



Ethnomathematics: Integration of Mathematical Concepts in The Preparation of Cireng Isi, a Traditional West Javanese Food

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Abstract: Mathematics is closely related to human activities and can be found in everyday life, including traditional food production. Mathematics learning becomes more meaningful when linked to contextual objects familiar to students, such as regional specialty foods. This study aims to identify and analyze mathematical concepts in making *cireng isi*, a traditional West Javanese food, to integrate them into mathematics learning. This research employs a qualitative descriptive method with an ethnographic approach. Data were collected through observations at the production site, interviews with *cireng isi* makers, and documentation of the production process. The findings indicate that the making of *cireng isi* involves the application of social arithmetic concepts in pricing and plane geometry concepts in its physical shapes, including circles, semicircles, trapezoids, rectangles, triangles, and kites. The study concludes that traditional food can serve as an effective learning medium for understanding mathematical concepts contextually. This study contributes to education by providing an alternative ethnomathematical-based approach that enhances student engagement and strengthens their comprehension of mathematical concepts through local culture.

Keywords: *cireng isi*; ethnomathematics; plane figures; social arithmetic

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INTRODUCTION

Mathematics cannot be separated from human life. Mathematical concepts can be found in various daily activities, from geometric shapes, numbers, and patterns to arithmetic operations. One branch of mathematics that studies how mathematics is practiced in a particular cultural context is ethnomathematics. Ethnomathematics bridges academic mathematics and practical mathematics applied in people's lives (D'Ambrosio, 1985; Marsigit et al., 2018; Ramadhani et al., 2023). Mathematical concepts are related to elements of community culture, such as community values or traditions, traditional buildings, traditional dances, and traditional food. Ethnomathematics research on the community includes values or traditions, such as Javanese Primbon at weddings (Utami et al., 2019). Ethnomathematics research on traditional buildings includes Sasak house architecture on geometric concepts (Supiyati et al., 2019), Toba Batak bolon houses on two-dimensional concepts (Sihombing & Tambunan, 2021), Riau traditional houses on the concepts of symmetry, congruence, transformation, and two-dimensional shapes (Fatimah et al., 2022), array traditional house to the concept of geometric transformation (Wikaningtyas et al., 2022), traditional tongkonan house from Toraja land to the concept of flat, tube, and cone build (Wahyuni et al., 2023). Ethnomathematics can also be found in traditional dances, including the Lio tribe's dance movements on the concepts of lines, angles and triangles (Naja et al., 2021), the traditional Banjar Baksa Kembang dance on the concepts of lines, angles, triangles, reflections and rotations (Habibah et al., 2022), honey pineapple dance to the concepts of geometry, and lines and angles (Nuraini et al., 2023), manuk dadali dance on the concept of angles, two-dimensional geometry and transformation geometry (Angel & Saija, 2023), Endel mask dance on vector concept (Qurohman et al., 2024).

Research is also interesting in studying traditional food, including *Cireng Isi*. *Cireng Isi* is a typical West Javanese food made from tapioca flour, water, and spices. Mathematical elements can be found in manufacturing, especially in two-dimensional shapes. *Cireng isi* is a very popular food among the people of West Java. Apart from its delicious taste, *cireng isi* has attractive visual characteristics. The geometric shapes seen in *cireng isi*, such as circles, semicircles, rectangles, and trapezoids, have the potential to be studied in more depth from an ethnomathematics perspective. By analyzing the concepts of two-dimensional shapes contained in making *cireng isi*, it is hoped that we can increase our insight into mathematics in the context of local culture.

Ethnomathematics research on traditional foods has strong relevance to mathematics learning in schools. Integrating traditional food elements, such as *cireng isi*, make mathematics learning more contextual and meaningful for students. They can understand the concepts of two-dimensional shapes more realistically and closer to everyday life. This aligns with mathematics learning objectives, emphasizing mastery of concepts and the ability to apply them in various real situations. Apart from providing benefits in mathematics learning, this research is also expected to contribute to efforts to preserve local culture. *Cireng isi*, one of West Java's

traditional foods, has historical and cultural value that needs to be preserved. Exploring the mathematical concepts contained in it is hoped to foster a deeper appreciation and understanding of the richness of local culture, especially among the younger generation.

