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AN EXPLORATION OF ETHNOMATHEMATICS IN THE GAME SEPAK TAKRAW GAME OF THE BUGIS MAKASSAR REGION

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ABSTRACT
Traditional games such as sepak takraw are an important part of Bugis-Makassar local culture that is rich in cultural values and mathematical concepts. This research aims to study the concept of mathematics, especially geometry, as well as the cultural values found in the implementation process of sepak takraw game. The research subject in this study is the traditional sepak takraw game performed by the Bugis-Makassar community. The research method used is a qualitative method with an ethnographic approach. Data collection techniques are through field observations, interviews with cultural sources, and documentation. The instrument used in this research is the researcher himself. The data analysis technique used is triangulation technique. The results showed that the concept of geometry in sepak takraw reflects the uniqueness of local culture, while values such as "siri' na pacce" (honor and empathy) strengthen the cultural identity of the Bugis-Makassar people. The conclusion of this study shows that sepak takraw game can be a medium for culture-based mathematics learning as well as a means of preserving cultural heritage.
Keywords : cultural value; ethnomathematics, geometry; math learning; sepak takraw.

ABSTRAK
Permainan tradisional seperti sepak takraw merupakan bagian penting dari budaya lokal Bugis-Makassar yang kaya nilai-nilai budaya dan konsep matematika. Penelitian ini bertujuan untuk mempelajari konsep matematika, khususnya geometri, serta nilai-nilai budaya yang tedapat pada proses pelaksanaan permainan sepak takraw. Subjek penelitian pada studi ini adalah permainan tradisional sepak takraw yang dilakukan oleh masyarakat Bugis-Makassar. Metode penelitian yang digunakan adalah metode kualitatif dengan pendekatan etnografi. Teknik pengumpulan data yaitu melalui observasi lapangan, wawancara dengan narasumber budaya, dan dokumentasi. Instrumen yang digunakan dalam penelitian ini adalah peneliti itu sendiri. Teknik analisis data yang digunakan yaitu triangulasi teknik. Hasil penelitian menunjukkan bahwa konsep geometri dalam permainan sepak takraw mencerminkan keunikan budaya lokal, sementara nilai-nilai seperti "siri' na pacce" (kehormatan dan empati) memperkuat identitas budaya masyarakat Bugis-Makassar. Kesimpulan penelitian ini menunjukkan bahwa permainan sepak takraw dapat menjadi media pembelajaran matematika berbasis budaya sekaligus sarana pelestarian warisan budaya.
Kata kunci : *etnomatematika; geometri; nilai budaya; pembelajaran matematika; sepak takraw.*

Introduction

Traditional games are an important part of community culture that reflects local wisdom and cultural identity. Traditional games are part of Indonesian Culture (Jannah et al., 2023). Traditional games are fun activities that have a key intrinsic

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motivational component to capture students' attention and keep them engaged and enthusiastic (Hariastuti et al., 2019). Culture in Indonesia changes every generation due to changes in thinking and advances in globalization so that some cultures have changed (Setyawati et al., 2023). In Indonesia, the existence of traditional games such as congklak, gasing, and engklek is not only a means of recreation, but also contains educational values. One of the traditional games that still survive in the Bugis-Makassar community is sepak takraw. This game not only involves physical activity, but also has the potential to be used as a learning medium, especially in understanding mathematical concepts, such as geometry.

Ethnomathematics can connect community traditions with education, especially in terms of learning mathematics at school (Diniyati et al., 2022). There are many Indonesian cultural products that show elements of creativity in mathematics Aminah, et.al. (2023). Research on ethnomathematics in traditional games has been conducted in various regions. Taus et al. (2022) discussed mathematical concepts in the game of congklak in East Nusa Tenggara, while Zuhri et al. (2023) studied geometry elements in the game of engklek. Research conducted by (Wangge, 2023) also discusses mathematical concepts in dedo gomo and gomo telu games originating from NTT. Another study by Saputra et al. (2023) showed that local culture can be used to improve students' understanding of mathematical concepts. Research by Pratiwi & Pujiastuti (2020)which applies the geometry field to marbles originating from West Java. Research conducted by Susanti (2020) which applies the concept of counting operations in the kempreng game originating from Java. However, specific research that discusses the exploration of ethnomathematics in sepak takraw games in the Bugis-Makassar region has yet to be found.

