. Based on Figure 3, we can calculate its perimeter by counting the number of woven squares (tiles) along each side, assuming that one square represents one unit of length. Each side contains 5 tiles, and since the square has four sides, the total number of tiles on all sides is the sum of four sides:

$$5 + 5 + 5 + 5 = 4 \times 5 \text{ units of length}$$

This can be written in a mathematical model as:

$$S + S + S + S = 4 \times S = 4S$$

This represents the formula for the perimeter of a square. Similarly, to calculate the area of the square, we observe that each side contains 5 tiles per row, and there are 5 rows. If we express this mathematically, it would be:

$$5 + 5 + 5 + 5 + 5 = 5\,x5$$

Given that 5 represents the length of each side, this can be rewritten as:

$$S \times S = S^2$$

Thus, the formula for the area of a square is $S^2$. Next, we will discuss the *oko mama* base with sides of unequal lengths.

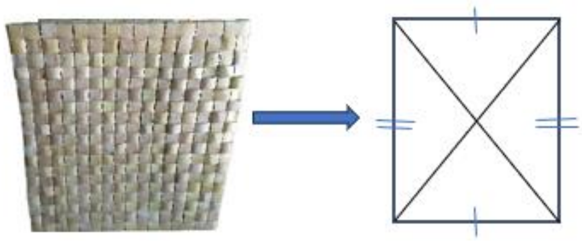

**Figure 4.** *The Rectangular Base of Oko Mama and Its Sketch*

Figure 4 displays several geometric properties: it has four sides, with each pair of opposite sides being parallel and equal in length; it has four right angles of 90 degrees; two diagonals that bisect each other equally; and two lines of symmetry. Based on these characteristics, the base of the *oko mama* in Figure 4 can be classified as both a parallelogram and a rectangle. The woven craft pattern used for this type of *oko mama* base can also be utilized as a meaningful tool in teaching fundamental mathematical concepts, particularly those related to calculating the perimeter and area of rectangular shapes. The first step involves a complete count of the total number of square units (tiles) forming the entire boundary of the rectangular base, as shown in Figure 4. This counting is performed tile by tile along each edge of the woven structure, where each tile is treated as one unit of length. Upon detailed observation, the base comprises 19 tiles along the longer side and 16 tiles along the shorter side. The perimeter can therefore be calculated by summing all four sides sequentially: $19 + 16 + 19 + 16 = 70\, units$.

This total count is then expressed as a repeated addition of opposite sides, written a $19 + 16 + 19 + 16$. To introduce algebraic representation, the longer side is assigned as $p$ (length) and the shorter side as $l$ (width), transforming the sum into $p + l + p + l$, which simplifies to $2p + 2l$, and further to $2(p + l)$. This process demonstrates how an everyday activity such as counting the number of repeated strips in a woven base can naturally lead to the mathematical concept of perimeter, using both arithmetic and algebraic reasoning.

A similar approach applies when introducing the concept of area. Instead of focusing only on side lengths, the area is derived from the total number of square tiles that fill the surface. With 16 tiles in each row and 19 rows in total, the number of square units covering the surface is $19 \times 16 = 304$ tiles. Generalizing this, if $p$ represents the number of tiles along the length and $l$, the number along the width, then the area is given by $p \times l$. Hence, the formula for the area of a rectangle is $A = p \times l$. The next section will explore the *oko mama* base with three sides, as illustrated in Figure 5.

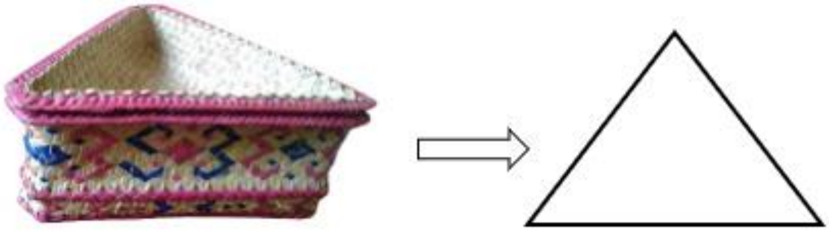

**Figure 5.** *Oko Mama Base with Three Equal Sides*

Figure 5 shows that the base of the *oko mama* is in the shape of an equilateral triangle. The following properties have been identified: the base has three sides of equal length and three angles of equal measure, which is why the base in Figure 5 is classified as an equilateral triangle. However, this *oko mama* is woven using the *pepa tenu* technique, which does not readily lend itself to the introduction of concepts for calculating its area and perimeter. Therefore, an alternative approach is required for such calculations.

