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Eksplorasi Etnomatematika pada Makanan Tradisional Banyumas di Daerah Sokaraja Jawa Tengah

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Abstrak

Penelitian ini bertujuan untuk mengeksplorasi konsep etnomatematika pada makanan tradisional Banyumas dan potensinya sebagai bahan ajar matematika untuk siswa sekolah menengah pertama. Dengan menggunakan metode studi etnografi dalam penelitian kualitatif, data dikumpulkan melalui observasi, wawancara, catatan lapangan, dan dokumentasi. Hasil penelitian menunjukkan bahwa makanan tradisional Banyumas, seperti rempeyek, nopia, dan getuk goreng, mengandung berbagai konsep matematika. Konsep-konsep tersebut meliputi bentuk makanan, alat masak, dan kemasan yang menyerupai bangun datar, seperti persegi dan lingkaran, serta bangun ruang, seperti tabung, kubus, dan setengah lingkaran. Selain itu, konsep kesebangunan juga terlihat pada beberapa aspek dari makanan dan alat-alatnya. Berdasarkan hasil ini, para peneliti merekomendasikan agar konsep etnomatematika dari pengukuran dan bentuk pada makanan tradisional Banyumas diintegrasikan ke dalam media pembelajaran matematika. Pendekatan ini diharapkan dapat membuat proses belajar lebih menyenangkan dan bermakna, karena menggabungkan pengetahuan matematika dengan unsur budaya lokal. Dengan demikian, siswa tidak hanya memahami konsep-konsep matematika, tetapi juga memperoleh wawasan mengenai warisan budaya setempat, menciptakan pengalaman belajar yang menarik dan relevan bagi mereka.
Kata Kunci: budaya lokal, etnomatematika, geometri, media pemebelajaran, trasisional

Exploration of Ethnomathematics in Banyumas Traditional Food in Sokaraja Area, Central Java

Abstract

This study aims to explore the ethnomathematics concepts found in traditional Banyumas foods and their potential as mathematics teaching materials for junior high school students. Using an ethnographic approach within a qualitative research framework, data were collected through observation, interviews, field notes, and documentation. The study results indicate that traditional Banyumas foods, such as rempeyek, nopia, and getuk goreng, contain various mathematical concepts. These concepts are reflected in the shapes of the food, cooking utensils, and packaging, resembling two-dimensional shapes like squares and circles, as well as three-dimensional shapes like cylinders, cubes, and half-spheres. Additionally, the concept of similarity is also observed in certain aspects of the food and its utensils. Based on these findings, the researchers recommend integrating ethnomathematics concepts of measurement and shape from traditional Banyumas foods into mathematics learning media. This approach is expected to make the learning process more enjoyable and meaningful, as it combines mathematical knowledge with elements of local culture. Thus, students not only gain an understanding of mathematical concepts but also acquire insights into local cultural heritage, creating a more engaging and relevant learning experience.
***Keywords**: ethnomathematics; geometry; learning media; local culture; traditional*

INTRODUCTION

Education is essential for every nation, as its quality determines national progress. In other words, the advancement of a country can be measured by the quality of its education, as education plays a vital role in development and cannot be separated from the development process itself (Irfai et al., 2020). Poor educational quality can cause a nation to lag others, and in Indonesia, the quality of education remains relatively low compared to other countries, with various factors hindering improvement (Kurniawati, 2022). One key issue is that students' learning mathematics often lacks meaning, resulting in weak conceptual understanding. To address this, teachers must connect students' prior knowledge and provide opportunities for them to rediscover and construct mathematical ideas independently (Rahmawati, 2020). Furthermore, improving the quality of human resources in terms of knowledge and morals is a fundamental educational goal. Education plays a crucial role in shaping students' attitudes, achievements, and competencies, which are key to driving national progress (Kurniawan & Pratama, 2021). Thus, enhancing the quality of education in Indonesia requires collaborative efforts from various stakeholders. Through quality education, Indonesia can foster a generation that is intelligent, creative, and of strong character, ultimately advancing the nation.