Research on ethnomathematics regarding traditional food is dominant in geometry and numbers (Fitriani & Putra, 2022). Ethnomathematics also exist in the pre-existing traditional foods, such as Bugis food (Pathuddin & Raehana, 2019), Sasak food (Sumayani et al., 2020), Karawang semprong cake (Rusmayanti & Sutirna, 2020), Malay *daik lingga* (Minah & Izzati, 2021), *lepet* sticky rice (Werdingingsih, 2022), Lampung traditional cake (Merliza et al., 2022), West Javanese block cake (Salsabila et al., 2022), Pekalongan food (Saniyah & Ardiansyah, 2023), Majalengka food (Herayanti et al., 2023), rengginang (Indriyani et al., 2023), and enbal from Kei Islands (Layan et al., 2023).

Although many ethnomathematics studies have been on traditional foods, none have specifically examined the mathematical concepts in making *cireng isi*, a traditional West Javanese food. The novelty of this research lies in exploring the mathematical concepts in the *cireng isi* production process through an ethnomathematical approach. This approach is expected to reveal various geometric shapes when making *cireng isi*. The contribution of this study not only enriches the understanding of the relationship between mathematical concepts and local cultural food but also supports the development of ethnomathematics-based learning models. The findings of this research are expected to serve as a reference for educators in designing more contextual and meaningful learning strategies, thereby enhancing students' understanding of mathematics in everyday life.

METHODS

This study employs a qualitative approach to explore the mathematical concepts in making *cireng isi* within the context of local culture. According to Creswell (2014), qualitative research is used to understand the meanings individuals or groups assign to a phenomenon within its natural setting. A qualitative approach is highly relevant in ethnomathematics studies as it allows researchers to examine the relationship between mathematical concepts and cultural practices (Rosa & Orey, 2021). Moreover, this method enables researchers to obtain factual data through observation, interviews, and documentation, providing a more comprehensive understanding of how mathematics is applied in everyday life (Miles et al., 2014). The research stages are shown in Figure 1.



Figure 1. Research Stages

Selection of location for the production of *cireng isi* in Galanggang Village, Batujajar District, West Bandung Regency. Direct observation at the location where *cireng isi* was made to understand the cultural context of this traditional West Java food in depth. Interviews with *cireng isi* makers were conducted to dig up information regarding the shapes of *cireng isi*, which resemble the two-dimensional shape concept. Documentation was in the form of photos of *cireng isi* that resembles a two-dimensional shape. Data from observation, interviews, and documentation of making *cireng isi* were analyzed. Interpretation of the data analysis to understand the cultural value of traditional *cireng isi* is linked to two-dimensional shapes.

Participants in this research were *cireng isi* makers in a home industry in Galanggang Village, Batujajar District, West Bandung Regency, West Java. This location was chosen because access is easy, and the makers are willing to provide comprehensive information on making *cireng isi*. This research instrument used were observation guidelines, interview guidelines, and a cellphone camera to document the making of *cireng isi*. The observation guide includes aspects of the stages of making *cireng isi*, the geometric shape of *cireng isi*, the size of *cireng isi*, and the printing process for *cireng isi*, which resembles a two-dimensional shape concept. The interview guide covers aspects of the beginning of the home industry for *cireng isi*, the ingredients for making *cireng isi*, the stages of making *cireng isi*, and the use of mathematical concepts in the form of *cireng isi*.

Data from observations, interviews, and documentation were analyzed descriptively, with stages of data reduction, data presentation, and conclusions drawn (Miles et al., 2014). Data reduction was made to simplify and transform data obtained from the location, such as by identifying two-dimensional shape concepts when making *cireng isi*. The data was presented in descriptions and tables to simplify the analysis process so that a clear picture of the concepts of two-dimensional shapes found in making *cireng isi* is obtained. Conclusions were drawn to obtain an interpretation of the findings by linking the concepts of two-dimensional shapes with the cultural values of traditional *cireng isi*. The interpretation process uses triangulation of observation data, interviews, and documentation to obtain data validity (Creswell, 2014).