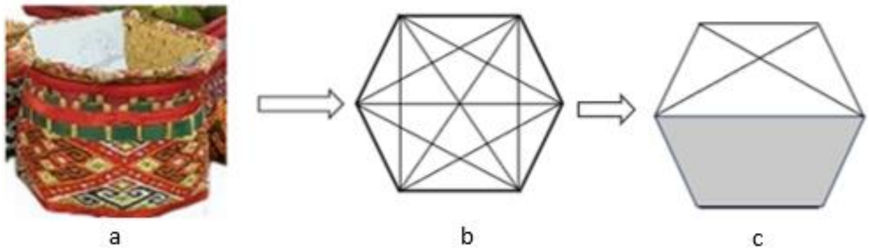


**Figure 6.** *The Base of Oko Mama with Six Equal-Length Sides and Its Sketch*

Based on Figure 6, the characteristics of the base of the shape can be identified as follows: it has six equal-length sides, six congruent angles, six lines of reflective symmetry, six rotational symmetries, nine diagonals, and it can be divided into six equilateral triangles. Given these properties, the base of the *oko mama* with six equal-length sides is classified as a regular hexagon. This type of *oko mama* is woven using the *pepa tenu* woven craft pattern, which makes it unsuitable for introducing the concepts of area and perimeter calculation. The base of the *oko mama* in the form of a regular hexagon, when one of its main diagonals is drawn as shown in Figure 6(c) can be divided into two congruent trapezoidal shapes. These fulfill the characteristics of a trapezoid, which include having four sides and four angles, one pair of parallel sides, adjacent angles along the parallel sides that are supplementary, and two diagonals of equal length that always intersect. The resulting trapezoids are classified as isosceles trapezoids. Another variant of the *oko mama* shape with six sides though not all of equal length is shown in Figure 7.

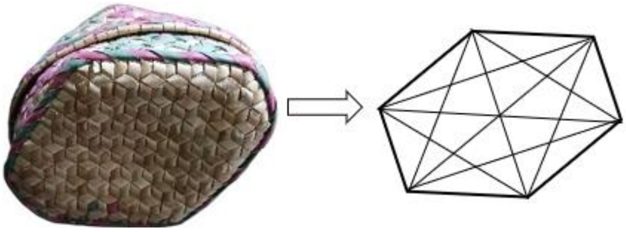

**Figure 7.** *Oko Mama with a Hexagonal Base and Its Sketch*

The base shape in Figure 6 appears to have six sides of unequal length, six angles, two lines of symmetry, and nine diagonals. Based on the analysis of its properties, the shape of the base in Figure 7 is identified as an irregular hexagon. From the sketch shown in Figure 7, it can also be decomposed into an isosceles trapezoid and a scalene trapezoid. Next, the spatial (three-dimensional) geometric shapes that can be identified from the *oko mama* woven craft will be examined.

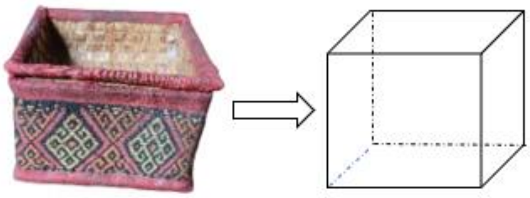

**Figure 8.** *Oko Mama in the Form of a Cube and a Rectangular Prism*

The *oko mama* comes in various sizes and shapes, depending on the creativity and preferences of the artisan. Figure 8 shows an *oko mama* with equal length, width, and height. Therefore, the characteristics of this shape must first be identified. The *oko mama* in Figure 8 has six congruent flat surfaces: the base, the lid, and four vertical sides front, back, left, and right. It has eight vertices, twelve edges formed at the intersection of its surfaces, all of equal length, as well as face diagonals and space diagonals. Based on this identification, the three-dimensional shape of the *oko mama* in Figure 8 can be categorized as a rectangular prism. However, since it possesses specific properties such as all faces being squares and all edges having equal lengths it can also be classified as a cube.

The *oko mama* structure in the form of a cube or a rectangular prism can also serve as a meaningful tool for introducing mathematical concepts, particularly those related to surface area and volume. Since all of its faces are squares, the concept of surface area can be introduced by applying the formula for the area of a square: side × side. Given that the cube has six congruent square faces, the total surface area is calculated using the formula:

$$\text{Surface Area} = 6 \times (\text{side} \times \text{side}) = 6S^2$$

Similarly, the concept of volume can be developed by imagining each unit of volume as representing one square of the woven surface, whether in terms of length, width, or height. To determine the volume, we first calculate the number of unit squares forming the base, which is obtained by:

$$\text{Base Area} = \text{side} \times \text{side} = S^2$$

Then, the number of such layers stacked vertically to reach the full height equal to the side length in a cube is counted. Thus, the formula for the volume becomes:

$$\text{Volume} = \text{side} \times \text{side} \times \text{side} = S^3$$

This practical application of traditional woven structures offers students a tangible and culturally relevant way to grasp abstract mathematical concepts. The following section will discuss the *oko mama* with unequal side lengths, as illustrated in Figure 9.

