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Integrating Ethnomathematics Through Traditional Maluku Snacks to Enhance Geometric Understanding of Junior High Students

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ABSTRACT

This study explores the potensial of utilizing traditional Maluku snacks (pom poms, bagea, embal kacang, sagu lempeng, serut kenari) as pedagogical tools to enhance students' understanding of geometric conceps. The aim of this research is to describe how to integrate Ethnomathematics through traditional Maluku snacks to improve junior high school students' understanding of geometry concepts. This research was carried out in November 2023 at Yos Sudarso Junior High School Dobo. The subjects in this research were 30 grade 8 students. In this research, students used traditional Maluku snacks to understand geometric concepts through demonstrations and discussions. This research uses a qualitative approach where the type of research is descriptive qualitative. The data collection technique in this research is through observation using students' worksheets, interviews, and documentation using a recording device. Furthermore, data analysis in this research is qualitative analysis with stages of data reduction, data presentation, and drawing conclusions. The results of the research are that students understand the concept of 2D shapes in traditional Maluku snacks: pom-poms (triangles and rectangles), bagea (circles), serut kenari (circles and rectangles), sagu lempeng (trapezoids and rectangles), and embal kacang (rectangle). The concept of 3D shapes in traditional Maluku snacks: pom-poms (triangular prisms), bagea (balls), serut kenari (tubes), sagu lempeng (trapezoidal prisms), and embal kacang (cube-shaped). The integration of ethnomathematics in learning can include learning experiences to the formation of mathematical concepts, especially geometry, mathematical problems, the use of terms in geometry. It is hoped that the integration of ethnomathematics in geometry learning at school can develop meaningful learning.

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A. INTRODUCTION

Indonesia is a country known for its rich culture. The vast area combined with geographical, ethnic, belief, and lifestyle differences creates a variety of cultures that characterize each region. The form of culture can be seen in the form of buildings, traditional clothing, handicrafts, musical instruments, dances, traditional weapons, food and even the language used. Culture consists of various forms of human behavior, so its existence cannot be separated from everyday life (Rewatus *et al.*, 2020). One of the regions that has cultural diversity in Indonesia is the Aru Islands.

Aru Islands Regency is one of the regions in Maluku Province, Indonesia. The capital of the region is Dobo in the Aru Islands. The population of the Aru Islands in 2021 was 102,920 people and a density of 15.91 people/km^2, and the indigenous population of the region is the Aru Tribe. Geographically, the Aru Islands Regency is located at 5°-8°N and 133°5'-136°5' East. The topography of the region is generally flat and swampy. Aru Islands Regency has 187 islands and only 89 islands are inhabited. The five largest islands are Kola, Wokam, Kobror, Maekor and Trangan. The land area is 6,426 km^2 and the ocean area is 7.6 times larger than the land (Maluku, 2021).

One of the cultures of the Aru Islands people is traditional food. Traditional foods also support culture that is symbolically linked to activities and religion. Traditional foods are often associated with certain social and spiritual rituals. The traditional foods of the Aru Islands, Maluku, which are most popular among tourists and local residents are pom-pom, bagea, embal nuts, sago plates, shaved walnuts and others. Each food has its own characteristics in terms of shape, texture and taste. Traditional Maluku snacks such as pom-poms, bagea, embal nuts, sago plates, shaved walnuts have a mathematical aspect, in this case understanding the concept of geometry. For example, students can understand the concept of two-dimensional and three-dimensional shapes from traditional Maluku snack shapes: pom-poms are in the shape of a triangular prism and have a triangular base and rectangular sides, bagea is a three-dimensional shape, namely a circle, shaved walnuts have the shape circles and rectangles, sago plates have trapezoidal and rectangular shapes, and peanut embal has rectangular shapes. So using traditional Maluku food can provide or form an understanding of geometric concepts for students. The introduction of culture can be added to mathematics education in schools by integrating local wisdom with the subject. However, in reality, it is still rare to find learning that utilizes the surrounding environment in its learning tools. This can make students less aware and appreciate the culture around them. The utilization of cultural elements in the teaching and learning process in the classroom is one way to preserve the local wisdom of the region (Zulfah, 2018). Learning is a process that combines learning and teaching, where learning focuses on what students do, while teaching focuses on what the teacher does as a teacher, where the teacher uses all available resources and opportunities to interact positively with students and create an active learning environment (Purba *et al.*, 2022).

