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The Ethnomahematics Exploration in the Traditional Game of Sipak Rago

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Abstract. Education and culture cannot be separated in daily life. Ethnomathematics exists to bridge the gap between culture and education, especially in mathematics. Humans are unaware of activities that use basic mathematical concepts and ideas like counting, measuring (length, area, volume, and weight), number construction, games, and buying-selling activities. This study examines and analyzes the Minangkabau traditional games in the scope of geometry. This research is exploratory research with an ethnographic approach. The subjects of this study were six players of the Sipak Rago game. The data was collected through observation, documentation, and interview to find mathematical concepts in the Sipak Rago game. Based on the research, there are mathematical concepts in the Sipak Rago game like the concept of circle elements, circle circumference formula, circle area formula, and angle on a circle.

Keywords: Ethnomatematics; Geometry; Minangkabau Tribe; Sipak Rago Game; Traditional Game

Abstrak. Pendidikan dan kebudayaan tidak dapat dipisahkan dalam kehidupan sehari-hari. Etnomatematika hadir untuk menjembatani kesenjangan antara budaya dan pendidikan, khususnya di bidang matematika. Manusia tidak mengetahui berbagai kegiatan yang menggunakan konsep dan ide matematika dasar seperti kegiatan berhitung, kegiatan mengukur (panjang, luas, volume, dan berat), konstruksi angka, permainan, dan kegiatan jual beli. Penelitian ini mengkaji dan menganalisis permainan tradisional Minangkabau dalam ruang lingkup geometri. Penelitian ini merupakan penelitian eksploratif dengan pendekatan etnografi. Subyek penelitian ini adalah 6 pemain permainan Sipak Rago. Pengumpulan data dilakukan melalui observasi, dokumentasi, dan wawancara untuk menemukan konsep matematika dalam permainan Sipak Rago. Berdasarkan penelitian yang dilakukan, terdapat konsep-konsep matematika dalam permainan Sipak Rago seperti konsep unsur lingkaran, rumus keliling lingkaran, rumus luas lingkaran, dan sudut pada lingkaran.

Kata kunci: Etnomatematika; Geometri; Permainan Sipak Rago; Permainan Tradisional; Suku Minangkabau

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INTRODUCTION

Education makes people cultured because culture and education are related. One part of education that is taught in schools is mathematics. Mathematics is a culture. Understandably, human mathematics is influenced by cultural backgrounds. Because essential cultural values are easy to integrate, each individual better understands the meaning of cultural values and what all life is about understanding, explaining, and interpreting how it works (Setiana et al., 2021; Merliza, 2021). Mathematics and culture are something that cannot be separated in life (Medyasari et al., 2019). By learning mathematics, someone is motivated by their culture, and they do it based on what they see and feel.

Furthermore, culture also affects individual behavior and has a vital role in individual development, including in learning mathematics. It is also supported by the results of research by (Sroyer et al., 2018), which says that this study shows the closeness of mathematical concepts to culture in the lives of Jambi people. The results of this study will provide readers with an understanding of the Jambi textile production process, such as rugs and woven hats, the mathematical aspects they contain, and their relevance in learning mathematics. It is in line with other researchs (Rachmawati Z & Muchlian, 2019; Irianti et al., 2022). In the activity of making the Rumah Gadang, there are mathematical elements and concepts used. Without studying the theory of the mathematical concept, the Minangkabau people have applied mathematical concepts in their daily life using ethnomathematics. It is proven that there is an ethnomathematical form of the Minangkabau community, reflected through various mathematical activities. The activities are owned and developed in the Minangkabau community, including making a design for the construction of a Rumah Gadang and making carving patterns on the carving motifs of the walls of the Rumah Gadang.

Etymologically, "ethno" is defined as something comprehensive that refers to the sociocultural context, including language, yells, codes of behavior, myths, and symbols. The root word "mathematics" refers to explaining, knowing, understanding, and performing activities such as coding, measuring, classifying, summarizing, and modeling. The suffix "tics" comes from techne and has the same meaning as technic (Sari et al., 2020). Ethnomathematics is a form of mathematics that is shaped or conditioned culturally. Therefore, with many studies on ethnological developments, it is not impossible to teach mathematics efficiently while still paying attention to local culture (Fauziah & Riekealyusfitri, 2018; Murtiawan et al., 2020). Ethnologists argue that the development of mathematics is inseparable from the culture and values that already exist in society.

