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Ethnomathematical Exploration of Gudeg Production, Presentation, and Trading Practices as a Contextual Resource for Mathematics Learning

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ABSTRAK

Penelitian ini bertujuan untuk mengungkap dan menjelaskan berbagai bentuk etnomatematika yang terdapat dalam proses pembuatan, penyajian, serta praktik jual beli gudeg sebagai representasi konsep matematika dalam kehidupan sehari-hari. Dengan menggunakan pendekatan kualitatif deskriptif, penelitian ini melibatkan pembuat gudeg, pedagang, dan konsumen yang memiliki pemahaman terhadap proses produksi dan penyajiannya. Pengumpulan data dilakukan melalui observasi langsung, wawancara mendalam, serta dokumentasi berupa foto dan video di sentra gudeg wilayah Wijilan dan Barek. Observasi difokuskan pada identifikasi konsep matematika, seperti geometri pada bentuk besek dan potongan bahan, aritmetika dalam perbandingan bumbu, pengukuran waktu, volume, dan suhu selama proses memasak, serta pola algoritmik dalam tahapan memasak. Wawancara digunakan untuk menggali makna budaya serta intuisi matematis yang dimiliki pedagang dalam memahami pola permintaan dan preferensi konsumen. Data dianalisis dengan teknik analisis tematik melalui tahapan reduksi data, penyajian dalam bentuk narasi, dan penarikan kesimpulan secara induktif. Untuk menjamin keabsahan data, dilakukan triangulasi dengan membandingkan hasil observasi, wawancara, dan dokumentasi. Hasil penelitian ini memberikan pemahaman yang menyeluruh tentang praktik matematika dalam budaya kuliner gudeg serta menawarkan rekomendasi praktis bagi guru dalam merancang pembelajaran matematika yang konkret, kontekstual, dan relevan dengan kehidupan siswa.

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A B S T R A C T

This study aims to identify and explain various forms of ethnomathematics embedded in the processes of preparing, presenting, and trading gudeg as representations of mathematical concepts in everyday life. Employing a descriptive qualitative approach, the study involves gudeg producers, vendors, and consumers who possess an understanding of both the production and presentation processes. Data were collected through direct observation, in-depth interviews, and documentation in the form of photographs and videos at gudeg centers in the Wijilan and Barek areas. Observations were focused on identifying mathematical concepts, including geometry in the shape of besek and ingredient cuts, arithmetic in the proportions of spices, measurements of time, volume, and temperature during the cooking process, and algorithmic patterns in the sequence of cooking steps. Interviews were conducted to explore cultural meanings as well as the mathematical intuitions employed by vendors in interpreting demand patterns and consumer preferences. The data were analyzed using thematic analysis techniques, involving stages of data reduction, narrative presentation, and inductive conclusion drawing. To ensure the validity of the findings, triangulation was conducted by comparing results from observations, interviews, and documentation. The findings of this study provide a comprehensive understanding of mathematical practices within the culinary culture of gudeg and offer practical recommendations for teachers in designing mathematics instruction that is concrete, contextual, and closely aligned with students' real-life experiences.

Keywords:

Ethnomathematics
Gudeg Culinary Culture
Contextual Learning,

1. INTRODUCTION

Mathematics learning in schools is frequently viewed as abstract and detached from students' daily experiences (Novantoro et al., 2025). Many learners find it difficult to grasp mathematical ideas because the material is often delivered without cultural relevance or concrete contexts that relate to their everyday lives (Lavidas et al., 2022). In reality, mathematics originates from human activities embedded within social, economic, and cultural practices. Approaches that connect mathematics with local contexts have been proven to foster deeper understanding, enhance student engagement, and improve problem-solving skills (Astutik et al., 2025). One such approach is ethnomathematics, which emphasizes that cultural practices inherently contain mathematical ideas that can serve as meaningful learning resources.

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Ethnomathematics, introduced by D'Ambrosio (2001), examines how cultural groups develop, structure, and apply mathematical concepts in their daily activities. This perspective not only highlights the value of local culture but also enriches teaching strategies by presenting mathematics in concrete and relatable forms. Studies by Gerdes (2018) show that ethnomathematics significantly contributes to improving mathematical literacy, as students learn through familiar cultural experiences. Therefore, exploring local cultural contexts is crucial in promoting mathematics learning that is relevant, human-centered, and meaningful (Fitriana et al., 2025).