Mathematics reveals patterns both in nature and human thought (Lange, 2006; Purniati et al., 2021). However, a fixed mindset among students contributes to the belief that they cannot understand mathematics, perceiving it as inherently difficult (Purbaningrum et al., 2023). Mathematics remains a subject that many students struggle to engage with, as reflected in their lack of interest and enthusiasm (Oktaviani et al., 2022). For some, mathematics is viewed as difficult, boring, and intimidating, even becoming a "bogeyman" to be avoided (Kholil & Zulfiani, 2020). Although mathematics is frequently applied in daily life, it continues to be a subject that students generally find challenging and unappealing. Many students persist in studying mathematics despite encountering difficulties along the way, but their overall interest and motivation remain low. This indicates the need for more effective strategies to enhance students' engagement and positive perception of mathematics.

Mathematics learning in one of the secondary schools is suspected to be ineffective in helping students solve problems related to geometric transformations (Syarifah et al., 2023). Many students still struggle to determine and identify geometric shapes based on their properties, indicating a lack of understanding of fundamental geometry concepts. This limited comprehension makes it difficult for students to interpret and solve geometry-related questions (Hikmayani et al., 2023). The low level of understanding highlights the need for improvements in the teaching of geometry. To address this issue, it is essential to develop student-centered learning approaches that actively engage students in the learning process. Learning activities should be designed to encourage students to construct their understanding of geometric concepts, fostering deeper comprehension and problem-solving abilities.

Mathematics is often regarded as free from cultural influence, leading to the assumption that the cultural diversity of students need not be considered in mathematics instruction (D'Ambrosio, 2014; Purniati et al., 2021; Rosa & Orey, 2011). In reality, mathematics learning is an interactive process between teachers and students, structured to help students acquire mathematical knowledge and skills (Hikmayani et al., 2023). However, mathematics is frequently perceived as abstract and monotonous, causing many students to lose interest in the subject (Farhan et al., 2021). For students to think logically, identify mathematical patterns, connect those patterns, and effectively communicate mathematical ideas through symbols and oral explanations, meaningful learning experiences are essential (Fionika et al., 2018). Achieving effective mathematics learning requires collaboration among teachers, students, schools, and parents. Through the creation of a supportive learning environment and the application of appropriate teaching methods, students can be better guided toward achieving their mathematical learning objectives.

Some teaching strategies applied in schools are not well-received by all students and have a minimal impact on their character development. One approach that helps students solve mathematical problems while simultaneously fostering character values is the incorporation of ethnomathematics (Rizqi & Hawa, 2022). Ethnomathematics emphasizes the relationship between mathematics and culture, helping students understand that mathematical concepts are embedded in various cultural practices. This approach aims to change students' perceptions by making mathematics more relatable

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and easier to comprehend (Hasanah, 2023). In essence, the goal of ethnomathematics is to recognize that different communities develop and apply mathematical knowledge in unique ways, reflecting diverse cultural contexts (Pratiwi & Pujiastuti, 2020). Thus, ethnomathematics provides an engaging and relevant alternative to mathematics learning. By integrating its principles, we can create a more meaningful and enjoyable learning experience that positively impacts students' academic achievement and character development.

Presidential Regulation Number 114 of 2022 on Cultural Strategy aims to achieve national objectives by advancing Indonesian culture within the context of global civilization. One way to promote national culture is through traditional foods, which often contain more natural and healthier ingredients compared to processed foods (Wibisono et al., 2020). Traditional food also plays a key role in the development of culinary tourism (Komariah et al., 2020). In modern times, food is valued not only for providing sustenance but also for fulfilling mental, emotional, and social needs. Food functions as more than a physiological necessity; it serves as a social asset, symbolizing customs, traditions, social status, and interpersonal connections within communities (Roudsari et al., 2019). Therefore, traditional food represents more than mere consumption it embodies a nation's cultural identity. Preserving and promoting traditional food is a valuable long-term investment that will benefit future generations by sustaining cultural heritage and fostering national pride.

Previous research on ethnomathematics has explored various cultural elements and mathematical topics. Some studies have focused on cultural objects, such as Unggan weaving in Minangkabau (Kusno et al., 2024), the Cibuntu tofu industry (Hakim et al., 2024), the Baitu Usyaqil Quran Mosque (BUQ), and the Darussalam Islamic Boarding School (Kumala et al., 2022; Kusno et al., 2022), as well as Kenthongan music art. These studies also examined a range of mathematical concepts, including transformation geometry such as translation, reflection, dilation, symmetry, and arithmetic patterns (Kusno et al., 2024). Other explorations include geometry related to the shapes and sizes of tofu and applications in social arithmetic (Hakim et al., 2024). Additionally, transformational geometry concepts such as symmetry, reflection, translation, rotation, and dilation were analyzed in the context of Islamic boarding schools (Kusno et al., 2022), while research on Kenthongan music art examined geometry topics like circles and cylinders, as well as concepts of integers and arithmetic sequences (Kumala et al., 2022).