RESULT AND DISCUSSION

From the observations and documentation, information was obtained on the stages of making cireng isi. Information from makers indicates that there are three stages in making cireng filling. Make a dough containing a mixture of wheat flour, tapioca flour, salt, pecin, and water using a mixing machine. The dough is thinned using a rolling machine. The dough is filled with chicken, beef, sausage and cheese. The shape of the cireng isi is made to resemble a two-dimensional shape. The following are the researcher's interviews with makers regarding the origins of the home industry of cireng isi, its ingredients, food security, size, number of production per day, and the unit price of cireng isi.

Researcher: What is the name of this home industry for cireng isi?

Maker: Cireng isi "Cinta"

Researcher: How did this home industry start?

Maker: It was established in 2018. It started as a reseller of cireng products. After having capital, we started a home industry and our own cireng.

Researcher: What are the ingredients for making this cireng isi?

Maker: The ingredients for the skin are water, wheat flour, tapioca flour, salt, and MSG. The ingredients for the filling are chilies, onions, chicken, cheese, meatballs, and beef.

Researcher: How long can cireng last?

Maker: At room temperature, it can last for 2 days. If refrigerated, it can last up to 5 days.

Researcher: What are the shapes and flavors of this cireng isi?

Maker: Large size, semi-circle shape, comes in original chicken, spicy chicken, and beef flavors. Small size, semi-circle shape, comes in chicken and sausage flavors. The love shape is beef-flavored, and the house shape is cheese-flavored.

Researcher: What size is this cireng isi?

Maker: Small size is 10 cm in diameter. Large size is 14 cm in diameter.

Researcher: How much does this cireng isi cost?

Maker: Small size is Rp 600. Large size is Rp 1,500

Researcher: How many cireng isi are produced daily?

Maker: Around 20,000 pieces

Researcher: How many employees work in this home industry?

Maker: There are 19 employees. The production department has 11 people. Four people each at the cireng filling station, including the driver.

Researcher: How much is the capital and profit from making this cireng isi per day?

Maker: Capital per day IDR 5,500,000, and profit per day IDR 3,000,000

Researcher: How many hours does this home industry operate per day?

Maker: 8 hours. Starting from 09.00-17.00 WIB.

Researcher: Where are the buyers from?

Maker: Soreang, Marga Asih, Batujajar, Cimareme, Padalarang, Cihampelas, and Cililin

Based on the interview, information on the selling price of cireng isi can be used to construct social arithmetic questions contextually. Teachers can ask questions about the operational costs of cireng isi in Table 1.

Table 1. Social Arithmetic in Operational Costs for Making Cireng Isi

Indicator	Open-Ended Questions	Answer
Determine the amount of product per unit and the remaining money	Sellers sell small cireng isi for Rp 600 and large ones for Rp 1,500. The buyer has IDR 20,000. How many small and large cireng do buyers get? Does the buyer still have money left? If yes, how much money does the buyer have left?	Is known: Price of Small Cireng (PSC) = IDR 600 Price of Large Cireng (PLC) = IDR 1,500 Money owned by the buyer (MB) = IDR 20,000
		Asked: How many large and small cireng? How much money is left?
		Solution: This question has many correct ways with different results according to student understanding (open-ended). One possible solution:
		Number of Large Cireng (NLC) obtained by buyers: $NLC = \frac{MB}{PLC} = \frac{Rp20.000}{Rp1.500} = 13$
		Remaining Money (RM) after buying small cireng:

$$RM = MB - (13 \times PLC)$$

$$RM = Rp20.000 - (13 \times Rp1.500)$$

$$RM = Rp5.500$$

Number of Cireng Kecil (NSC) that can be purchased with Remaining Money (RM):

$$NSC = \frac{RM}{PSC} = \frac{Rp5.500}{Rp600} = 9$$

The remaining money is IDR 500

Cireng isi resembles two-dimensional shapes such as semicircles, triangles, circles, and combinations of trapezoids and rectangles. The shape of the cireng isi that has been made resembles the two-dimensional shape in Figure 2.

