



Ethnomathematics exploration of geometry concepts in traditional games in karanganyar regency

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Article History:

Accepted: 18 January 2025

Revised: 20 July 2025

Published: 29 July 2025

Abstract

The purpose of this study is to describe the concept of geometry concepts contained in traditional games in Karanganyar Regency such as: engklek, kites, and marbles. This research uses qualitative research with an ethnographic approach. The data collection methods used in this research are observation, documentation, and interviews. The results of this study indicate that there is the concept of geometry in traditional games in Karanganyar district. The geometry concepts contained are flat shapes (square, rectangle, triangle, kite, semicircle and circle), space shapes (tube and ball), geometry transformation (reflection), and congruence. The concept of geometry is illustrated in the game arena and game tools.

Keywords: Ethnomathematics, Geometry, Traditional Games

INTRODUCTION

In the development of increasingly advanced technology, the role of mathematics itself is classified as one of the important subjects (Aniyawati & Dewi, 2023). Mathematics is often considered a rigid science, difficult to understand, boring and detached from everyday life because students think that math is only about numbers, formulas, and things that complicate students at school (Pratiwi & Pujiastuti, 2020). Talking about education, it will not be far from the discussion about learning done in class (Ardhani & Kristin, 2023). When learning mathematics in class, of course, it is not enough to only convey subject matter in accordance with the applicable curriculum but must be accompanied by different meanings and concepts so that students are free and unencumbered when learning mathematics (Exacta et al., 2021). Indirectly through education a person will have broad knowledge, think critically, and be able to bring himself to change in keeping up with the times (Kristiawan et al., 2023). Improving education is certainly the main capital in efforts to improve the welfare of the nation. For this reason, we need to explore, preserve and develop Indonesian culture. One of them is culture-based learning (Karina et al., 2021).

According to (Wahyuni et al., 2024), culture-based learning provides space for students to connect contextually based on students' experiences as a community and makes culture-based learning an interesting and enjoyable learning alternative. According to (Andari et al., 2022), the presence of mathematical concepts that are different from learning in schools will make a huge contribution and the concept has cultural nuances or is often called ethnomathematics. Ethnomathematics is a branch of study that connects or studies mathematical concepts with local culture, this concept arises because of the understanding that mathematics does not only develop in an academic or theoretical context, but also develops in people's daily lives, including in local wisdom and traditions. The emergence of Ethnomathematics from the way or habits of the community that blend with local traditions or culture in a way that is carried out for generations and has use value for the community which is still maintained today (Surmiyanti et al., 2021). Ethnomathematics also creates cultural wisdom so that it can motivate students and the community to learn mathematics with existing culture (Widyaningrum & Prihastari, 2021).

Indonesia has a very diverse cultural wealth because it is the largest archipelago in the world. Each region has unique characteristics, ranging from language, art, traditions or customs. All of Indonesia's diversity is a charm for Indonesia itself and reflects the unique identity of each tribe and region throughout the archipelago. One important aspect of this culture is traditional games, which serve not only as entertainment, but also as a means to build social solidarity, teach values, and preserve culture. Traditional games also have rules in playing them, played with tools or without tools and based on the traditions of each region, thus traditional games will provide a feeling of joy and harmony (Astanti & Fitroh, 2022).

As time goes by, it triggers the development of technology, supported by the rapid development of the times, making children no longer play or even know traditional games. As Indonesian children we must be able to preserve traditional games because with the development of this era many children do not socialize and even prefer to stay at home or just play online games (Damayanti et al., 2023). However, today its existence has gradually experienced extinction, especially for those who live in urban areas, even in some areas it is no longer recognizable by the community (Lubis et al., 2021).

Karanganyar Regency, located in Central Java province, is not only famous for its natural and cultural wealth, but also for various traditional games that are still preserved today. Traditional games in Karanganyar are not just entertainment, but also contain educational values, one of which is ethnomathematics. In Karanganyar Regency, there are several traditional games that contain elements of ethnomathematics, such as engklek, kites, and marbles. Each of these games not only teaches physical skills, but also involves mathematical thinking in planning,

calculating, and game strategies. For example, in cricket, children learn about patterns, sequences and symmetry, while in kite games, they recognize the concepts of aerodynamics and balance that can be related to the principles of geometry. Through these games, children in Karanganyar can develop their mathematical skills without realizing it, as they are engaged in a fun and social activity. Therefore, studying the ethnomathematics elements contained in these traditional games is very important to preserve the culture while introducing mathematical concepts in a contextual and applicable manner.