Ethnomathematics-based learning integrates cultural aspects into mathematics education, making the material more meaningful and enhancing students' representational skills. This approach encourages students to observe and apply cultural elements within mathematical concepts (Astuti et al., 2022). Furthermore, ethnomathematics preserves the role of culture in mathematics learning, ensuring that students engage with both mathematical content and local cultural heritage (Gunadi et al., 2024). As a result, the learning process becomes more meaningful, as students not only acquire mathematical knowledge but also deepen their understanding and appreciation of the cultural practices present in their environment (Wulantina & Maskar, 2019).

Previous research on ethnomathematics has explored tourist attractions in Banyumas (Kusno et al., 2022), but traditional Banyumas cuisine remains unexplored. The novelty of this research lies in the exploration of traditional Banyumas food, which is linked to mathematical content, particularly geometric concepts analyzed through the shapes of the food and the tools used in its preparation. This study integrates historical and cultural meanings with mathematical concepts, particularly in geometry, involving both flat and spatial shapes found in food. By exploring the Sokaraja area in Central Java and conducting interviews to collect information about Banyumas' traditional cuisine, the researchers aim to bring attention to these dishes through the lens of ethnomathematics. Therefore, this study aims to explore ethnomathematics in the traditional food of Banyumas in Sokaraja, Central Java.

METHODS

This research employs an ethnographic approach, which involves a detailed description of a culture within a community. In simple terms, ethnography is a written account of specific tribes or ethnic groups, typically authored by an anthropologist (Fadila & Yulifar, 2023). In this study, the ethnographic approach is utilized to identify mathematical concepts related to traditional food from

Banyumas, specifically in the Sokaraja area of Central Java, as well as the ethnomathematics associated with that traditional food.

The researcher selected subjects comprising three chefs, three entrepreneurs, and three cultural figures. The research procedure will be conducted from March to July 2024 in the village of Banjarsari Kidul, Sokaraja. This study utilizes various instruments, including observation sheets, interview guidelines, documentation, and the researcher as a participant observer. The data collection method employed is the triangulation technique, incorporating observation, interviews, and documentation. In this study, interviews will be conducted in person to facilitate discussions and clarifications regarding the forms of Banyumas food as they relate to mathematics learning.

Data collection techniques refer to the methods employed to obtain data in a research study. In this research, the data collection methods include observation, interviews, and documentation related to the concepts of mathematics and the history of traditional Banyumas food. Therefore, the research design employed in this study is qualitative research.

RESULTS

The interview data indicate that traditional Banyumas food currently tends to develop primarily through viral trends, as people often follow ongoing fads, which may then fade away. The researchers interviewed three sources a cultural expert, a chef, and a businessman regarding traditional Banyumas food in the Sokaraja area. Traditional Banyumas cuisine possesses distinctive characteristics and meanings. The preparation of traditional Banyumas food incorporates various mathematical concepts, such as flat shapes, spatial forms, angles, and symmetry.

Following the observations and interviews with the resource persons, the researcher will present the data obtained from the field. Below is the data from an interview conducted with Mrs. Tri, a traditional Banyumas food entrepreneur, specifically focusing on the preparation of nopia. This interview was aimed at exploring the process of making nopia, and the results are presented below (Note: R: Researcher, E: Entrepreneur)

R : I would like to ask, in what year did you introduce nopia to the community?
E : Yes, you're welcome. I have been making nopia since I was a child. My grandfather shared with me the knowledge of how to make nopia. I am one of the people who started making nopia with entrepreneurs in 1980.
R : Wow, amazing! So, according to you, what distinguishes Banyumas nopia from nopia from other places?
E : In my opinion, Banyumas nopia has distinct characteristics, such as an extraordinary contrast in texture: the outer skin is crispy and delicious, providing a satisfying crunch in every bite, while the inside is soft, tender, and slightly moist, offering a delightful textural contrast.
R : Truly amazing! Does it have any meanings associated with its shape?
E : Yes, "nopia" has meanings related to its circular shape, which can symbolize unity, perfection, and wholeness. This interpretation aligns with the aspect of togetherness in enjoying nopia, which is often shared with family and friends, fostering a sense of unity and harmony. The shapes of food and cooking utensils often involve geometric concepts.
R : The meaning behind that is great! According to you, is there a difference in how the name is pronounced compared to others?
E : In other regions, nopia is known by different names. For example, in Purwokerto, this cake is called "Bakpia," while in Yogyakarta, it is known as "Pia." This variation is most likely influenced by the different ethnic groups in those areas.
R : Is there any significance in the name "nopia," ma'am?
E : Yes, nopia comes from the term "Ndog Gludhug," which in Banyumasan means "Thunder Egg." This nickname refers to the large round shape of nopia, which is white and resembles an egg, as well as its crispy skin texture, similar to an

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eggshell.