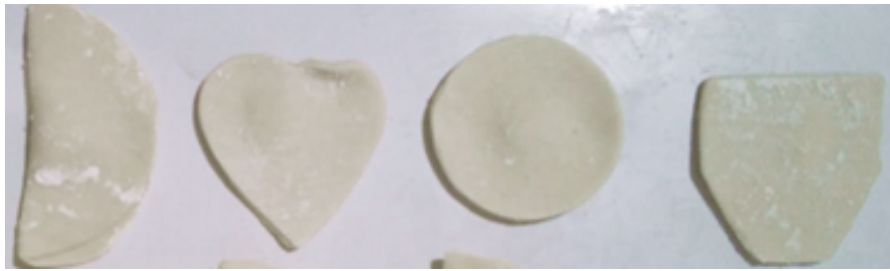
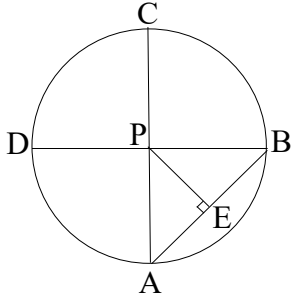
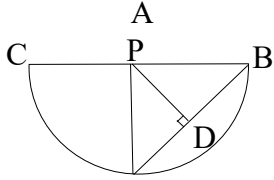
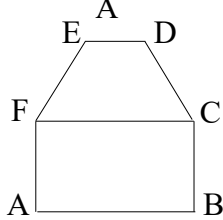
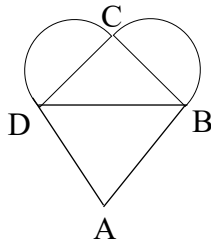


Figure 2. The Shape of the Cireng Isi Resembles a Two-dimensional shape

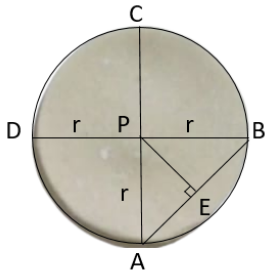
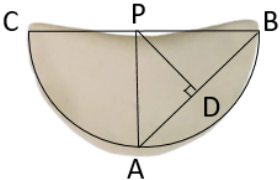
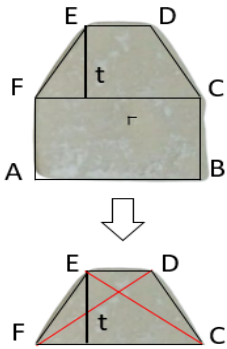
Figure 2 shows two-dimensional shape concepts such as circles, semicircles, trapezoids, rectangles, triangles, and kites in Table 2.

Table 2. Two-dimensional Shape of Cireng Isi

Shape	Cireng Isi Form	Concept of Two-dimensional Shapes
Circle		
Semi-circle		
Trapezoid and Rectangle		
Half Circle, Triangle, and Kite		

Students can introduce the properties of two-dimensional shapes in the form of circles, semicircles, trapezoids, triangles, and kites in learning using *cireng isi*. Table 3 explains the elements of two-dimensional shapes using *cireng isi*.