Ethnomathematics is an approach that can be used to connect school mathematics with cultural aspects in mathematics learning. According to Ambrosio 1985, ethnomathematics studies originate from local wisdom that grows and develops in society (Hanik & Nurtamam, 2017). Ethnomathematics is an activity that uses numbers, geometric patterns, calculations, etc., and is considered an application of mathematics that involves local culture (Pusvita et al., 2019). This is in accordance with Minister of Education and Culture Regulation number 21 of 2016 concerning the family, school and everyday play environment as sources of learning. This approach can be applied by integrating ethnomathematics in mathematics learning. In certain areas, one dominant ethnic group rarely uses Indonesian when using mathematical terms and concepts in class. This is also not uncommon for mathematics teachers who use Indonesian in classroom learning. So that more and more ethnomathematics studies originating from local culture can develop meaningfulness in learning. For example, the shapes of traditional snacks from the Aru Islands, Maluku, can be used as objects of application in mathematics learning, especially in geometry material, namely flat shapes and spatial shapes. Some examples of traditional Maluku snacks include pom-pom, bagea, shaved walnuts, and peanut embal.

Ethnomathematical research is also widely conducted in Indonesia, especially in the study of mathematics. Some tend to focus on this approach, including cross-sectional ethnomathematics problem solving (Ulya & Rahayu, 2020), and ethnomathematics of Sukapura Batik (Mulyani & Natalliasari, 2020). Ethnomathematics studies of Surakarta keraton batik patterns using symmetry analysis (Astriandini & Kristanto, 2021). The impact, importance, interest and evaluation of certification training influenced problem-solving in ethnomathematics (Aprilyani & Hakim, 2020).

Ethnomathematics is a driving force for the development of mathematics education that takes into account various factors such as context, cultural and ethnic influences (Prayoga et al., 2022). This is in line with the purpose of the independent curriculum, which is to overcome previous educational problems. The goal of the independent curriculum is to develop the skills and potential of Students. The mission of this curriculum is to develop potential by designing interactive and relevant learning. One of the interactive learning methods is the use of ethnomathematics (Purba *et al.*, 2023).

The ethnomathematics approach is one of the most important issues in creating constructive inquiry-based mathematics learning and personality development (Verner et al., 2019). Contextual culture-based learning encourages interaction between teachers and students because it can connect the surrounding culture that is often encountered with the material being taught. Based on this background description, the aim of this research is to describe how to integrate Ethnomathematics through traditional Maluku snacks to increase junior high school students' understanding of geometry concepts.

B. METHODS

This research was conducted in November 2023 at Yos Sudarso Junior High School Dobo. This research uses a qualitative approach where the type of research is descriptive qualitative. Qualitative descriptives are used to obtain and explain information in a comprehensive and in-depth manner (Prahmana & Kusumah, 2017). The subjects in this research were 8^{th} grade students at Yos Sudarso Junior High School Dobo who were taken based on a purposive sampling technique with the consideration that 8^{th} grade students were more flexible in managing their time and the students were easier to communicate with, thus helping in the data collection process. To obtain this research data, researchers used research instruments:

1. Student Worksheet
   Student worksheets are used to observe children's activities in working on worksheets, which include how to determine the concept of flat shapes found in traditional snacks, how to determine the concept of flat shapes found in these snacks, how to determine the sides, edges and corner points of traditional snacks, how to measure the length, width, height and radius of traditional snacks. How to measure the volume of traditional snacks.
2. Interview Protocol
   The interview protocol used in this research contains questions asked to research subjects related to students' understanding of geometry using traditional snacks.

3. Recording Device'
   The recording equipment used in this research was a digital camera and mobile phone. Recording devices are used to collect data more concretely. This documentation data is needed as material for re-checking the data that has been obtained. Furthermore, after the data was collected, data analysis was carried out using qualitative analysis with stages of data reduction, data presentation, and drawing conclusions.