Although there are many studies exploring ethnomathematics in traditional games, most of them focus on games from specific regions such as Java or Sumatra. No studies have specifically highlighted sepak takraw as a medium for learning mathematics based on Bugis-Makassar local culture. Therefore, this study fills the gap by exploring the cultural values and mathematical concepts in sepak takraw game. Facts show that math learning is often less contextual and far from students' daily lives, so it is considered difficult and boring (Yanti, 2024). Ethnomathematics provides the contextual meaning needed for many abstract mathematical concepts (Sholihah et al., 2024). Forms of community activities that have mathematical nuances in the nature of arithmetic operations practiced and developed in the community such as ways of adding, subtracting, counting, measuring, determining location, designing buildings, types of games practiced by children, spoken language (Hasanah et al., 2024).

According to Pathuddin & Raehana (2019), local culture is a contextual learning resource that can be used. Local cultures such as sepak takraw games are starting to be marginalized by the influence of globalization and modern games, which threaten the preservation of the cultural values contained in them. Research results Alditia et al., (2023) show that geometry is one of the most abstract areas of mathematics. Students' views of math as a difficult, boring lesson, and usually irrelevant to everyday life are other factors that cause learning difficulties in geometry material (Ayu et al., 2021). The results of research conducted by Naja et al., (2022) showed that contextual learning based on ethnomathematics can improve students' mathematical abilities and learning outcomes.

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The solution offered is to integrate the ethnomathematics concepts contained in the sepak takraw game into mathematics learning at school. This is done by teaching geometry concepts in the game, such as pentagon, circle, triangle, square, and rectangle, and instilling cultural values such as cooperation, discipline, and siri' na pacce. Geometry is the study of spatial relationships that builds concepts by starting from the introduction of various shapes and investigating their properties. In this context, learners are invited to identify and explore geometric shapes such as rectangles, circles and triangles to understand their structure and relationship in everyday life (Hidayat et al., 2021).

This research aims to explore mathematical concepts, especially geometry, as well as cultural values contained in the sepak takraw game. The results of the research are expected to enrich the literature on ethnomathematics, preserve local culture, and provide an alternative to learning mathematics that is contextual and relevant to students' lives.

Research Methods

This study uses a type of qualitative research with an ethnographic approach. This research is a research tool used to research, study and describe by looking at the cultural aspects of a society (Ugwu, Chinyere, N; Eze Val, 2023). Ethnography helps researchers understand how people organize their culture by distinguishing between 'emic' (view from within the community) and 'etic' (view from outside) perspectives (Suhendar, 2022). This research was chosen to explore the concept of mathematics, especially geometry and cultural values contained in traditional games, namely Sepak Takraw / Maraga. The instrument used in this research is the researcher himself. According to Waruwu (2023) humans as researchers who act as tools themselves to collect the data needed in the study to make conclusions.

This research was conducted through several systematic stages. First, at the research preparation stage, the research location was determined in the community of Bugis-Makassar people who actively play sepak takraw. The researcher developed research instruments in the form of interview guides and coordinated with local cultural and community leaders for access and support. The second stage was data collection, which involved observation of sepak takraw games, semi-structured interviews with local culturists, and collection of relevant documentation. Furthermore, in the data analysis stage, the information obtained was categorized based on themes, such as geometry concepts and cultural values, and validated through technical triangulation.

This research was conducted for 1 month in the Makassar area. The researcher collaborated with a local cultural expert, Mr. Tajuddin Arif, who has in-depth knowledge about this game. The research time included observations in the field, interviews with cultural experts, and literature studies to support the research results. To ensure the validity of the research results, triangulation procedures were carried out by comparing data from observations, interviews, and documentation. All findings were critically analyzed by referring to relevant literature to ensure that the data obtained could be accounted for.

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Conclusion and Suggestion

The research results are described based on three different techniques, namely field observations, interviews and documentation/literature studies. Sepak takraw is a traditional game that is well known among the Bugis-Makassar people and throughout Southeast Asia. Sepak takraw in Bugis-Makassar tradition is known as "sepak raga" or "takraw". Based on the results of the research, it was found that there are cultural elements and mathematical elements in the game of sepak takraw.

Philosophy and Cultural Values in Sepak Takraw/Maraga Game

Sepak takraw, known as "sepak raga" or "takraw" in Bugis-Makassar culture, has a long history dating back to the 15th century when the game was brought by Southeast Asian traders. Sepak takraw developed in various Southeast Asian countries, with different names such as "Sipa" in the Philippines, "Chinlone" in Myanmar, "Kator" in Laos, and "Raga" in Indonesia. In its early days, the game was played simply, without strict rules, as a form of social activity that honed skills as well as a symbol of honor in the community.