Table 3. Introduction to Two-Dimensional Shape Elements through *Cireng Isi*

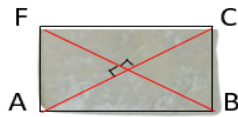
Two-Dimensional Shape of <i>Cireng Isi</i>	Elements of Two-Dimensional Shape
Circle 	- Center of circle - Denoted by point P - All points on the circle are the same distance from the center of the circle P - Radius of circle r A straight line connecting the center of a circle with a point on the circle (line AP=BP=CP=DP) - Circle diameter - Pass line that connects two points on a circle and passes through the center point P (line AC=BD) - The diameter length is twice the length of the circle's radius. - Circle bowstring A straight line that connects two points on a circle and does not pass through the center of the circle P (line AB) - Circle apothem The straight line that connects the circle's center with the chord's midpoint and is perpendicular (EP line). - Circle arc The part of a circle's circumference bounded by two points on the circle (arcs AB, AC, AD, BC, BD, CD) - Circumference Distance around a circle. $K = 2\pi r = \pi(2r) = \pi d \text{ with } \pi = \frac{22}{7} = 3,14$ - Circle area A circle bounds the area. $L = \pi r^2$
Semicircle 	A semicircle has the same elements as a circle. Special elements in the semicircle: - Only has 1 diameter (CB line) - Circumference of the semicircle. $K = \frac{1}{2}(2\pi r) = \pi r$ - Area of a semicircle. $L = \frac{1}{2}\pi r^2$
Trapezoid and Rectangle 	Trapezoid CDEF - Trapezoidal side - Has four sides (CD, DE, EF, and FC lines) - Has 2 parallel sides (line DE is parallel to CF) - Has 2 sloping sides (CD and FE lines) - Trapezoidal angle Has 4 corners $\angle FCD$, $\angle CDE$, $\angle DEF$, $\angle EFC$ - Trapezoidal diagonals Has 2 diagonals intersecting each other and are not perpendicular (lines CE and FD). - Trapezoidal height Distance between 2 parallel perpendicular sides (t line) - Perimeter of the trapezoid The sum of the lengths of the four sides (CD+DE+EF+FC) - Area of the trapezoid

Two-Dimensional Shape of Cireng Isi

Elements of Two-Dimensional Shape

$$L = \frac{1}{2} \times (\text{number of parallel sides}) \times \text{height}$$

$$L = \frac{1}{2} \times (CF + DE) \times t$$



Rectangle ABCF

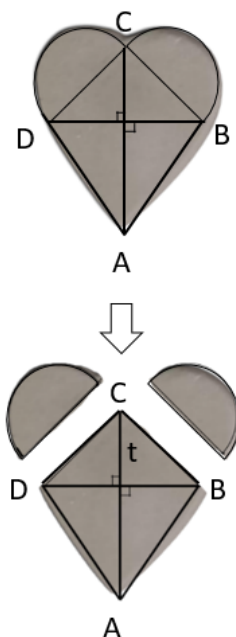
1. Rectangular sides
 - a. Has 4 sides (lines AB, BC, CF, FA).
 - b. Opposite sides are the same length (a line AB=FC is called length and a line AF=BC is called width)
2. Rectangular corners

Has 4 right angle 90° ($\angle FAB$, $\angle ABC$, $\angle BCF$, $\angle CFA$)
3. Rectangular diagonals
 - a. Has 2 diagonals that intersect each other perpendicularly (lines AC and BF)
 - b. Diagonals divide a rectangle into 4 isosceles triangles.
4. Perimeter of the rectangle

The sum of the lengths of all sides.
 $K = AF + BC + AB + FC$
 Line $AF = BC$ (length) and $AB = FC$ (width)
 $K = AF + AF + FC + FC$
 $K = 2AF + 2FC$
 $K = 2(\text{length}) + 2(\text{width})$
 $K = 2(\text{length} + \text{width})$
5. Area of a rectangle

$L = \text{length} \times \text{width}$

Half Circle, Triangle, and Kite



The elements of circles and semicircles have been explained previously.