Ethnomathematics is one of the studies in mathematics education that relates mathematics to the culture in which students live. In ethnomathematics, students are not only invited to develop mathematical abilities but also introduced to the culture, which is the original character of their

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nation (Bakhrodin et al., 2019). Ethnomathematics is a variety of outputs of mathematical activities that are owned or developed in the community, including mathematical concepts, for example, on cultural heritage in the form of temples and inscriptions (Puspitasari & Putra, 2022), pottery and traditional tools (Hafifah & Putra, 2021; Amanda & Putra, 2022), batik and embroidery motifs (Yolanda & Putra, 2022; Delviana & Putra, 2022), and local units. Many researchs also show that there are mathematical activities in several aspects of culture like folklore (Nova & Putra, 2022), traditional musical instruments (Adawiah & Putra, 2022), traditional ceremonies (Wahyudi & Putra, 2022), traditional houses (Nurfauziah & Putra, 2022), traditional culinary (Fitriani & Putra, 2022), and traditional games (Zayyadi, 2017).

Traditional games are fun and opportunities for students to learn about culture, improve math and thinking skills, and shape elementary school mathematics using context (Merliza, 2021; Putra et al., 2021). One of the Nagari children's games in Minangkabau is the Sipak Rago game. The game Sipak Rago comes from *sipak*, which means kick, and *rago* means body. Usually, the game is done to pass the time in the afternoon. The Sipak Rago game is played using a ball made of rattan skin woven as well as possible to resemble a round ball shape. 5-10 people play the Sipak Rago game with a specific technique. The movement of the Sipak Rago game uses the Pencak Silat movement, which is used as a game.

The way to play Sipak Rago is by passing the ball from one player to another, provided the ball does not touch the ground. The game will be stopped and restarted if the ball hits the ground. The Sipak Rago game is played using the limbs, namely, the legs, head, chest, and shoulders, except for the hands. The Sipak Rago game is played in a circular arena. Players stand in a circle that has been provided. If the ball exceeds the circle line, the game will be stopped and restarted. The transfer of the ball from one player to the next is not the same sometimes, there are fast and slow, and there are no rules for kicking the ball to the next player, so it is required for each player to focus and be ready to wait for the ball to be given to him.

Many cultural values are contained in the Sipak Rago game (Mardoni, 2021). Firstly, the value of cooperation and cohesiveness, because with *rago*'s attitude, players can recognize themselves and their potential and realize that they cannot live alone in society. In social life, they must be able to work together with others. Secondly, religious values, in the game of Sipak Rago, the ball should not fall to the ground. It means keeping humans safe in social life and not falling into actions that damage them both physically and mentally. Thirdly, the value of good relations between groups. The Sipak Rago game shows how hard, complex, and challenging the ball comes to the player. The player will try to return the ball by using the type of *sipak* so that the ball will be directed to other players in easy conditions. Fourthly, the value of sportsmanship in the Sipak Rago game is a technique of processing rattan balls that move from foot to foot with different kicking

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skills, so this is called containing the value of sports because it uses the physical movements of the players. Fifthly, the moral values in the Sipak Rago game are cooperation. This cohesiveness will lead to a sense of sincerity by players to share the ball with other players. Lastly, the value of aesthetics can be seen because of the players' beautiful gestures with the body's bending and flexible legs and chanting the ball swiftly and firmly.

Integrating ethnomathematics in school mathematics curricula and learning tools can be done by educators, as has been done in several countries (Rahmadhani, 2022; Muslimin & Rahim, 2021). Using ethnomathematics and traditional games is an alternative that educators can use to help students understand mathematics and reduce the abstract nature of mathematics. If culture-specific mathematics is packaged well in learning, the learning process will be successful, and the mathematical concepts taught to students will be easier to understand. It follows that ethnomathematics can be used as a complement to the mathematics curriculum, become a mainstay, and can be taken into account in learning preparation.