In Indonesia, traditional culinary practices represent cultural expressions rich in mathematical content. Gudeg, a well-known traditional dish from Yogyakarta, embodies various mathematical concepts in its preparation, presentation, and commercial activities, including geometry, measurement, proportion, algorithmic thinking, and informal statistics. For instance, the besek container reflects geometric properties useful for teaching plane shapes; the proportional mixing of spices illustrates ratios and arithmetic; and the extended cooking process introduces concepts of time and temperature measurement. These authentic elements make gudeg a valuable subject for ethnomathematical exploration.

Moreover, the way gudeg is presented provides opportunities to introduce geometric and symmetrical concepts. The arrangement of complementary dishes such as eggs, krecek, tofu, and tempeh often follows organized or symmetrical patterns, representing spatial structures that can be applied in geometry learning. Research by Krismasanti (2024) indicates that mathematical visualization within culinary traditions can support students' understanding of spatial concepts. The aesthetic presentation of food also encourages learners to observe patterns and shapes, making it a meaningful medium for developing mathematical representation and visual reasoning abilities (Alam et al., 2025).

Beyond preparation and presentation, the trading practices of gudeg in areas like Wijilan and Barek reveal rich examples of informal statistical reasoning. Vendors commonly rely on experience-based intuition to estimate customer demand, adjust flavor preferences such as sweetness levels, and determine portion sizes preferred by buyers. These practices correspond to basic descriptive statistics and data-driven decision-making. Batdı et al. (2024) suggest that traditional microeconomic activities can serve as concrete contexts for teaching statistics, helping students understand how data operates within real sociocultural environments.

Despite its strong potential, the integration of ethnomathematics into classroom practice remains limited. Although the Merdeka Curriculum promotes contextual learning, many teachers still face challenges in identifying, analyzing, and incorporating cultural elements into mathematics instruction (Afandi et al., 2025; Tarso et al., 2024). Previous studies Astiwi et al. (2024) reveal that teachers often depend on conventional teaching methods and seldom utilize local culture as a learning resource. In fact, integrating cultural elements not only enhances conceptual understanding but also fosters students' sense of identity and appreciation for their cultural heritage.

Based on these considerations, this study is important to comprehensively explore the forms of ethnomathematics embedded in the production, presentation, and trading of gudeg as representations of mathematical concepts in everyday life. The research seeks to identify naturally occurring mathematical ideas within culinary cultural practices and to provide practical guidance for teachers in designing mathematics instruction that is concrete, contextual, and aligned with students' characteristics. By positioning gudeg as a culturally grounded learning medium, this study contributes both to the preservation of local culture and to the development of innovative pedagogical approaches that support students' mathematical literacy.

2. METHOD

This study adopts a descriptive qualitative design to investigate and illustrate the ethnomathematical elements embedded in the processes of preparing, serving, and trading

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gudeg as representations of everyday mathematical concepts. The participants consist of gudeg producers, sellers, and consumers who possess an understanding of both the production and presentation practices. Data collection was carried out through direct observation, in-depth interviews, as well as photographic and video documentation at gudeg centers in the Wijilan and Barek areas (Creswell & Poth, 2018). The observations were directed at identifying mathematical ideas, including geometric concepts reflected in the shapes of besek containers and ingredient cuts, arithmetic in the proportions of spices, measurements of time, volume, and temperature during cooking, and algorithmic patterns in the sequence of preparation steps. Meanwhile, interviews were conducted to explore cultural meanings and the implicit mathematical reasoning employed by practitioners, particularly in understanding demand patterns and consumer preferences.

The data were analyzed using thematic analysis, starting with data reduction to select relevant information, followed by data display in the form of narrative descriptions, diagrams, and categorized representations of mathematical concepts, and concluding with inductive interpretation. To ensure the credibility of the findings, data triangulation was applied by comparing results from observations, interviews, and documentation (Aprianto et al., 2023). Furthermore, the analysis sought to identify how these mathematical concepts can be integrated into classroom learning, thereby formulating the potential of gudeg as a culturally responsive instructional medium. Overall, this methodological approach not only provides a comprehensive understanding of mathematical practices within gudeg culinary traditions but also offers practical guidance for teachers to design learning experiences that are concrete, contextual, and closely related to students' real-life experiences.

3. RESULT AND DISCUSSION

Geometry (Forms and Presentation Structures)

The presentation of gudeg in a besek (woven bamboo container) serves as a concrete example of how geometry is embedded within Javanese culinary culture. A besek is typically shaped as a square or rectangle, representing plane figures that can be explored through concepts of sides, angles, perimeter, and area. Beyond its basic shape, the bamboo weaving pattern also displays more complex geometric ideas such as repeated patterns (tessellations), translation, and reflection, as illustrated in ethnomathematics research by Utami & Irawati (2024) on traditional crafts. Thus, the besek is not merely a serving container but also a pedagogical object that demonstrates the relationship between cultural visual order and formal mathematical concepts.