R : Wow, it seems like quite a lengthy process. What tools are used in making nopia, ma'am?

E : The tools used include an oven, a large pot, a small basin, jars, a large bamboo tray, and a cake pan.

R : According to my mother, do the tools used during the cooking process exhibit flat shapes, three-dimensional shapes, angular shapes, and symmetrical shapes?

E : Yes, nopia does not have flat shapes; they form a hemisphere. The three-dimensional shape of nopia is indeed a hemisphere. The angles in the equipment used during the manufacturing process are right angles, specifically 90 degrees, which include the angle between two radii of the circular base and the angle of inclination of the slant line. The symmetrical shapes in the equipment used during the manufacturing process include flat shapes, such as squares and circles, which exhibit foldable symmetry. In contrast, three-dimensional shapes, such as cubes and cylinders, have rotational symmetry nine times and three reflective symmetry planes, along with one instance of rotational symmetry and one reflective plane.

R : It turns out that flat shapes are not present in nopia, while three-dimensional shapes, angles, and symmetrical forms are indeed found in nopia!

Based on the analysis of the interview data and the presented documentation, it can be concluded that traditional Banyumas food exhibits remarkable diversity. The examples highlighted in this study nopia, rempeyek, and fried getuk each possess unique characteristics regarding raw materials, manufacturing processes, and packaging. The interview with the traditional Banyumas food entrepreneur revealed that nopia is made from wheat flour and brown sugar, emphasizing its distinct texture and shape. Specifically, nopia has a round, hemispherical form, symbolizing unity and harmony, while rempeyek is primarily composed of peanuts. The documentation of these traditional foods underscores their cultural significance and economic potential within the culinary landscape of Banyumas.

Moreover, the analysis uncovered several mathematical concepts integrated into the preparation of traditional Banyumas food. These concepts include comparisons of raw materials, as well as the flat and three-dimensional shapes of the equipment used in the manufacturing process, alongside the angles and symmetrical shapes present in both the cooking utensils and the food itself. For instance, the design of nopia and the tools used to create it illustrate geometric concepts such as angles and symmetry, reinforcing the connection between mathematics and culinary arts. Additionally, the time required for preparation and the shapes of the packaging also reveal underlying mathematical principles. This research not only contributes to the field of ethnomathematics but also serves as a valuable resource for the public, culinary businesses, and local governments, fostering a deeper understanding of the rich cultural heritage and mathematical concepts embedded in traditional Banyumas cuisine.

Study of Mathematical Aspects of Banyumas Traditional Food

The data used in this study focuses on traditional Banyumas food, specifically nopia. Data collection was conducted at the house of Mr. Sungep, a nopia entrepreneur. Nopia is a food that he makes and produces himself, as it is also handmade in Sokaraja.

Upon careful examination of this traditional Banyumas food, it becomes evident that several mathematical concepts are present. Nopia can serve as a tool to introduce various mathematical concepts, such as geometry, making it easier to understand abstract concepts like squares, rectangles, circles, tubes, cubes, half spheres, and similarity. The following pictures illustrate these concepts.

a) Shapes on Food

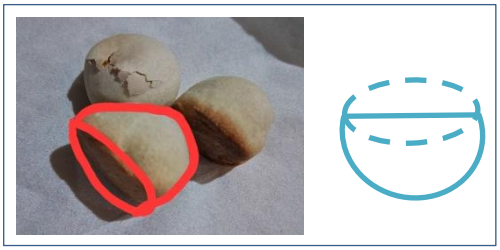

Figure 1. Shapes of nopia Food

Figure 1, a mathematical concept related to nopia food can be observed: the hemispherical shape. The design of nopia forms a hemisphere, which has a specific volume. This characteristic becomes evident when one closely examines the shape of the food.

