JAMBURA JOURNAL OF MATHEMATICS EDUCATION
Jambura J. Math. Educ. Vol. 6, No. 1, pp. 59-66, Maret 2025
Journal Homepage: http://ejurnal.ung.ac.id/index.php/jmathedu
DOI: https://doi.org/10.37905/jmathedu.v6i1.34009

Ethnomathematics of Ilabulo: Exploring Mathematical Concepts in Gorontalo's Traditional Food

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INFO ARTIKEL

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Received:
31 March 2025

Accepted:
30 June 2025

Online
1 July 2025

Format Sitasi:
T. Damayanti and A. Irfah, "Ethnomathematics of Ilabulo: Exploring Mathematical Concepts in Gorontalo's Traditional Food" *Jambura J. Math. Educ.*, vol. 6, no. 1, pp. 59-66, 2025.

ABSTRACT

Mathematics is often perceived as abstract and disconnected from students' daily lives, yet ethnomathematics highlights that mathematical ideas are embedded in cultural practices. This study explores the ethnomathematical concepts found in the preparation of *Ilabulo*, a traditional food of Gorontalo, Indonesia, through a qualitative ethnographic approach involving observation, documentation, and informal interviews with two local participants. The findings reveal two main concepts: ratio and proportion in mixing ingredients and geometry in wrapping and shaping, both of which were mapped to relevant school mathematics topics and further developed into contextual word problems. In addition, the study suggests that the process of preparing *Ilabulo* can be adapted into a video-based learning resource to support the problem-orientation stage in Problem Based Learning (PBL). These results demonstrate that everyday cultural practices can serve as meaningful contexts for mathematics learning, making abstract concepts more engaging and relevant while also strengthening students' cultural identity.

Keywords: ethnomathematics; Ilabulo; Gorontalo traditional food; mathematics learning

1. Introduction

Mathematics is a discipline that plays a central role in human life, yet it is often perceived by students as abstract and disconnected from their daily experiences. This perception frequently contributes to difficulties in learning mathematics and leads to low levels of engagement and achievement. To address this challenge, researchers have emphasized the importance of contextualizing mathematics in meaningful situations that are familiar

to learners [1], [2]. One promising approach is ethnomathematics, a field introduced by D'Ambrosio [1], which explores the relationship between mathematics and culture.

Ethnomathematics asserts that mathematical ideas are not exclusively the product of formal schooling but are also embedded in cultural practices, traditions, and daily activities [2]-[5]. Prior studies have revealed that cultural artifacts, traditional games, crafts, and food preparation embody mathematical concepts that can enrich mathematics education [6]-[12]. Integrating culture into teaching enables students to appreciate mathematics, strengthens problem-solving skills, and makes learning more relevant to their lives.

In Indonesia, numerous studies have investigated ethnomathematics in traditional games, handicrafts, batik patterns, and culinary practices [10], [11], [13]-[15]. For instance, research has highlighted the integration of mathematical concepts in *lepet ketan*, *terang bulan*, and other traditional foods [13]-[15]. In the context of Gorontalo culture, however, ethnomathematics research remains relatively scarce. Existing studies have primarily examined the Dulohupa Traditional House and the Karawo traditional fabric in relation to transformation geometry [16], [17]. Despite these contributions, no study has specifically explored ethnomathematics in Gorontalo's culinary traditions, leaving a research gap that warrants further investigation.

This study addresses that gap by investigating *Ilabulo*, one of Gorontalo's most distinctive traditional foods. Widely consumed in both everyday life and ceremonial events, *Ilabulo* not only serves as a nutritional source but also embodies cultural identity [18]. Importantly, its preparation reflects mathematical elements such as ratio and proportion in mixing ingredients and geometry in wrapping. By exploring these practices, this study positions traditional food as a culturally meaningful context for teaching mathematics, thereby offering a fresh perspective to ethnomathematics research. The aim is to uncover the mathematical ideas embedded in *Ilabulo* and to explore their potential integration into contextual mathematics learning.

2. Methods

This study employed a qualitative ethnographic design to explore mathematical concepts embedded in the preparation of *Ilabulo*, a traditional food of Gorontalo, Indonesia. Two native participants were involved: one vendor who regularly produces and sells *Ilabulo*, and one community member who makes it for household consumption. Their perspectives allowed the study to capture both economic and domestic practices.

Data were collected primarily through direct observation and documentation of the Ilabulo-making process. Observations were carried out to capture details of the activities, such as mixing ingredients, wrapping the mixture in banana leaves, arranging and steaming the food, and serving it. Documentation took the form of field notes and photographs, while informal conversations with local food makers were conducted to gain deeper insights into the procedures and cultural values surrounding Ilabulo.