Triangle DBC

1. Triangle side

Has 3 sides (BC, CD, and DB lines)
2. Triangle corner

Has 3 corners ($\angle DBC$, $\angle BCD$, $\angle CDB$)
3. Altitude line

A line drawn from one corner of a triangle and perpendicular to the opposite side (t line)
4. Perimeter of the triangle

The sum of the lengths of the three sides.
 $K = BC + CD + DB$
5. Area of triangle

$$L = \frac{1}{2} \times \text{base} \times \text{height}$$

$$L = \frac{1}{2} \times BD \times t$$

Kite ABCD

1. Kite side
 - a. Has 4 sides (lines AB, BC, CD, and DA)
 - b. Adjacent sides are the same length (lines $AB = DA$ and $BC = CD$)
2. Kite angle
 - a. Has 4 corners ($\angle DAB$, $\angle ABC$, $\angle BCD$, $\angle CDA$)
 - b. Opposite angles are equal ($\angle DAB = \angle BCD$, $\angle ABC = \angle CDA$)
3. Kite diagonals
 - a. Has 2 diagonals that intersect each other and are perpendicular (lines AC and BD)
 - b. One of the diagonals (line AC) divides the kite into 2 congruent triangles ($\triangle ABC \cong \triangle ADC$)
4. Go around the kite

Two-Dimensional Shape of Cireng Isi	Elements of Two-Dimensional Shape
	The sum of the lengths of the four sides. $K=AB+BC+CD+DA$
5. Kite area	$L = \frac{1}{2} \times \text{diagonal 1} \times \text{diagonal 2}$
	$L = \frac{1}{2} \times AC \times BD$

Using cultural context in conveying mathematical concepts can make students understand more because it follows their everyday experiences. Presenting contextual problems according to students' experiences can improve their mathematical abilities (Putra et al., 2017; Kyunghee-So, 2025). Students easily understand problems with ethnomathematics nuances related to local culture (Acharya et al., 2021; Aisyah et al., 2023; Payadnya et al., 2024). Teachers can design teaching materials or LKPD based on ethnomathematics, which are integrated through traditional clothing, traditional games, traditional dances, typical foods, community activities, musical instruments, and museums (Luthfi & Rakhmawati, 2022; Wahyuni & Suherman, 2023; Hayati et al., 2024). Ethnomathematics can also be applied to learning models, such as ethnomathematics teaching materials with problem-based learning (Dwidayati, 2018; Hisni et al., 2022) and realistic mathematics education (Uskono et al., 2020; Fauzana, 2022). Introducing life values to students, such as leadership and good deeds, can also be taught through ethnomathematics (Prahmana & D'Ambrosio, 2020).

This research has implications for mathematics learning. By integrating ethnomathematics, such as making cireng isi, in teaching mathematical material, students can understand the concepts of two-dimensional shapes in a more real and relevant context to their daily lives. This can increase students' interest and understanding of mathematics and help them learn the richness of local culture regarding traditional food. This research identifies various concepts of two-dimensional shapes in making cireng isi. The limitation of the research is that it only focuses on one type of traditional cireng isi at one maker's location in West Bandung, West Java. The shape of the cireng isi differs from makers' places in other areas. The mathematical concept of interest in this research is about flat figures consisting of circles, semicircles, trapezoids, rectangles, triangles, and kites. Exploring the symbolic meaning of other geometric shapes in making cireng isi is still possible, which can enrich a broader understanding of ethnomathematics. Further research can expand the scope of research objects regarding traditional food types and makers' locations.

CONCLUSION

Making traditional cireng isi closely relates to mathematical concepts, especially social arithmetic, and two-dimensional shapes. The social and artistic concept determines operational costs for making cireng isi. The concept of two-dimensional shapes, such as circles, semicircles, squares, rectangles, trapezoids, triangles, and kites, can be found in cireng isi. The makers apply their understanding of the properties of two-dimensional shapes in making cireng isi. Even though they do not have a formal educational background in mathematics, makers can create products by utilizing two-dimensional shape concepts. This shows the existence of ethnomathematics practices in the tradition of making cireng isi. Integrating ethnomathematics through cireng isi into learning can help students understand the concepts of two-dimensional shapes more contextually and meaningfully. Apart from that, this effort can also contribute to preserving and developing local cultural heritage. This research shows that mathematics cannot be separated from the cultural context of traditional food, which can be utilized to enrich students' learning experiences regarding cultural diversity.

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