Ethnomathematics is one of the studies in arithmetic education that links mathematics with the culture in which students live (Febriana et al., 2022). In ethnomathematics, students are not solely invited to develop mathematics but are introduced to the culture, one of which is the Minangkabau game, Sipak Rago. Therefore, ethnomathematics is seen as terribly relevant for lessons that are happening these days. As a result, it will foster learning motivation for students to find out mathematics. So the ethnomathematics during this study is focused on exploring the circle's weather within the Sipak Rago game.

METHOD

This research is exploratory with ethnographic approach (Setiana et al., 2021). An ethnographic approach is an approach that seeks to explore a community culture through exploration, documentation, literature study, and observation of the Sipak Rago game (Setyowati, 2014). The data in this study are the results of observations of this object in the form of theoretical data from the study of literature and photo documentation used to find mathematical concepts in the Sipak Rago game. After the data has been obtained and analyzed thoroughly, a general picture related to the idea of mathematics according to the ethnomathematical domain, especially circles. Furthermore, this taxonomic analysis in detail is based on the concept of a circle contained in the Sipak Rago game section.

This research was conducted in Padang Pariaman, Padang city. The subjects of this study were Sipak Rago players consisting of 6 people. Data collection techniques used in this study were interviews, observation, and documentation. The steps in data collection are: the pre-field stage,

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namely the selection of field locations according to the needs, and the second stage is conducting interviews with respondents.

The data analysis technique used in this study is a qualitative method of data analysis, including data reduction, data presentation, and conclusion drawing. According to Shidiq & Choiri (2019), reducing data is an activity to summarize, choose the main things, focus on the critical things, and look for themes and patterns. The way to reduce it is that the researcher collects all the data from interviews conducted with the Sipak Rago game players, and also the documentation results are then converted into written form based on the formats that have been made respectively. Research data that has been reduced will make it easier for researchers to find out how to get a clearer picture in collecting research data. Next is the presentation of the data. Researchers carried out the data presentation by analyzing data from interviews related to the Sipak Rago game. Researchers analyze and describe the fundamental mathematical activities applied to the Sipak Rago game activity. The data is analyzed further by mathematical mapping activities related to geometric material. After the data analysis is complete, it is followed by concluding, namely the results of research that answer the research focus based on the results of data analysis.

RESULTS AND DISCUSSION

The Sipak Rago is a traditional game in West Sumatra, Indonesia. Sipak Rago game is usually played during the traditional ceremony of the Minangkabau tribe. This traditional game is played by 5-10 players who use a rattan ball with a diameter of 15 cm. This game is played outdoor in a circular area with a diameter of 4.5 meters divided into some sectors following the number of players. The players stand in their respective sectors. To begin the game, one of the players stands in the center of the circle to throw the ball to another player. If the Sipak Rago game is associated with the concept of a circle, it can be seen in Figure 1. Suppose A, B, C, D, E, F, G, and H are eight players of the Sipak Rago game and O is the center of the circular area or the intersection of all lines connecting two players facing each other.

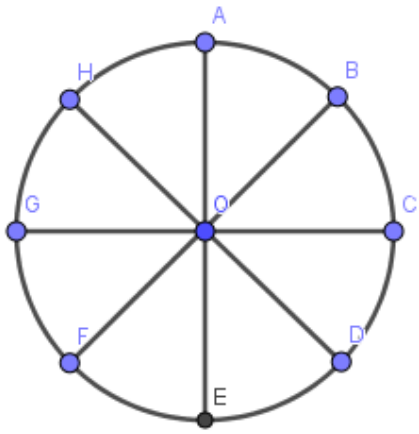

Figure 1. The Concept of Circle in the Sipak Rago Game

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In ancient times, the Sipak Rago game has existed since the Malay era around 634-713 AC. This game was a game played by kings before the royal event began. Then the game was played by ordinary people like young village children in the afternoon to fill their spare time and entertainment. Currently, this game can still be found on the outskirts of Padang and other areas in West Sumatra, but in urban areas, it is starting to be abandoned by the community. In 2019, Sipak Rago entered the Siti Surabaya festival to preserve the game.

The Sipak Rago game is divided into two stages: the preliminary round is called *trot*, and the final round is called *boko*. The *trot* duration is 15 minutes, while *boko* is 30 minutes. The game can be extended if deemed necessary by the referee. In this game, receiving and giving the ball must be through a kick. The assessment is made on the technique and style of kicking the ball called rent. There is no standard rating on this game because this game is not contested. There is only an assessment of the player's skill in playing the ball, so it does not fall to the ground.