Data analysis followed an interactive model of reduction, display, and conclusion drawing. The analysis consisted of describing cultural practices, interpreting them in relation to mathematical concepts, and mapping the findings to school mathematics

content. Particular emphasis was placed on identifying ratio and proportion in ingredient mixing and geometric ideas in the shape and dimensions of the wrapped *Ilabulo*. Credibility was ensured through source triangulation, comparing and contrasting information obtained from both participants.

3. Results and Discussion

3.1. Cultural and Culinary Context of Ilabulo

Ilabulo is one of the most distinctive traditional foods of Gorontalo and represents both daily sustenance and cultural identity. It is widely consumed during special events such as weddings, family gatherings, and traditional ceremonies, yet also found in everyday contexts through local markets and street vendors [18]. The main ingredients include sago flour (**Figure 1**), chicken liver, gizzard, coconut milk, and various spices such as garlic, chili, and pepper. The mixture is carefully wrapped in banana leaves shaped into rectangular packages, then steamed for approximately 25 minutes or grilled over charcoal [19][20].

Figure 1. Sago flour, the main ingredient of Ilabulo

Beyond its culinary significance, Ilabulo carries symbolic meaning. The sticky texture of sago represents the local philosophy of *totombowata*, meaning "unity," which symbolizes harmony in diversity within Gorontalo society. Nutritionally, Ilabulo provides carbohydrates from sago and protein from chicken liver and gizzard, making it a balanced food that reflects the wisdom of local food practices. This cultural and nutritional richness creates a strong foundation for its use as an ethnomathematical object, where mathematical concepts can be drawn from everyday cultural practices.

The detailed preparation of Ilabulo was documented through direct observation and informal interviews with local food makers in Gorontalo. The process begins by boiling chicken liver, cutting it into small pieces, and mixing it with ground spices and coconut milk. Sago is then gradually incorporated to form a uniform mixture, which is heated until thickened. The mixture is wrapped in banana leaves and steamed for 20–25 minutes, during which the leaves turn brownish-green, signaling that the food is cooked.

At this stage, Ilabulo can already be consumed, but in many cases it is further grilled (*Ilabulo bakar*) over charcoal fire to enhance its aroma and flavor. This variation demonstrates not only the culinary creativity of the Gorontalo people but also provides richer cultural material that can be contextualized in mathematics learning. (**Figure 2**).

Figure 2. Cooked Ilabulo wrapped in banana leaves, ready to be served as a traditional Gorontalo dish.

3.2 Ratio and Proportion in Ilabulo Preparation

The preparation of Ilabulo strongly reflects the use of **ratio and proportion**, especially in mixing ingredients. Local cooks naturally apply proportional reasoning when balancing sago, coconut milk, and spices to achieve the desired texture and taste. For example, if the ratio of sago to coconut milk is set at 2:1, doubling the amount of sago requires doubling the coconut milk to maintain the same consistency. Similarly, when the recipe is scaled up to serve more people, each ingredient is increased in the same proportion. Such practical examples can be translated into mathematics problems that students may encounter in school (see **Figure 3**). This contextualized practice helps students understand that ratio and proportion are not only abstract mathematical concepts but also essential tools embedded in everyday decision-making.

A recipe for Ilabulo uses 200 g of sago and 100 ml of coconut milk, giving a ratio of 2:1.

a. **If a cook wants to prepare twice the amount, how much sago and coconut milk are needed?**
b. **If 300 g of sago are available, how much coconut milk should be used to keep the same ratio?**

Figure 3. Example Problem: Ratio and Proportion

3.3 Geometrical Concepts in Ilabulo Preparation

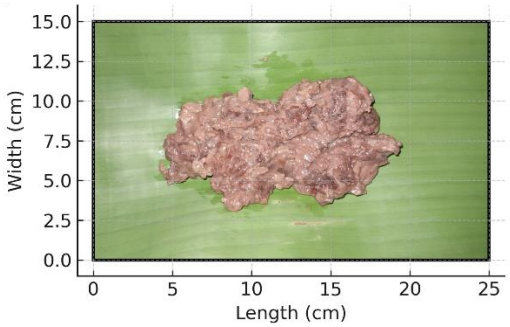
In addition to ratios, Ilabulo also illustrates fundamental concepts in geometry. The food itself, when wrapped in banana leaves, resembles a rectangular prism (cuboid), even though in practice it is not perfectly regular. Its approximate dimensions, for example 10 cm × 4 cm × 1 cm, allow students to calculate volume using standard formulas. At the same time, the banana-leaf wrapper provides opportunities to explore plane geometry,

since it is typically cut in the form of a rectangle. Both contexts connect directly to the elementary mathematics curriculum, enabling students to learn about three-dimensional and two-dimensional figures through a culturally meaningful object. These applications can be further illustrated through contextualized mathematics tasks (see **Figure 4** and **Figure 5**).