C. RESULT AND DISCUSSION

1. Concept of 2D shape in traditional Maluku Snack

Maluku traditional snacks in the form of pom poms, embal kacang, serut kenari, bagea and sagu lempeng have different geometry concepts in the form of both 2D and 3D shapes. The researcher instructed students to observe the traditional Maluku snack in front of them and see what 2D shape concepts are contained in the snack then fill in the appropriate answers on the worksheet. The descriptions of the interview regarding the concept of 2D shape in traditional Maluku Snack are presented in Dialog 1.

Dialog 1

Researcher : "Dear students, let's examine the shapes of our bagea. Can you identify the 2D shapes present in bagea?"

Student : "I believe bagea resembles a ball, so the 2D shape is a circle."

Researcher : "Thank you. Now, what 2D shapes can you observe in pom pom?"

Student : "When I look from the front, I see a triangle, but from the other side, I see a rectangle."

Researcher : "Well done. How about sagu lempeng?"

Student : "From the front, I notice a trapezium, but from the other side, it appears as a rectangle."

Researcher : "Excellent observation. Now, let's consider embal kacang. Can you identify the 2D shapes in embal kacang?"

Student : "From all sides, I can see a rectangle."

Researcher :"Thank you. Lastly, let's focus on serut kenari. What 2D shapes do you see in serut kenari?"

Student : "When I view it from the front, I see a circle, but from the other side, it looks like a rectangle."

Researcher : "Excellent job, students. Your observations are commendable."

Students understood the concept of 2D shapes in traditional Maluku snacks: pom-pom (triangle and rectangle), bagea (circle), serut kenari (circle and rectangle), sagu lempeng (trapezium and rectangle), and embal kacang (rectangle), as shown in Figure 1.

Figure 1. Students observed traditional snacks and fill in worksheet no. 1

2. Concept of 3D shape in traditional Maluku Snack

The researcher instructed the students to observe the traditional Maluku snacks in front of them and see the concept of 3D shape implied in the snack then fill in the appropriate answers on the worksheet. The descriptions of the interview regarding the concept of of 3D shape in traditional Maluku Snack are presented in Dialog 2.

Dialog 2

Researcher : "Dear students, let's delve into the shapes of our bagea. What is the concept of 3D shapes you can find in bagea?"

Student : "I think bagea resembles a ball, miss."

Researcher : "Thank you. Now, what is the concept of 3D shapes you can find in pom pom?"

Student : "It's close to a triangular prism."

Researcher : "Excellent. How about sagu lempeng?"

Student : "It looks like a trapezium prism."

Researcher : "Very good, students. Now, let's shift our attention to embal kacang. Can you identify the concept of 3D shapes in embal kacang?"

Student : "Miss, it's quite thin, but I guess it's a cuboid."

Researcher : "Great observation. Now, let's consider serut kenari."

Student : "Serut kenari looks like a tube, miss."

Researcher : "Good idea, students. Your insights are appreciated."

Students understood the concept of 3D shapes in traditional Maluku snacks: pom-pom (triangular prism), bagea (ball), serut kenari (tube), sagu lempeng (trapezium prism), and embal kacang (cuboid).

Figure 2. Students observed traditional snacks and fill in worksheet no. 2

3. Concept of the number of sides, ribs and corner points in traditional Maluku Snack

The researcher guides students to make observations on the traditional Maluku snack in front of them and determine the number of sides, ribs and corner points on the snack and then fill in the appropriate answers on their worksheet.

Dialog 3

Researcher : "Students, today we will examine the number of sides, ribs, and corner points in our bagea."

Student : "Miss, I think bagea doesn't have sides, ribs, or corner points because it's shaped like a ball."

Researcher : "Thank you, students. Now, please take a look at your pompom. How many sides, ribs, and corner points does it have?"

Student : "Pompom has 5 sides, 9 ribs, and 6 corner points, miss."

Researcher : "Excellent. How about sagu lempeng?"

Student : "I guess sagu lempeng has 6 sides, 12 ribs, and 8 corner points, miss."

Researcher : "Very good, students. Now, let's consider embal kacang. Can you count the sides, ribs, and corner points?"

Student : "Miss, it's quite thin, and I'm unsure, but I will try. I think it has 6 sides, 12 ribs, and 8 corner points."