In the past, the game of sepak takraw was limited to the royal elite, and could not be played by commoners to maintain dignity. However, over time, sepak raga evolved and became more inclusive, allowing the general public to participate. The sacred value of the game shifted to a competitive and disciplined sport on an international scale.

Sepak takraw has a deep philosophical meaning, especially the value of "siri' na pacce," which teaches the importance of maintaining dignity and honor. This philosophy is reflected in sportsmanship and team pride in every game, as well as being a symbol of self-respect that must be maintained. In addition, the game is inherited with other cultural values such as cooperation and togetherness (sipakatau, sipatokkong), mutual respect and reminder (sipakainge), as well as discipline and agility (warani/sipakalebbi). Aspects of self-control, patience (asitinaja), commitment and responsibility are also emphasized in sepak takraw, instilling important values for personal character and social bonding in Bugis society.

The game is not only played during leisure time, but also in important moments such as traditional celebrations and harvest parties, for example at mappadendang events or cultural festivals. In these moments, sepak takraw becomes a medium to strengthen social relations between residents and strengthen cultural identity. However, in the modern era, sepak takraw faces challenges from technology and modern games. To preserve the game, various efforts are made, such as introducing sepak takraw in the school curriculum as part of physical education, organizing festivals, and holding competitions at local to national levels. These measures ensure that the younger generation continues to inherit the game and its cultural values.

Thus, sepak takraw serves as more than just a sport, but as a cultural heritage that teaches a life of respect, resilience and courage that is relevant throughout the ages.

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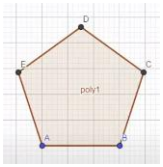
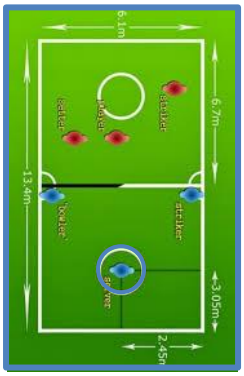
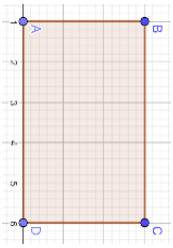
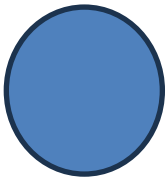
Geometry Concept in Sepak Takraw Game

Based on the research results from observations, interviews, and documentation that have been carried out based on the concept of geometry in sepak takraw games. Furthermore, the research results are contained in Table 1 and Table 2.

Table 1. Exploration of flat-building geometry concepts

Concept of Flat Buildings			
No.	**Image**	**Math Concept**	**Description**
1.	 Figure 1. Takraw Ball		The results of the observation, the webbing on this ball forms a flat geometry, namely a pentagon that has the same length. This shows that the weaving on the sepak takraw ball follows the concept of a regular pentagon. The formula for determining the area and perimeter of a pentagon: $L = \frac{1}{4}\sqrt{5(5+2\sqrt{5}} \times s^2$ $K = 5 \times s$
2.	 Figure 2. Illustration of Sepak Takraw Field	 	The results of observations on the takraw field show the concept of flat buildings, namely rectangles, In addition, there is the concept of a circle in the service circle, which is the place where players serve. The formula for determining the area and perimeter of a rectangle: $L = p \times l$ $K = 2\ (p \times l)$ Formulas for determining the area and circumference of a circle : $L = \pi \times r \times r$ $K = 2 \times \pi \times r$

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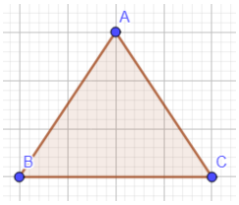
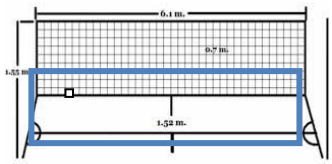
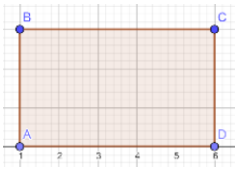
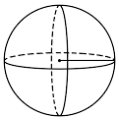
3.	 Figure 3. Sepak Takraw Game		The results of further observations, in the formation of sepak takraw players form a geometric pattern, namely a triangle. With the same distance, the player formation forms an equilateral triangle. Area and perimeter formulas for equilateral triangles: L = $\frac{s^2\sqrt{3}}{4}$ K = 3s
4.	 Figure 4. Illustration of Sepak Takraw Net	 	The results of the observation, can be seen the net in sepak takraw. The sepak takraw net is rectangular with a square net. The shape of this net shows the visualization of flat shapes, namely rectangles and squares. The formula to determine the area and perimeter of a rectangle: L = $p \times l$ K = 2 $(p \times l)$ Rumus untuk menentukan luas dan keliling persegi : L = s× s K = s + s + s + s