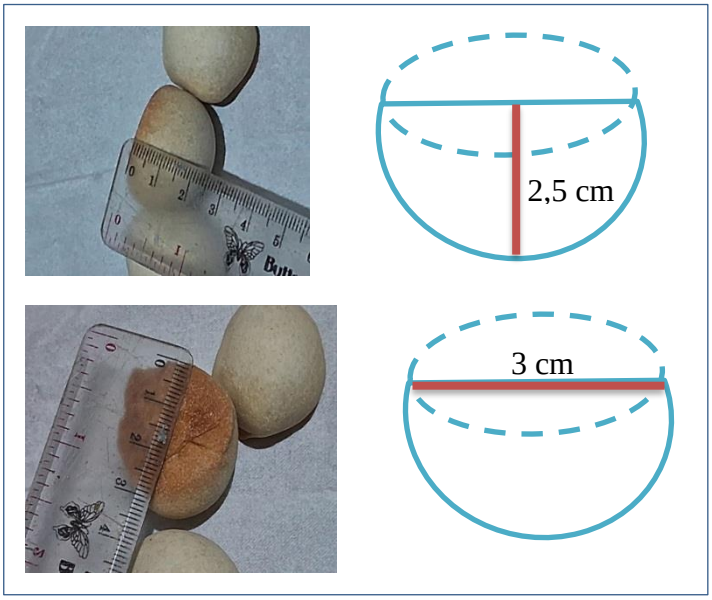

Figure 2. Sizes in the nopia shape

In Figure 2, the mathematical concept of a hemisphere is evident in the shape of the nopia. With a measured diameter of 3 cm, the radius is calculated to be 1.5 cm, and the height is 2.5 cm. This indicates that the nopia has equal diameter and height, resulting in a volume equivalent to that of a hemisphere.

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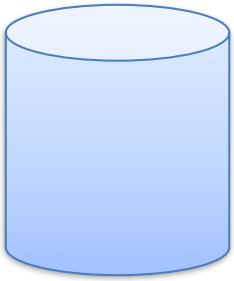
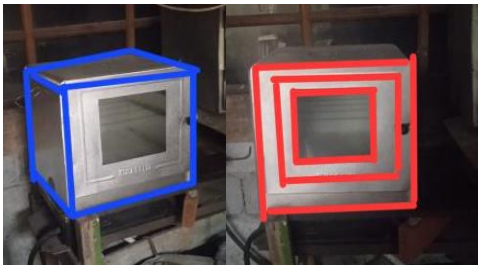
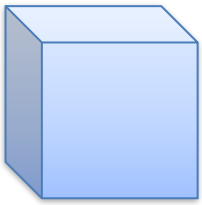
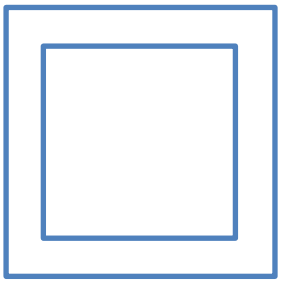
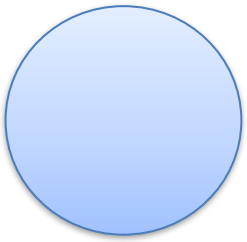
b) Shapes on Cookware

Tabel 1. Cooking Equipment for Nopia

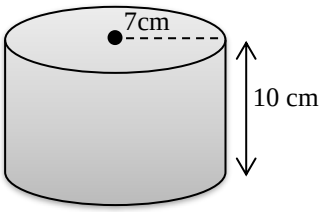
image of cooking utensils	illustration of flat shapes / three-dimensional shapes
 A Jar for storing flour. There is a mathematical concept present in that jar, which is the shape of a cylinder. If you observe the shape of the jar, it forms a cylinder.	
 Cake Pane for placing nopia molds. There is a mathematical concept present in the pane cake, which is its square shape. If you observe the image, you can see that it has a geometric square form.	
 Oven Machine for baking nopia. From the shape of the oven machine, it can be seen that it has a cubic shape and similarity. Therefore, upon observation, this oven machine forms a cube and is similar in the shape of a square.	 



A Tray for for holding or placing the baked nopia dough. From the base of the sieve, it can be seen that it has a flat shape, so after observation, the base of the sieve is circular. The placement of the filter is measured at distances that form an increasingly larger circle as it is considered.