Complementary gudeg ingredients such as tofu, tempeh, and eggs also contain three-dimensional geometric forms that can be used as instructional materials. Cubed tofu, rectangular-prism-shaped tempeh, and eggs resembling spheres or ellipsoids exemplify solid figures that are closely connected to daily life. The simplicity of these shapes enables students to better understand volume, surface area, and relationships among geometric solids. Fatkhurohman et al. (2021) and Siswanto (2025) emphasizes that traditional culinary objects can serve as powerful conceptual bridges for understanding spatial geometry, as students can manipulate and observe these forms directly. The visual elements found in gudeg presentation therefore provide natural and relevant ethnomathematical contexts.

In addition to the shapes of containers and food pieces, geometry also appears in the arrangement patterns of gudeg on plates or besek. Many vendors arrange dishes such as krecek, eggs, tofu, and tempeh in circular patterns or radial symmetry compositions for instance, an egg placed at the center while the other components are set around it. Such arrangements illustrate concepts of symmetry, balance, and geometric composition that students can directly observe. Plaiphum & Tansuchat (2023) found that using traditional foods as visual objects enhances students' ability to understand symmetry because the representations are concrete rather than abstract. In this context, the presentation of gudeg helps students see how geometric concepts operate in real-life situations through cultural practices

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Example Problem: A square besek has a side length of 20 cm. Inside it, cube-shaped tofu pieces with an edge length of 4 cm will be arranged in one layer.
Determine:
The area of the besek base.
The number of tofu cubes that can be arranged in one layer.
Solution:
Area of the besek base = 20 × 20 = 400 cm^2
Area of one tofu cube base = 4 × 4 = 16 cm^2
Maximum number of cubes = $\frac{400}{16} = 25$ cubes per layer.

This example illustrates the application of area, tiling, and spatial optimization. Such contextual approaches align with findings by Rosa & Orey (2016), who assert that ethnomathematics enhances students' mathematical understanding through culturally familiar contexts. By incorporating gudeg-based contexts, teachers can facilitate mathematics learning that is concrete and meaningful.

Geometric findings in gudeg presentation are consistent with research by Ernaningsih (2021) and Susanti et al. (2023), which demonstrates that the use of local culinary culture improves students' geometric literacy and spatial reasoning because the objects are tangible and easily observable. Furthermore, Puspadewi et al. (2025) and Yanti (2025) highlight that ethnomathematical culinary contexts enhance learning motivation, as students perceive the knowledge as relevant to their daily lives. This suggests that integrating geometry into traditional food contexts such as gudeg not only enriches understanding of mathematical concepts but also strengthens students' local cultural identity. By connecting cultural contexts with formal instruction, teachers can create learning experiences that are more authentic, engaging, and pedagogically meaningful.

Arithmetic (Measurement and Ingredient Proportion)

The process of making gudeg is strongly influenced by the ability to calculate and determine the correct proportions of ingredients. Each component such as young jackfruit, coconut milk, palm sugar, salt, and ground spices has specific measurements that must be considered to produce the signature sweet and savory taste of Yogyakarta's gudeg. These proportions are not random; they follow inherited comparison patterns passed down through generations. For example, some gudeg artisans use a 1:2 ratio between palm sugar and coconut milk, or measure that every 1 kilogram of jackfruit requires 250–300 ml of thick coconut milk. This practice demonstrates that arithmetic is not merely an abstract concept but an essential tool for maintaining flavor consistency in culinary traditions.

The use of ingredient ratios in gudeg reflects ethnomathematics in a highly tangible form. Traditional communities may not explicitly refer to these practices as "ratios" or "proportions," but they apply them through practical experience and orally transmitted local standards. This proportional approach aligns with the findings of Rosa & Orey (2011), who emphasize that cultural practices such as cooking contain mathematical principles that can be elevated as learning contexts. Gudeg offers a concrete example of how arithmetic operations including ratios, scaling, and addition are practiced without modern measuring instruments. Even more interestingly, some vendors use non-standard measuring tools such as scoops (centong) or ladles (gayung), which still embody mathematical concepts such as scale and estimation.