Researcher : "Good effort, and that's a correct answer. Lastly, we have serut kenari. Can you help me find out?"

Students : "Yes, miss. We think it has 3 sides, 2 edges, and 0 corner points."

Researcher : "Well done, students. Your participation is appreciated."

Figure 3. Students observed traditional snacks and fill in worksheet no. 3

4. Concept the volume of 3D shape in traditional Maluku Snack

The researcher guides students to make observations on the traditional Maluku snack in front of them and directs Students to measure the length, width, height and radius of the snack using a ruler and then fill in the appropriate answers on their worksheet. Students can measure the length, width, height and radius of the traditional snack.

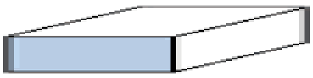
Figure 4. Students measure the length of a traditional snack

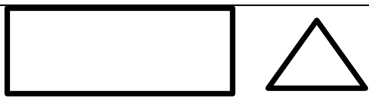
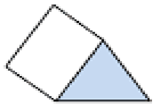
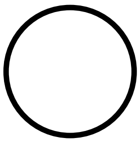
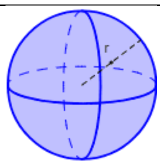
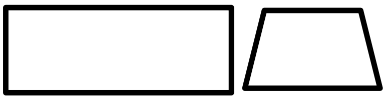
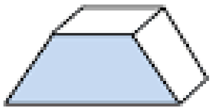
The researcher guides students to calculate the snack volume based on the measurements of length, width, height, and radius that they have done before and fill in the appropriate answers in their worksheet. Students can calculate the volume of the traditional snack.

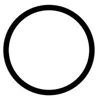
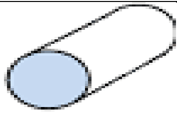
Figure 5. Students calculate the volume of a traditional Maluku snack

Some geometry concepts of 2D and 3D shapes related to traditional snacks that students have understood can be seen in the following Table 1.

Tabel 1. Geometric shapes in traditional Maluku snacks

Traditional Snack	**Geometry**	
	2D Shapes	**3D Shapes**
	 Rectangle	 Cuboid known: Length = 5 Width =4 Height =1 Asked: Volume? Answer: Volume = length x width x height Volume = 5cm x 4cm x 1cm = $20cm^3$

Traditional Snack	**Geometry**	
	2D Shapes	**3D Shapes**
		So the volume of the embal kacang snack is 20 cm^3
	 Rectangle Triangle	 known: Base of triangle=2.2 cm Triangle height = 2 cm Prism height = 10.5 cm Ask: Volume? Answer: $\text{Triangle Area} = \frac{1}{2}\text{ x a x t}$ $\text{Triangle Area} = \frac{1}{2}\text{ x 2cm x 2.2cm}$ $\text{Triangle Area} = 2.2\text{ cm}^2$ $\text{Volume} = \text{base area x prism height}$ Since the base is triangle then: $\text{Volume} = \text{triangle area x prism height}$ $\text{Volume} = 2.2\text{cm}^2\text{x}10.5\text{cm} = 23.1\text{cm}^3$ So the volume of the pom pom is 23.1 cm^3
	 Circle	 Ball Known: Radius = r = 2 cm Ask: Volume? Answer: $\text{Volume} = \frac{4}{3}\text{x}\pi\text{xr}^3$ $= \frac{4}{3}\text{x}3.14\text{x}(2\text{cm})^3$ $= 33.493\text{ cm}^3$ So the volume of bagea is 33.493 cm^3
	 Rectangle Trapezoid	 Trapezoidal Prism known: Shortest side of trapezium=a=7 cm Longest side of trapezium=b=8.5 cm Height of trapezium = t = 6 cm Prism height 2.5 cm Ask: Volume? Answer: $\text{Area of trapezium} = \frac{1}{2}\text{x}(\text{a} + \text{b})\text{xt}$ $\text{Area of trapezium} = \frac{1}{2}\text{x}(7\text{cm} + 8.5\text{cm})\text{x}6\text{cm}$ $\text{Area of trapezium} = 46.5\text{ cm}^2$