The Sipak Rago game has social values found by researchers based on interviews and observations that the traditional game of Sipak Rago contains many social values such as tolerance, cooperation, cohesiveness, mutual respect, selflessness, and difficulty giving up between players. The game played with different characters from different backgrounds needs mutual respect between the players. On the other hand, even the traditional game of Sipak Rago teaches not to give up easily. The small ball from rattan makes the ball difficult to tame. It requires patience with players that are not easy to give up.

As for information from Sipak Rago players, the Sipak Rago game played in the open under the hot sun is very suitable for players' growth and physical health. Players interact with other players. Games played in groups affect the mental development of players so that the players have direct contact with other players with different characters from various backgrounds. This Sipak Rago game also requires the equipment used to play it, such as the ball. Sipak Rago ball is made of dry rattan skin. It shows the agility value needed to process rattan skin into balls as a playset. At the same time, before starting the game, the player must create and determine the game's location and the playing field's size. Therefore, this game has good value in human life and can turn useless items into valuable items.

In the Sipak Rago game, there are many mathematical concepts. This fact is based on the interviews and observations. As in Figure 1, before the game begins, the Sipak Rago players first make a circle.

The Elements of a Circle

There is some terminology in a circle like center point, radius, diameter, arc, cord, segment, apothem, and so on. In Figure 2, it can be seen that point O is the center of the circle, the radius of

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the circle is OA, OC, OG, and OH, the diameter of the circle is CG, and the arc is curve GH, also AH, AC, DF and so on. The cord is AC and DF. The area bounded by arc AC and cord AC is a segment of AC. The apothem is the perpendicular line with the arc.

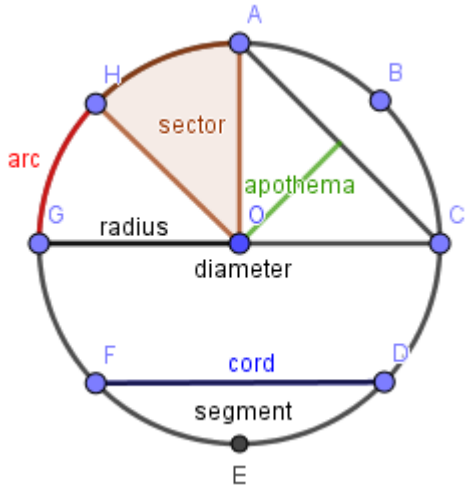

Figure 2. Some Elements of a Circle

The Concept of Circle Circumference

The rule of the Sipak Rago game is to randomly pass the ball to the player. For example, from B to C, then to F, to H, and so on. If the ball is passed sequentially from A to B, C, D, E, F, G, and H, it means that the ball will spin in a circle following a circle circumference.

The Concept of Inscribed Angle on a Circle

An inscribed angle is an angle formed by two chords that intersect on the circle's circumference. Suppose that path of the ball is C-G-H-C or C-G-A-C, the path form two inscribed angles in H and A. The measure of angle H equals the measure of angle A. It is also equal to the haft of the measure of central angle O (see Figure 3).

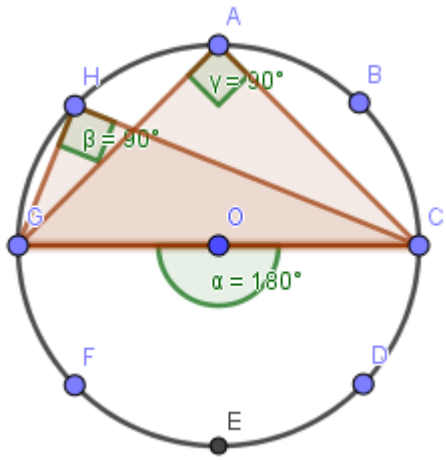

Figure 3. The Inscribed Angles in a Circle

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Figure 5 is an example of three theorems of inscribed angle: the inscribed angles subtended by the same arc are equal, the inscribed angle in a semicircle is 90 degrees, and an inscribed angle is haft of a central angle that subtends the same arc (Figure 4).