The ingredient proportions used in gudeg can be integrated into mathematics instruction to strengthen students' understanding of comparison, scaling, and unit conversion. Such authentic contexts have been shown to enhance the connection between mathematical concepts and everyday life. This is supported by the findings of Oo et al. (2024) and Sikandar et al. (2025), who state that local culture–based learning improves students' understanding of ratio and proportion. In classroom practice, teachers can guide students to analyze *gudeg* recipes, determine adjusted proportions for larger or smaller servings, and calculate the total amount of

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ingredients needed. Thus, mathematics learning becomes more meaningful by linking abstract concepts to a culinary practice familiar to students.

Example Problem: A homemade gudeg recipe uses a palm sugar : coconut milk ratio of 1 : 2. If an artisan uses 450 grams of palm sugar, how much coconut milk is needed? In addition, if the original recipe is designed for 3 kg of jackfruit, how much palm sugar and coconut milk would be required to prepare 9 kg of jackfruit while maintaining the same flavor consistency?
Solution:

1. A 1:2 ratio means that every 1 part of sugar requires 2 parts of coconut milk. If sugar = 450 g → coconut milk = 2 × 450 = 900 g/mL (equivalent in volume).
2. If 3 kg of jackfruit requires 450 g of sugar and 900 g of coconut milk, then for 9 kg (three times as much):
   Sugar = 450 × 3 = 1350 g
   Coconut milk = 900 × 3 = 2700 g/Ml
   This example illustrates the use of direct proportion, scaling, and ratio concepts, which are highly relevant for junior and senior high school arithmetic. The gudeg context makes the problem more realistic and applicable.

The application of ingredient comparisons in making gudeg aligns with the findings of Aziz (2025) and Opesemowo (2025), who assert that local culinary activities provide rich ethnomathematical sources for teaching arithmetic concepts. They found that students better understand comparison concepts when learning activities are connected to familiar traditional foods. Likewise, Owusu & Addo (2023) and Pathuddin & Nawawi (2021) argues that culinary activities create opportunities for contextual learning involving measurement, estimation, and taste consistency checks as a form of mathematical validation. Therefore, the ingredient proportions in preparing gudeg not only reflect culinary tradition but also illustrate how mathematics is lived and developed within everyday cultural practices of Javanese society.

Measurement (Time, Temperature, and Volume)

The gudeg cooking process which requires a long duration of 8 to 12 hours shows that traditional culinary practices are deeply connected to the concept of time measurement. The use of such an extended time span requires precision in estimating cooking durations to ensure the jackfruit becomes tender and the seasoning fully absorbs. Gudeg artisans typically do not use digital timers; instead, they rely on experience, color changes, and aroma as indicators of time, reflecting non-formal measurement practices. Nevertheless, the process still contains mathematical principles such as time estimation, interval calculation, and determining the length of specific cooking stages. This knowledge is traditionally inherited, demonstrating that the cultural understanding of time in cooking is part of ethnomathematics embedded in society.

Beyond time, measuring the volume of coconut milk and water is essential to the success of gudeg. Rather than using standard measuring cups or liters, many gudeg makers rely on traditional tools like scoops, ladles, or gayung (water dippers) as non-standard measurement units. This practice underscores that volume concepts in daily life can be contextual and flexible. The use of non-standard tools does not reduce precision; instead, it shows that communities have internally consistent measurement systems even without official units. This supports Gerdes (2018) view that local tools reflect culturally embedded mathematical knowledge. Therefore, volume measurement in gudeg production enriches students' understanding of diverse measurement systems within ethnomathematics.

Controlling low heat throughout the cooking process reflects the application of qualitative temperature measurement. Although they do not use thermometers, gudeg makers can distinguish heat intensity based on visual cues such as flame height or evaporation rate. Sensitivity to temperature changes requires strong observational skills, which represent mathematical thinking in cultural contexts. Barton (2020) notes that traditional practices often use non-numeric indicators as measurement tools, such as heat, texture, or color. In the context

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of gudeg, maintaining low heat for 8–12 hours is not merely a culinary tradition but demonstrates the community's ability to develop consistent temperat ure measurement systems despite their informal nature.

Example Problem: A gudeg maker cooks the mixture for 10 hours. Every 2 hours, they add 100 mL of coconut milk to maintain a soft texture. They also use a scoop (centong) with a capacity of about 60 mL as a non-standard measuring tool. How much coconut milk is added during the entire cooking process? If 1 ladle (gayung) of water equals 350 mL, how many ladles are needed to meet the requirement of 1.4 liters of water?