Traditional Snack	Geometry	
	2D Shapes	3D Shapes
		Volume = base area x prism height Since the base is triangular then Volume = area of trapezium x height Volume = 46.5cm^2 x 2.5cm Volume = 116.25 cm^3 So the volume of the sagu lempeng is 116.25 cm^3
	  Rectangle Circle	 Tube known: Radius = r = 1 cm Prism height = 10.6 cm Asked: Volume? Answer: Circle Area = πr^2 Circle Area = 3,14cm x $(1cm)^2$ Circle Area = $3.14cm^2$ Since the base is circular then: Volume = base area x prism height Volume = $3.14cm^2x10.6cm = 33.284\ cm^3$ So the volume of serut kenari is 33.284 cm^3

This research focuses on some traditional Maluku snacks namely: embal kacang, pom pom, bagea, sagu lempeng, and serut kenari. After analyzing the shape of traditional Maluku snacks, students found geometry concepts that are specific to the ethnomathematics of traditional Maluku snacks, including the following:

a. Embal Kacang

Embal is a specialty of Tual in southeastern Maluku. Embal is made from cassava that has been processed into flour. For the production process, cassava taken from the garden is grated, then the grated cassava is put into a bag. After being pressed with a stone and left overnight, the cassava water becomes flour. After being processed into flour, we can use this cassava flour to make embal. There are many kinds of embals such as: Embal Kacang which tastes sweet. This embal is eaten in the morning and evening. Both types of Embal can be served with tea or coffee to add to the sweetness. The geometric shape of the traditional embal kacang snack is a cuboid, as shown in Figure 6.

Figure 6. Embal Kacang

b. Pom Pom

Pom pom is a traditional and typical Aru Islands food. Pompom is a food made from sago juice which is filtered and then only the juice is taken. The process of making this food is quite long because after making pom poms, they are dried in the sun and it takes a longer time. But this traditional process makes this snack last longer and tastier. Pompom is a complement and companion to coffee, this food from the Aru Islands can be used as a snack for relaxation. The geometric shape of a pom pom is a triangular prism, as shown in Figure 7.

Figure 7. Pom Pom

c. Bagea

Bagea is a traditional snack typical of Maluku, North Maluku, and Palopo City, South Sulawesi, Southeast Sulawesi, Indonesia. Bagea is usually round in shape and light brown in color. Bagea is processed sago. Bagea is usually eaten with tea or coffee. The geometric shape of the traditional bagea snack is a ball, as shown in Figure 8.

Figure 8. Bagea

d. Sagu lempeng

Sagu lempeng is a typical Maluku and Papuan snack. Sagu lempeng is a type of food cooked by burning a stone or clay mold called forna. The result is a brownish-colored sago slab. Because of its firm texture, sagu lempeng is usually eaten as a light snack with coffee or tea. The geometric shape of the traditional Maluku sagu lempeng is a trapezoidal prism.

Figure 9. Sagu lempeng

e. Serut Kenari
   Serut Kenari is a popular snack in Maluku. The texture is almost like bagea. When observed, it is almost similar to bangket ginger cookies in Java except that it does not use ginger and there is the use of walnuts. The geometric shape of the traditional Maluku serut kenari snack is a tube.

Figure 10. Walnut Drawstring

The outcomes of this investigation indicate that the people of Maluku have integrated mathematical principles into the creation of traditional snacks such as pompom, bagea, serut kenari, sagu lempeng, and embal kacang. This aligns with the objectives of ethnomathematics, which seeks to connect mathematics with the everyday reality and perceptions of society. As ethnomathematics research progresses, there is a growing proposal to incorporate it into formal mathematics education in schools. This stems from the recognition that much of the mathematics taught in schools lacks relevance to real-world scenarios, resulting in students struggling to apply it effectively.

The exploration of ethnomathematics has not only yielded valuable insights but has also been implemented in mathematics education across several Indonesian schools. This integration of culture into learning has proven effective in altering students' negative perceptions of mathematics, consequently enhancing both their academic achievements and interest in the subject. Previous studies have successfully developed mathematics learning designs based on ethnomathematics exploration, showcasing positive impacts on both teachers and students (Supriadi et al., 2016). The incorporation of ethnomathematics into school curricula has been shown to boost motivation, learning achievements, and problem-solving abilities among students (Disnawati & Nahak, 2019; Mahendra, 2017; Prabawa & Zaenuri, 2017; (W Widada *et al.*, 2019); Wahyu Widada et al., 2019). The problem solving ability of students who study with ethnomatematics oriented youtube media was higher than students who learn not to ethnomathetics oriented after controlling the students' initial abilities (Nugroho et al., 2019).