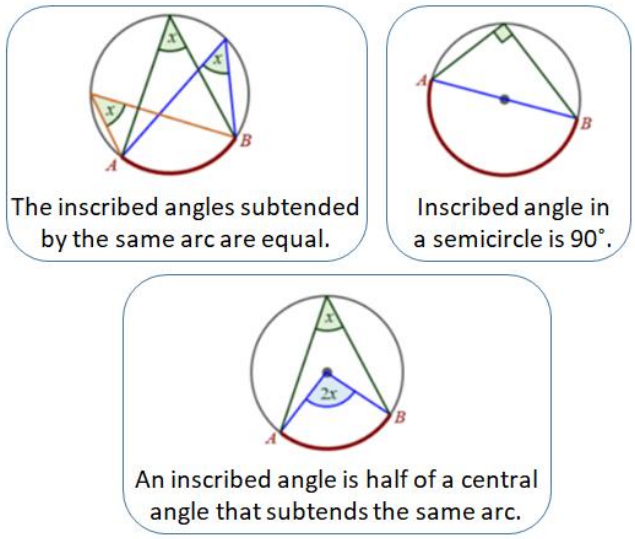

Figure 4. Three Theorems of Inscribed Angle

The Concept of Circle Area

The circular play area of the Sipak Rago game can be divided into some sectors that can be rearranged to form a rectangle. It can be seen in Figure 5. Note that half of the circle's circumference is the length of the rectangle (πr), and the circle's radius is the rectangle's width (r). So, the area of the circle (circular play area) is equal to the area of the rectangle formed from the sectors of the circle or $A = \pi r^2$.

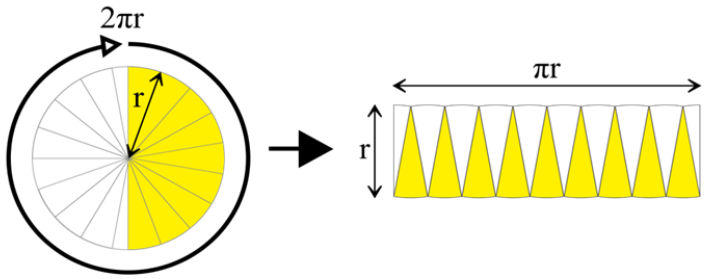

Figure 5. The Area of the Rectangle Formed from the Sectors of the Circle

Based on interviews with Sipak Rago players and observations made, the authors associate the Sipak Rago game with circles. The circle concept in the Sipak Rago game is the circle's elements, the circle's circumference, the circle's area, and the concept of angles in the circle. So it can be concluded that in the Sipak Rago game, there is a circle concept that makes it easier for students to learn about mathematics. In the circle material, teachers and students can relate to the Sipak Rago game or watch the Sipak Rago video to find the basic concepts of the circle and the

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ring. This fact completes the previous research in Minangkabau culture that shows the design of the Rumah Gadang existing the concepts of number, size, and geometry (Fitriza et al., 2018). Moreover, this research also completes the researchs on traditional games like the traditional marbles game has ethnomathematics related to geometric concepts such as circles, spheres, and triangles as well as mathematical concepts such as the concept of distance (Pratiwi & Pujiastuti, 2020). These mathematical concepts can be used to introduce and understand the concepts of geometry and distance through local culture.

By associating culture with learning, it is hoped that students will remember the concept easily because it is done while playing. Based on the research results above, it is found that, in fact, many in everyday life, there are unintentional concepts of learning in general, especially mathematics, both in the form of buildings or in the form of existing traditional games. This finding is in line with research (Fadila & Mariana, 2021) which says that learning by connecting everyday games helps students understand certain items related to their lives. Therefore, the concept of traditional math games can be used as an alternative to learning at school because it is an exciting activity and can provide meaningful learning.

CONCLUSION

Based on the above discussion, the mathematical concept is found in the Sipak Rago game, namely concepts related to geometry, especially circles in which there are elements of circles, the concept of the circumference of a circle, the concept of area of a circle and the concept of angles in a circle. So it can be concluded that the concept contained in the Sipak Rago game can be applied to mathematics learning in schools on circle material so that mathematics learning becomes more exciting and fun. Thus, it can improve mathematical ability and understanding of circle material. Through observation activities on the Sipak Rago game, it is proven that learning mathematics can be connected with cultural elements.

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