Solution:

Cooking time: 10 hours → addition interval: every 2 hours → number of additions = $\frac{10}{2} = 5$ times

Total coconut milk = 5 × 100 mL = 500 mL.

If using a 60 mL scoop → $\frac{500}{60} \approx$ 8.33, so 9 scoops are needed.

1.4 liters = 1400 mL.

Number of ladles $= \frac{400}{350} =$ 4 ladles.

This problem teaches unit conversion, volume measurement, time intervals, and the use of standard and non-standard measurement tools. The gudeg context makes the learning experience more meaningful and realistic.

Measurement concepts in gudeg preparation align closely with previous research emphasizing the importance of ethnomathematics as a source of contextual learning. Rosa & Orey (2016) found that estimation and measurement skills can be enhanced through cultural activities such as cooking because students more easily grasp concepts when they are connected to familiar experiences.Maria et al. (2022) and Smaniotto et al. (2023) also highlight that local contexts strengthen students' understanding of time and volume units, especially when using non-standard tools. Additionally, Hendriana et al. (2025) and Kadonsi (2025) show that traditional culinary practices improve mathematical literacy by introducing non-formal yet internally consistent measurement systems. These findings reinforce that *gudeg* preparation is not only a culinary activity but also a culturally rich medium for mathematical learning.

Patterns and Algorithms (Sequential Cooking Procedures)

The process of making gudeg illustrates a culinary algorithm composed of sequential steps: cutting the ingredients, boiling the jackfruit, mixing the ground spices, adding coconut milk, and cooking until the flavors are fully absorbed. This ordered structure aligns with the mathematical concept of an algorithm and with computational thinking, both of which involve systematic instructions for achieving a specific outcome. Mathematically, each step can be regarded as a function that receives an input (raw ingredients) and produces an output (the next stage of preparation). For example, let f_1 = cutting jackfruit, f_2 = boiling, f_3 = adding spices, and so on; the composite function $f_5(f_4(f_3(f_2(f_1(x)))))$ represents the complete gudeg preparation algorithm. Rosa and Orey (2016) demonstrate that traditional cooking activities can serve as concrete examples for teaching algorithmic thinking in ethnomathematics, as students can directly observe how real-world procedures resemble formal algorithmic structures.

In many gudeg-making families, there exists a repeated pattern of soaking, boiling, and reheating in every production cycle. This "cook–rest–reheat" pattern reflects the mathematical concept of recurrence, in which a value or process is determined by its previous state. In practice, reheating not only deepens the characteristic brown color of the jackfruit but also enhances the signature sweet–savory flavor of gudeg. Mathematically, this cycle can be expressed using a simple recurrence relation such as $G_n = aG_{n-1} + b$, where G_n represents the level of doneness in cycle n. Fauzi et al. (2022) found that repeated patterns in traditional

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culinary practices help students intuitively understand sequences and recurrence because they can observe the outcome of each iteration through visible changes in color, texture, and taste.

The ideal composition of gudeg results from precise proportions among ingredients such as shallots, garlic, candlenuts, palm sugar, galangal, and coconut milk. These proportions can be analyzed using the mathematical concepts of ratio and comparison. For instance, some gudeg makers use a 1:2 ratio between ground spices and coconut milk, or a 3:1 ratio between palm sugar and salt to achieve Yogyakarta's characteristic sweetness. Any change in ratio produces a different taste, consistent with the principle of proportionality in mathematics. Gerdes (2018) showed that culinary activities are an effective medium for teaching ratios because students can directly taste the differences produced by even slight changes in ingredient proportions. Thus, seasoning ratios in gudeg represent not only culinary wisdom but also rich mathematical applications.

Gudeg preparation requires a long cooking duration, typically between 8 and 12 hours, which artisans manage through precise time estimation. They do not always rely on digital timers, but instead observe visual cues such as jackfruit color changes, coconut milk thickness, and aromatic transitions as indicators of elapsed time. This practice constitutes a form of non-standard measurement that is central to ethnomathematics. Mathematically, total time can be calculated by summing the duration of each stage, such as: initial boiling (2 hours), cooking with coconut milk (4 hours), and reheating (3 hours), giving an estimated total of 9 hours. Siswanto et al. (2025) emphasizes that traditional measurement techniques form a foundation for understanding time and estimation in mathematics education because they link sensory observations to numerical values.