Table 2: Exploration of the concept of spatial geometry

Concept of Building Space

No.	Image	Math Concept	Description
1.	 Figure 5. Takraw Ball		The observation shows that the takraw ball is in the shape of a ball with a frame that resembles a webbing of several curved lines that meet each other and form a unique pattern. The formula for determining the area and circumference of a circle: L = $\pi \times r \times r$ K = $2 \times \pi \times r$

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Based on field observations, interviews, and documentation studies that have been collected in table 1 and table 2, the research shows that sepak takraw games have mathematical elements that can be used in mathematics learning. The sepak takraw game shows the concept of geometry, namely flat and space. For example, the shape of the takraw ball represents the concept of a spherical shape with a regular pentagon woven pattern, while the playing field reflects the concept of a rectangle with a circle element in the service circle. It is expected that students will more easily understand and grasp mathematical concepts if cultural elements are included in the mathematics learning process (Nursanti et al., 2024).

The results of this study with theory or previous research show consistency with the view of ethnomathematics as an approach that integrates local culture in mathematics learning. In addition, this study is also in line with Saputra et al. (2023), which states that students' cultural understanding can be improved through the integration of local culture into learning materials. Research by Zuhri et al. (2023) also corroborates this result, which shows that traditional games such as engklek can teach various geometry concepts, which also applies to sepak takraw games.

Based on the above research results, ethnomathematics in sepak takraw games can be used in learning with the following steps:

1. Introducing Geometry Concepts through Game Elements: Teachers can use takraw balls to teach flat concepts such as the regular pentagon, and takraw fields to understand rectangles and circles.
2. Engage Students in Practical Activities: Students can be asked to make a mini model of a takraw field or draw a woven pattern of a takraw ball while calculating its area and perimeter.
3. Linking Cultural Philosophy to Learning: Values such as cooperation, discipline and “siri' na pacce” contained in sepak takraw game can be integrated to build students' character during math learning.
4. Organizing Educational Competitions: Teachers can organize a sepak takraw game simulation in the classroom to teach mathematical and cultural skills simultaneously.

Ultimately, ethnomathematics can be used in mathematics learning as an alternative to overcome boredom and make sepak takraw games interesting for students. Ethnomathematics in mathematics learning offers new motivation and different variations, confirming that mathematics learning involves interaction with local culture and is not limited. Therefore, the main purpose of the ethnomathematics-based mathematics learning approach is to enrich the nation's character and apply and internalize cultural principles through mathematics learning (Rhamdania & Nugraha, 2021).

Theoretically, the results of this study enrich the literature on ethnomathematics, especially in connecting traditional Bugis-Makassar games with geometry concepts, thus providing a new perspective on the integration of local culture in mathematics learning. This research also supports D’Ambrosio (1985) theory which emphasizes that ethnomathematics can be an effective approach in connecting formal learning with local wisdom.

In terms of application, this study provides guidelines for educators to integrate elements of sepak takraw games in mathematics learning. Teachers can use the geometric patterns on the sepak takraw ball and playing field as teaching

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media to introduce geometry concepts contextually. In addition, the cultural values contained, such as cooperation, discipline, and "siri' na pacce," can be used to build students' character during the learning process. This approach can increase the relevance of the subject matter to students' lives, making learning more interesting and effective.

Conclusions and Suggestion

Based on the results and discussion, this study shows that the concept of geometry in sepak takraw reflects the uniqueness of local culture, while values such as "siri' na pacce" (honor and empathy) strengthen the cultural identity of the Bugis-Makassar people. In addition, the implementation process of sepak takraw contains mathematical concepts, especially geometry, such as the shape of a square, rectangle, triangle, pentagon, circle, as well as the spatial shape of the ball seen in its implementation. Therefore, this research also shows that sepak takraw game can be a medium for culture-based math learning as well as a means of preserving cultural heritage.

It is highly recommended that future researchers conduct research to study different mathematical concepts without paying attention to a single concept of mathematics. It is suggested that the results of the study be incorporated into the school curriculum to improve students' understanding of mathematics. One way to do this is to use bida as a learning tool. Therefore, students' learning process becomes more significant as they make connections between mathematics and their environment.

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