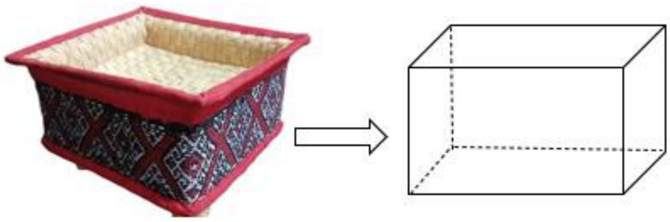

**Figure 9.** *Oko Mama in the Form of a Rectangular Prism and Quadrilateral Prism*

Another form of *oko mama*, as shown in Figure 9, features side lengths that vary in size. To better understand the geometric characteristics, we begin by identifying its inherent properties. The *oko mama* depicted in Figure 9 has six faces, all of which are rectangular. The opposite faces are congruent, and the object has twelve edges, with parallel edges being of equal length, as well as eight vertices. Based on this identification, the shape satisfies the characteristics of both a quadrilateral prism and a rectangular prism (cuboid). This particular form of *oko mama* is also woven using the *pepa mese* technique, making it suitable for exploring mathematical concepts such as surface area and volume of three-dimensional objects. The instructional approach can follow the same conceptual model used when calculating the surface area and volume of a cube. Accordingly, the formula for calculating the surface area of a rectangular prism is:

$$A = 2(pl + pt + lt)$$

And the volume can be determined using:

$$V = p \times l \times t$$

Where:

- $p$ = length,
- $l$ = width,
- $t$ = height.

In the next section, we will explore an *oko mama* whose base has three sides, as shown in Figure 10.

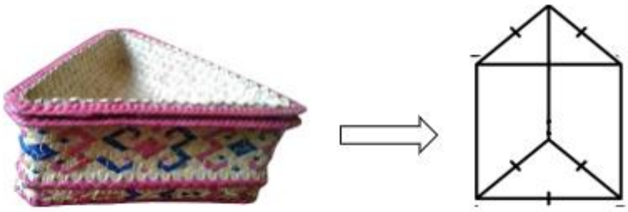

**Figure 10.** *Oko Mama in the Form of a Triangular Prism*

Figure 10 shows an *oko mama* with a base shaped like an equilateral triangle. The overall structure of this particular *oko mama* will now be identified. The identified characteristics include five faces, where the base and the top are congruent equilateral triangles. The remaining three faces are rectangular lateral faces. The shape also has six vertices, nine edges three of which are vertical and equal in length and no pairs of opposite lateral edges or faces. Based on the analysis, it can be concluded that the o*ko mama* shown in Figure 10 is a triangular prism. The approach to teaching the concepts of surface area and volume must be adjusted due to the use of *pepa tenu* woven craft, which does not clearly display unit squares. Next, the identification of an *oko mama* with a regular hexagonal base, as shown in Figure 11, will be discussed.

**Figure 11**. *Oko Mama in the Form of a Regular Hexagonal Prism*

Figure 11 shows an *oko mama* with a three-dimensional geometric shape, which must first be identified to determine its geometric classification. Based on Figure 11, the *oko mama* has the following properties: it possesses 12 vertices and 18 edges 6 of which are vertical edges. It also has 8 faces, consisting of 6 rectangular lateral faces and 2 congruent bases that are regular hexagons. In addition, it features both face diagonals and space diagonals. This analysis indicates that the *oko mama* depicted in Figure 11 is a regular hexagonal prism. However, this form does not allow for direct implementation of surface area and volume calculations due to the use of the *pepa tenu* woven craft technique. Therefore, alternative pedagogical approaches are required for teaching these geometric concepts. The next *oko mama* to be examined, as shown in Figure 12, features a hexagonal base with unequal side lengths.