Table 1 presents the tools used in the process of making bapia. The images illustrate the flat and three-dimensional shapes that student's study in geometry. Several tools are included, such as a jar, a cake pan, an oven, and a bamboo tray. These tools can serve as illustrations or starting points for explaining the flat and solid shapes covered in school mathematics content.

Based on the research findings, it is possible to elaborate on the mathematical aspects of traditional Banyumas food that have been examined, demonstrating the connection between these findings and the educational framework for mathematics instruction. This presents an opportunity to integrate elements of traditional Banyumas cuisine from Sokaraja into junior high school mathematics lessons, serving as content for modules, worksheets, problem creation, and other instructional materials. For instance, traditional foods can be utilized in the classroom to teach concepts related to flat and solid shapes in elementary education, as well as topics such as reflection and similarity in junior high school. Below is an example question related to mathematics in cooking equipment:



Look at the picture above! This is a cooking tool for baking nopia called a gentong, which is made of clay. The gentong is a traditional cooking utensil from Banyumas, and its shape is cylindrical. If the radius is 7 cm and the height is 10 cm, what is the volume of the cylinder in this gentong?

Figure 3. Example Questions About the Cylinder Shape in a Jar

Figure 3 presents an example question designed for 9th-grade students. This question focuses on the volume of a cylinder as it pertains to traditional Banyumas cooking utensils. It serves as a valuable learning tool for junior high school teachers in enhancing students' understanding of this mathematical concept.

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Discussion: Given: r (radius) = 7 cm t (height) = 10 cm The answer:	The answer: V $= \pi \times r^2 \times t$ $= \frac{22}{7} \times 7^2 \times 10$ $= \frac{22}{7} \times 7 \times 7 \times 10$ $= 22 \times 7 \times 10$ $= 22 \times 70$ $= 154\ cm^3$

Figure 4. Discussion of the Example Questions

Figure 4 provides a detailed discussion and an accurate answer to the posed question. It can be concluded that students will learn to calculate the capacity of a cylinder using the correct formula. By engaging with a variety of example problems, students will gain a deeper understanding of the application of the cylinder volume formula in everyday life. Below is the response from the junior high school student:

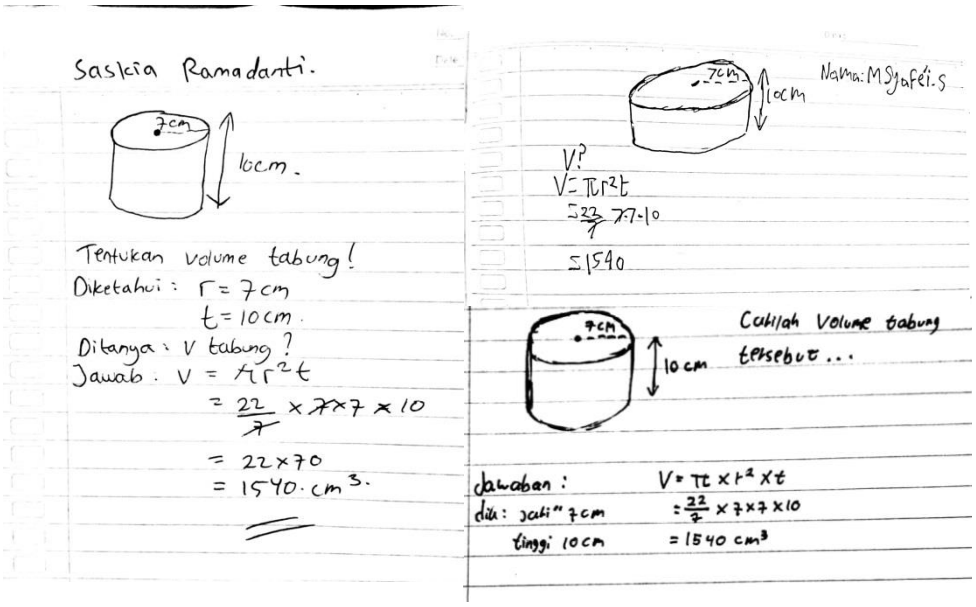

Figure 5. Student's Response After Addressing the Question

Figure 5 presents the student's response after addressing the question. Based on the provided results, it can be concluded that while the student's answer is correct, it lacks sufficient detail and depth. Thus, it can be summarized that the student demonstrates an understanding of the material; however, their response is overly brief, despite being accurate. Additionally, the student recognizes that the shape of the jar resembles that of a cylinder. This example illustrates how cultural elements, such as the image of a tube from Geto a traditional tool from Banyumas can be connected to mathematical concepts, including the shapes of cooking utensils and traditional Banyumas cuisine.