The material to be discussed in this article includes an introduction to some traditional games in Karanganyar Regency and the identification of ethnomathematics elements contained in them. The article will also discuss how these games can be used as effective learning media to teach basic mathematical geometry concepts to children, especially in the modern era that is starting to be exposed to technology. The purpose of this article is to reveal how elements of ethnomathematics can be found in traditional games in Karanganyar Regency, as well as provide an understanding of the importance of integrating local culture with mathematics learning. It is hoped that by understanding ethnomathematics in these traditional games, readers can appreciate local culture while realizing the importance of applying mathematics in everyday life, which can enrich learning experiences, especially for the younger generation.

METHODS

This research uses descriptive qualitative field research with an ethnographic approach. This research uses an ethnographic approach, where this research focuses on describing, analyzing, and providing interpretations of a particular cultural pattern (Nur & Syahril, 2022). This approach involves researchers living in the community under study to gain an in-depth understanding of the daily life, values, and practices of the community (Diniyati et al., 2022). The reason the author chose the ethnographic approach in this study is to reveal mathematical concepts in traditional games in Karanganyar Regency.

This research was conducted in Jatiroyo Village, Jatipuro District, Karanganyar Regency. The research subjects were elementary school-age children (6-12 years old) as many as 5 people. Data collection methods were taken from observation, documentation and interviews. Observation activities are carried out by observing some traditional games in Karanganyar Regency such as: *engklek*, kites, and marbles to find out what aspects contain the concept of geometry. Documentation conducted in this study is with photos of traditional games. The photo serves as a reinforcement of the researcher's argumentation and provides real evidence visually how the form of the concept of geometry in traditional games in Karanganyar Regency. Furthermore, the field activity stage is a research activity by conducting research and conducting interviews with

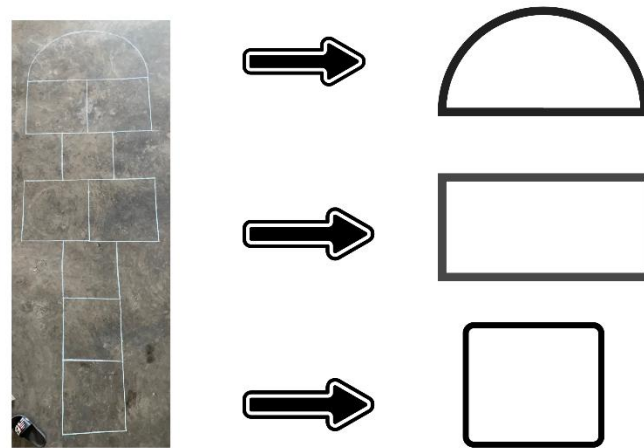
respondents. This interview aims to obtain information related to the Karanganyar Regency Community's knowledge of the concept of geometry in traditional games as well as to find out the names, tools, and regulations on traditional games in Karanganyar Regency.

RESULTS AND DISCUSSION

Indonesia is known as a nation rich in diversity. Starting from fauna, flora, customs, traditions, to culture. One of the traditions inherited by the Indonesian people until now is traditional games because traditional games are one of the wealth found in Indonesia and must be preserved, traditional games in Indonesia are very numerous, it's just that in each region there are differences such as the way of mentioning and playing rules. According to (Indriyani et al., 2021). Traditional games are old folk games that are often played by ancient children and usually these traditional games have characteristics and the way the game is played is still simple. Researchers will discuss traditional games in Karanganyar Regency such as: *engklek*, kites, and marbles. Some of these games will be explored with the concept of ethnomathematics (mathematics and culture). Exploration of ethnomathematics in traditional games in Karanganyar Regency is used to explore mathematical concepts, namely the concept of geometry found in *engklek*, kites, and marbles. In *engklek*, kites, and marbles, many geometry concepts are found, among others: lines, angles, flat shapes, spatial shapes, congruence, and geometric transformations. The concept of geometry which is found in traditional games in Karanganyar Regency can later be used as a new learning resource in learning mathematics that can facilitate students in understanding the concept of geometry. The following are various traditional games in Karanganyar Regency that contain geometry concepts.

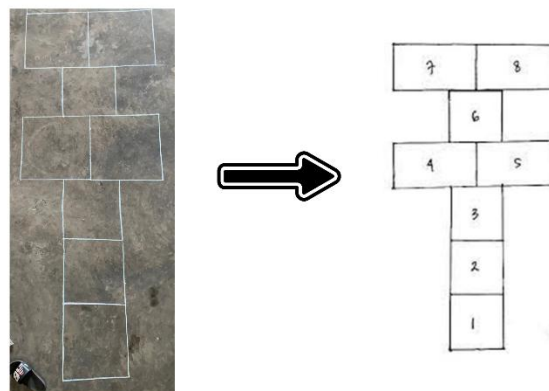
Engklek'