When preparing ingredients, young jackfruit is cut into particular shapes that consider not only aesthetics but also heat distribution during cooking. The shapes often resemble small prisms or frustums to facilitate the absorption of seasoning. Geometrically, uniform cuts allow even cooking because each piece has nearly identical volume and surface area. Mathematically, students can learn concepts of surface area, volume, and basic three-dimensional geometry from these jackfruit pieces. Prasittisopin (2024) found that geometry embedded in traditional culinary activities particularly the shapes of ingredients enhances students' understanding of solid geometry because they learn through real objects that can be handled, observed, and cut.

Statistics (Flavor Preferences, Customer Choices, and Production Patterns)

Gudeg vendors in the Wijilan and Barek culinary districts have long applied intuitive statistics in assessing customer preferences, despite not keeping formal records. They observe patterns such as "Sundays are busier" or "more customers prefer dry gudeg", which are forms of descriptive statistics based on experiential frequency. Mathematically, these intuitions resemble the concept of mode for example, if dry gudeg runs out earlier on most days, vendors conclude that it has the highest purchase frequency. This finding aligns with Barton and Frank (2006), who assert that many traditional communities develop statistical reasoning through repeated observations of everyday events rather than formal tools.

Vendors also use intuitive data to estimate daily customer numbers, a practice known in mathematics as simple forecasting. For instance, a vendor may mentally note that the average number of weekday customers is around 60, while weekends draw 100–120 customers. Mathematically, this estimate can be calculated using a simple moving average formula, $\bar{x} = \frac{x_1+x_2+x_3}{n}$, allowing vendors to determine the amount of ingredients needed based on the preceding week's averages. Gaftandzhieva et al. (2023) show that traditional market vendors often apply highly accurate informal averaging without calculators as a practical form of ethnomathematics relevant for learning.

When vendors distinguish customer preferences such as sweetness level (moderately sweet or very sweet), gudeg texture (wet or dry), or side dish options they are applying the mathematical concept of classification. This can be represented as categorical data distribution

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tables. For example, a vendor may observe over one week that 40% of customers prefer dry gudeg, 35% prefer medium, and 25% prefer wet. This corresponds to descriptive statistics for categorical data. In Pasar Beringharjo, it was found that merchants consistently use preference classification to manage stock and determine product variations, demonstrating that intuitive classification is a statistical skill developed through direct experience.

Determining the portions of side dishes such as how much koyor, eggs, or sambal krecek to prepare is also based on observed proportions of customer habits. If a vendor knows that out of 100 customers, 60 prefer eggs, 25 choose koyor, and 15 choose tofu–tempeh, they apply proportions 60/100, 25/100, and 15/100 to plan side dish quantities. Mathematically, these proportions can be converted into percentages to guide operational decisions. Fauzi et al. (2022) and Kumar & Gopinath (2025) show that proportion-based decision making derived from observed frequencies is an adaptive strategy that minimizes losses and optimizes stock, even without formal records.

The observation that Sundays or holiday seasons attract more buyers indicates that gudeg vendors intuitively understand seasonal patterns or trends. Mathematically, this can be represented by a frequency distribution based on days of the week: Monday–Thursday (50–60 customers), Friday–Saturday (70–80 customers), Sunday (100–120 customers). Such a distribution curve shows a significant increase on weekends, which forms the basis for vendors to increase production. Siswanto et al. (2024) and Rahmadhani (2022) confirms that local knowledge of seasonal buyer trends among traditional food sellers constitutes a form of naturalistic statistics that represents time-based data distribution and is highly valuable for culturally contextualized statistics education.

4. CONCLUSSION

An ethnomathematics study of gudeg reveals that every aspect of its preparation and presentation from the *besek* (traditional bamboo basket) shape representing geometric concepts, ingredient proportions reflecting arithmetic, measurements of time, volume, and temperature during cooking, structured culinary algorithms, to traders' statistical intuition in interpreting demand patterns constitutes a rich, authentic, and relevant source of mathematical learning for students. Such local cultural practices have been shown to enhance mathematical literacy, strengthen reasoning skills, and increase learning motivation by presenting mathematical concepts in real-life contexts. Therefore, teachers are encouraged to incorporate traditional culinary practices like gudeg as culturally based learning media to help students understand concepts more concretely, develop problem-solving skills, and appreciate local cultural heritage. However, this study has several limitations, including its focus on a single cultural context, which may limit generalizability, and its reliance on qualitative, interpretive analysis that may involve subjectivity. Future research is suggested to examine a broader range of ethnomathematical contexts across cultures, apply mixed-method or experimental approaches to more rigorously assess learning outcomes, and design structured instructional models or teaching modules to support wider implementation and scalability in educational settings.

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