One possible benefit of using ethnomathematics as a way to teach math is that it might help students do better in school. Both Achor (2009) and Presmeg (1998) came to the same conclusion: students who were taught using ethnomathematics did much better than those who were taught using more traditional methods. This demonstrates that ethnomathematics is an effective approach to the teaching of mathematics. Additionally, teaching materials grounded in ethnomathematics have captured students' interest in learning mathematics (Imswatama & Lukman, 2018). These findings, rooted in the traditional Maluku snacks like pompom, bagea, serut kenari, sagu lempeng, and embal kacang, serve as a foundation for developing learning designs that aim to enhance critical thinking and increase students' motivation in mathematics education. This is particularly impactful as these snacks are cultural heritages closely intertwined with students' daily activities, allowing them to draw upon contextual resources in their mathematical learning.

The study identifies various mathematical concepts embedded in Maluku culture, such as 2D shapes in traditional Maluku snacks: pom-pom (triangle and rectangle), bagea (circle), serut kenari (circle and rectangle), sagu lempeng (trapezium and rectangle), and embal kacang (rectangle); and the concept of 3D shapes in traditional Maluku snacks: pom-pom (triangular prism), bagea (ball), serut kenari (tube), sagu lempeng (trapezium prism), and embal kacang (cuboid). These concepts hold the potential to be integrated into formal mathematics education, serving as contextual learning resources for students in schools. The study's findings align with previous research demonstrating the successful application of ethnomathematics in different ethnic groups across Indonesia. For instance, the Javanese community employs geometry transformation concepts in Batik motifs, offering a foundation for mathematics learning design (Risdiyanti & Prahmana, 2017). Similarly, the Sundanese society incorporates symbolic mathematical calculations in daily activities, presenting an opportunity for educators to integrate ethnomathematics into realistic mathematics education programs (Abdullah, 2017).

The study also highlights geometric concepts in Sasaknese and Lionese architecture, demonstrating their potential application in school mathematics education (Supiyati & Hanum, 2019); (Wondo et al., 2020). In comparison to previous ethnomathematics studies, this research contributes by delving into mathematical concepts within Maluku culture, an area that has been minimally explored. Maluku, like other ethnicities, boasts a rich cultural heritage, making this investigation a valuable reference for future research on Maluku ethnomathematics and extending the broader understanding of cultural influences on mathematics education.

D. CONCLUSION AND SUGGESTIONS

This study describes the preservation of the cultural heritage of the Maluku people, especially focusing on traditional snacks such as embal kacang, pom poms, bagea, sagu lempeng, and serut kenari. Maluku people, even though they do not have formal education, unconsciously practice mathematics when making these snacks. The findings revealed that the process of making these snacks incorporates mathematical concepts, thereby showing potential application in formal mathematics education. The mathematical aspects identified are related to the 2D shapes found in traditional Maluku snacks, including triangles and rectangles in pom-poms, circles in bagea, circles and rectangles in serut kenari, trapezoids and rectangles in sagu lempeng, and rectangles in embal kacang. Apart from that, this research also identified 3D shapes such as triangular prisms on pom-poms, balls on bagea, tubes on serut kenari, trapezoidal prisms on sagu lempeng, and blocks on embal kacang. Therefore, these traditional snacks have the potential to become a basis for designing mathematics learning activities. This research aims to integrate ethnomathematics through traditional Maluku snacks to improve junior high school students' understanding of geometry concepts. Therefore, the integration of ethnomathematics is needed in mathematics learning. With this integration, mathematics learning is more meaningful. Because students in learning mathematics are associated with things that are often encountered in everyday life. The integration of mathematics in mathematics learning is from learning experiences to the formation of mathematical concepts, especially geometry, mathematical problems, the use of terms in geometry. Suggestions for educational practitioners should be to integrate ethnomathematics in mathematics learning that grows and develops in the community where students live so that it is easier to form mathematical concepts.

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