An Ilabulo is modeled as a cuboid with dimensions 10 cm × 4 cm × 1 cm.

a. **What is its volume?**
b. **If a vendor makes 50 pieces of Ilabulo of this size, what is the total volume?**

Figure 4. Example Problem: Solid Geometry (Volume)



A banana leaf used for wrapping Ilabulo is cut into a rectangle measuring 15 cm × 25 cm.
Calculate its area.

a. **Calculate its perimeter.**
b. **If the leaf is folded exactly in half lengthwise, what are the new dimensions and area?**

Figure 5. Example Problem: Plane Geometry (Rectangle)

3.4 Discussion

The results of this study confirm that Ilabulo, as a traditional culinary practice, provides a culturally grounded context for learning mathematical concepts. The identification of ratios and proportions in ingredient mixing, and geometrical concepts in the form and wrapping of Ilabulo, illustrates how mathematical reasoning naturally emerges from daily cultural activities. This demonstrates that mathematical ideas are not confined to classrooms but are embedded in the lived practices of communities, aligning with D'Ambrosio's [1][2] perspective on ethnomathematics.

These findings are consistent with previous research highlighting the potential of traditional food as a resource for mathematics education. Studies on lepet ketan [14], terang bulan [15], and other traditional foods [13] have revealed similar connections between food preparation and mathematical ideas. The present study extends this line

of work by situating Ilabulo within the Gorontalo context, thereby enriching the growing body of Indonesian ethnomathematics research and addressing the previously identified gap concerning Gorontalo's culinary traditions.

From a pedagogical standpoint, integrating *Ilabulo* into mathematics teaching supports the principles of contextual and culturally responsive education. In particular, the preparation of *Ilabulo* offers an authentic and engaging way to teach ratio and proportion. For instance, students can explore how altering the amount of sago requires proportional adjustments of coconut milk to maintain texture, or how scaling the recipe for more servings requires proportional reasoning. Embedding such problems in a cooking context helps students see ratio and proportion not as abstract concepts, but as practical tools embedded in everyday decision-making. As noted by Prahmana [10] and Rosa & Orey [7], embedding cultural contexts in instruction enhances both cognitive understanding and affective appreciation of mathematics.

This approach also has implications for lesson design. Teachers may develop problem-based tasks inspired by *Ilabulo* preparation, encouraging students to calculate ingredient quantities, predict outcomes, and verify results through reasoning. These activities can foster collaboration, since cooking naturally involves cooperation, planning, and shared responsibilities. At the same time, learning mathematics through local culinary practices strengthens cultural identity and pride among Gorontalo students, aligning with the goals of culturally responsive pedagogy.

In addition, the process of making Ilabulo can be developed into a video-based learning resource, particularly for the problem-orientation stage in Problem Based Learning (PBL). By presenting authentic scenarios from cooking practices—such as determining ingredient proportions or exploring the geometric form of the wrapping—students are encouraged to engage in inquiry, collaboration, and problem-solving within a meaningful cultural context. Such media not only increases student engagement but also provides teachers with practical tools for implementing culturally relevant PBL.

Nevertheless, the study has limitations. The findings are based on qualitative exploration of cultural practices and have not yet been implemented in formal classroom interventions. Further empirical studies are needed to examine the effectiveness of Ilabulo-based tasks in improving students' mathematical achievement and problem-solving abilities. In addition, extending the analysis to other mathematical domains—such as measurement, statistics, or algebra—could provide richer insights into the full scope of mathematical reasoning embedded in Ilabulo preparation.

Overall, the study reaffirms the value of ethnomathematics in bridging culture and mathematics learning. By contextualizing mathematics in Ilabulo, educators can demonstrate that mathematics is not an isolated discipline but a human activity interwoven with culture, tradition, and daily life.

4. Conclusion

This study revealed that the preparation of *Ilabulo*, a traditional food of Gorontalo, contains mathematical concepts that can be integrated into classroom learning. The findings highlight the presence of ratio and proportion in mixing ingredients, as well as geometry in the shapes and dimensions of the wrapping. These results demonstrate that everyday cultural activities, such as food preparation, can serve as rich contextual sources for connecting abstract mathematical ideas with students' real-life experiences.

Accordingly, *Ilabulo* can be utilized as a culturally based learning medium that not only strengthens students' mathematical understanding but also fosters appreciation for local cultural identity. Moreover, the cooking process of *Ilabulo* can be further developed into a video-based learning resource to be used as the problem-orientation stage in Problem Based Learning (PBL). Such an approach provides students with authentic problem contexts while equipping teachers with practical tools to support contextual and culturally responsive mathematics instruction.

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