DISCUSSION

The exploration of ethnomathematics in traditional Banyumas food can be seen in the shapes of the food itself. This aligns with the findings of Hakim et al. (2024), who states that ethnomathematics can be observed through the flat and spatial forms present in the cultural representations of food. For instance, traditional Banyumas dishes often exhibit geometric patterns and shapes that can be analyzed

mathematically, providing a rich avenue for understanding how cultural practices are interwoven with mathematical concepts. This connection emphasizes the significance of traditional food not only as a source of nutrition but also as a medium for teaching mathematical principles.

Furthermore, the shapes of cooking utensils also contribute to the exploration of ethnomathematics in traditional Banyumas cuisine. This is in line with the work of Febriyanti and Afri (2023), who indicate that ethnomathematics can be found in the flat shapes of cooking tools used in food preparation. The geometric properties inherent in these utensils highlight the relationship between daily cultural practices and mathematical concepts. Similarly, Oktaviani et al. (2022) Observed that the properties of bagelan, a traditional food, involve various mathematical ideas, including flat shapes, solid shapes, and symmetry during the batik-making process. This demonstrates how everyday items used in cooking can serve as practical examples of mathematical applications in cultural contexts.

Moreover, the analysis extends to the shapes used in packaging traditional Banyumas food. This aspect resonates with the findings of Salsabila et al. (2022), who assert that the packaging of block cakes can be understood through the geometry of a rectangular prism. The utilization of various shapes in packaging not only enhances the visual appeal of traditional foods but also serves as a practical representation of mathematical concepts. Munahefi & Melisawati (2020) Further support this by examining the packaging of honey pineapples, which incorporates cylindrical shapes. Such examples demonstrate how ethnomathematics can bridge cultural heritage and mathematical learning.

In this research, the researchers conducted interviews and observations in the Sokaraja area of Central Java to gather valuable insights into traditional Banyumas cuisine. By emphasizing the mathematical concepts related to the shapes found in both traditional foods and cooking utensils, the researchers aim to provide an engaging and educational perspective for students. The integration of these concepts into the curriculum can enhance students' understanding of mathematics while simultaneously promoting appreciation for local cultural heritage (Febriyanti & Afri, 2023; Hakim et al., 2024).

The findings from this study can serve as a valuable resource for teachers and educators in elementary and junior high schools. By utilizing the insights gained from this research, educators can develop instructional materials that integrate ethnomathematics into their teaching practices. This approach not only makes mathematics more relatable to students but also fosters a deeper understanding of their cultural identity (Munahefi & Melisawati, 2020; Salsabila et al., 2022). Additionally, teachers can expand upon this research by incorporating other mathematical topics and cultural studies, thereby creating a more comprehensive educational experience.

This research underscores the importance of ethnomathematics in understanding traditional Banyumas food and its associated practices. By highlighting the mathematical concepts embedded within cultural artifacts, this study contributes to the field of ethnomathematics and provides a framework for further research and educational initiatives. The insights gained from this exploration can be further developed by future researchers, ensuring the continued relevance of cultural studies in mathematics education (Kusno et al., 2024). This study not only enriches the academic discourse on ethnomathematics but also serves as a practical guide for educators seeking to create engaging and culturally relevant learning experiences for their students.

CONCLUSION

Traditional Banyumas food is closely related to the learning of flat geometry (squares and circles) as well as spatial geometry (cubes, cylinders, and hemispheres) found in the junior high school mathematics curriculum. Additionally, it connects to the topic of transformation geometry, particularly the concept of similarity. Moreover, traditional Banyumas cuisine embodies a unique philosophy rooted in the community's beliefs, which have been passed down through generations. For instance, the history behind the naming of traditional Banyumas foods reflects these cultural values. Distinctive characteristics also set Banyumas traditional food apart, such as the round shape of Banyumas rempeyek, which contrasts with the irregular shapes found in similar foods from other regions. It is hoped that further research will be conducted to gain a deeper understanding of how local culture can

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be integrated into mathematics education, including the fundamental mathematical activities embedded within that culture. Additionally, it is crucial to engage more competent and willing individuals in the data collection process, such as cultural experts, mathematics scholars, and educators. This collaboration aims to enhance the quality of mathematics education in Indonesia, particularly in areas rich in local cultural heritage.

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