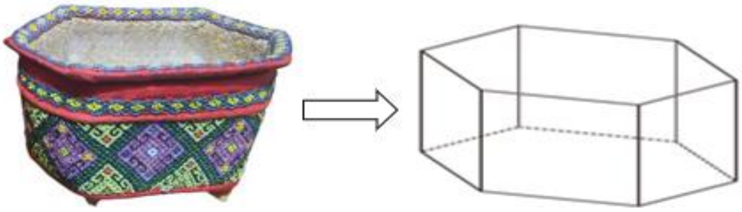

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**Figure 12.** *Oko Mama in the Form of an Irregular Hexagonal Prism*

The *oko mama* shown in Figure 12 is woven using the *pepa tenu* technique, in which the addition of strips during the woven craft process is not symmetrical at each angle. As a result, the base of the *oko mama* takes the shape of an irregular hexagon. Several geometric properties can be observed from this form. Both the base and the top of the object are irregular hexagons, indicated by unequal side lengths and varying interior angles. The shape consists of eight faces six lateral faces that are rectangular in shape, and two bases (top and bottom) in the form of irregular hexagons. It also has twelve vertices and eighteen edges, with its diagonals not intersecting at a central point due to the irregularity of the base. Based on these characteristics, it can be concluded that the *oko mama* in Figure 12 represents a three-dimensional irregular hexagonal prism.

A range of mathematical concepts that can be explored from the *oko mama* woven craft are comprehensively presented in Table 1

***Table 1.*** *Geometric Concepts Identified in the Woven Craft of Oko Mama*

| No | Forms of *Oko Mama* | Identified Geometric Concepts |
|---|---|---|
| 1 |  | The properties and elements of plane figures such as parallelograms, squares, and rhombuses, as well as solid figures like cubes and rectangular prisms, include the concepts of calculating the perimeter and area of a square, and the surface area and volume of a cube. |
| 2 |  | The properties and elements of plane figures such as parallelograms and rectangles, as well as solid figures like rectangular prisms and quadrangular prisms, are discussed along with the concepts of calculating the perimeter and area of a rectangle, and the surface area and volume of a rectangular prism. |
| 3 |  | The properties and elements of plane figures such as equilateral triangles, as well as solid figures like triangular prisms, are discussed. |
| 4 |  | The properties and elements of plane figures such as regular hexagons and isosceles trapezoids, as well as solid figures like regular hexagonal prisms, are discussed. |
| 5 |  | The properties and elements of plane figures such as irregular hexagons and isosceles trapezoids, as well as solid figures like irregular hexagonal prisms, are discussed. |

As presented in Table 1, different forms of *oko mama* reflect a variety of geometric concepts rooted in plane and solid geometry. Each woven design carries mathematical structure and meaning, offering aesthetic and functional value while also serving as a contextual learning medium. These findings support Pradhan and Orey (2021), who state that mathematical practices are passed through generations in cultural groups. Similarly, Pradhan (2023) argues that every culture naturally engages in mathematics through counting, measuring, designing, and playing. This aligns with Gattegno's view that mathematics develops through cultural activity (Frankenstein & Powell, 2023).

The results affirm that *oko mama* can enrich culturally contextualized math instruction. Connecting mathematics to students' cultural environments enhances learning (Bustan et al., 2022; Sudirman et al., 2018). The integration of culture into education makes mathematical content more relatable and improves academic performance (Fouze & Amit, 2023). Moreover, integrating culture into mathematics learning has been shown to improve students' academic performance (Fouze & Amit, 2019).

This research goes beyond identifying shapes. By engaging with artisans and documenting their decision-making, the study reveals the reasoning behind shape choices, symmetry, and proportions driven not by formulas but by cultural logic and visual harmony. These practices embody mathematical thinking situated in lived experience. Thus, *oko mama* is not just a craft but a meaningful representation of mathematical reasoning deeply rooted in local wisdom and everyday practice.

## Conclusion

The *oko mama* weaving tradition of the Amanuban community, preserved across generations, reflects rich mathematical thinking, especially in the field of geometry. Although the artisans have no formal mathematical training, their work reveals an intuitive understanding of plane and solid shapes such as squares, rectangles, parallelograms, cubes, prisms, and more as well as concepts like perimeter, surface area, and volume. These findings show that *oko mama* is not only a cultural artifact with aesthetic and functional value but also a meaningful learning resource for geometry instruction.

Grounding mathematics education in cultural contexts like *oko mama* helps students connect abstract concepts to their lived experiences, increasing comprehension, confidence, and interest. As supported by Fouze and Amit (2023), culturally based learning enhances academic achievement and fosters stronger cultural identity. Therefore, integrating the geometric concepts embedded in *oko mama* into classroom practice through an ethnomathematical lens offers a powerful strategy to make mathematics more relevant, accessible, and inclusive.

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