Engklek is a traditional game often played by children in rural areas, usually played by two or more people. This game does not require a lot of money, because it can be drawn with chalk on a field with a size of 2x4 meters or even 1x3 meters on the road. This game can be found in various regions such as Java, Bali, Sumatra, Sulawesi, and Kalimantan, only the mention, specifically in Java this game is called *engklek*. The game can be played on a flat field and is usually played by girls, but boys can also play it. Children play the game by jumping from one box to another using one foot in the order of play (Maulida, 2020). Research (Anggraini & Pujiastuti, 2020) shows that there are elements of mathematics in the traditional game of *engklek*, this makes children feel happy to learn math by playing, and children participate in preserving Indonesian culture so that it does not fade or even become extinct. It can be concluded that the *engklek* game is a game that contains elements of mathematics because children mention the box where the box or can be called a rectangle is included in math learning.



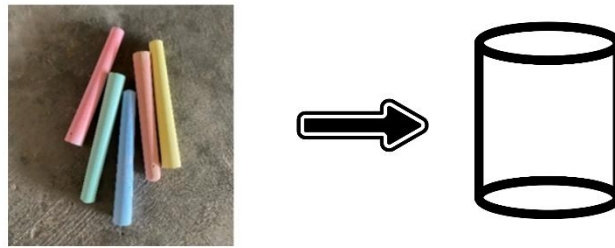
Picture 1.
Square, rectangular, and semi-circular playgrounds

Figure 1 shows that there is ethnomathematics with the concept of geometry in the traditional game arena, namely flat shapes such as: square, rectangle and semicircle. Apart from being in the form of flat shapes, the arena has an element of mirroring (reflection). This can be shown from its shape that if we draw the axis of symmetry so that it cuts the engklek plot into two right and left parts, it will be seen that the right part is symmetrical with the left part.

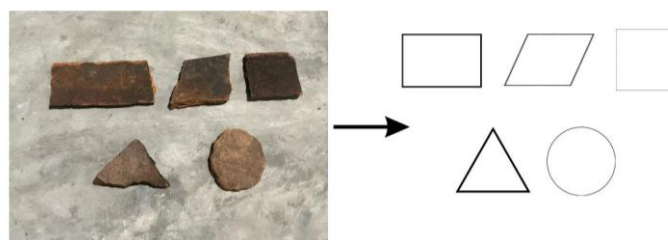


Picture 2.
Element of mirroring or reflection at the playground

The tool to make an *engklek* drawing can use chalk. Tube-shaped chalk which is also a mathematical element with the concept of geometry of space. For the implementation of the game by throwing stones into the box or what is often called *gacok* into the arena that has been drawn using chalk, the stones used are usually flat circles or can use tile fragments or ceramic fragments that are triangular or rectangular.



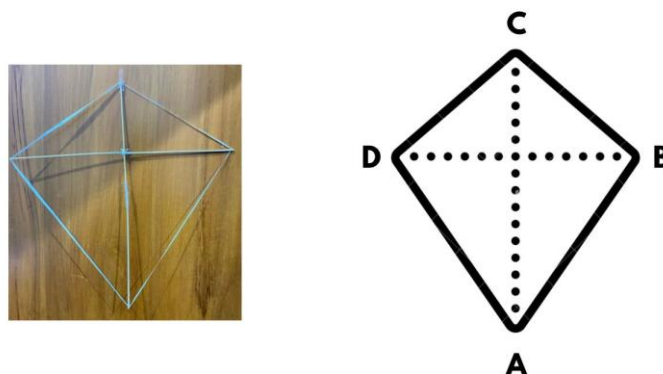
Picture 3.
Chalk as a tool to make a tube-shaped cricket arena



Picture 4.
Gacok in the shape of various flat shapes

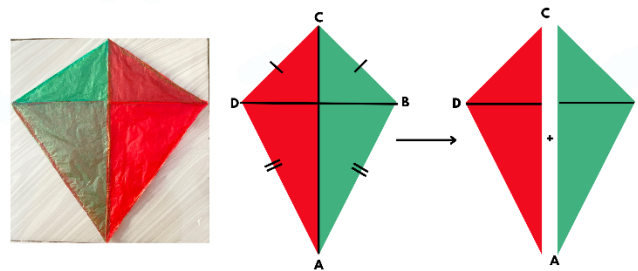
Kites'

Kites are a type of traditional game commonly played by children to adults. This game is almost found in every corner of the region in Indonesia because this game has been going on since ancient times. Kite itself is a fairly affordable game with a price that is not too expensive, because this traditional game is also easy to obtain either by making your own or buying. Based on the results of the research, kites which are traditional games have mathematical elements such as: flat geometry, lines, corner points, angles and diagonals.



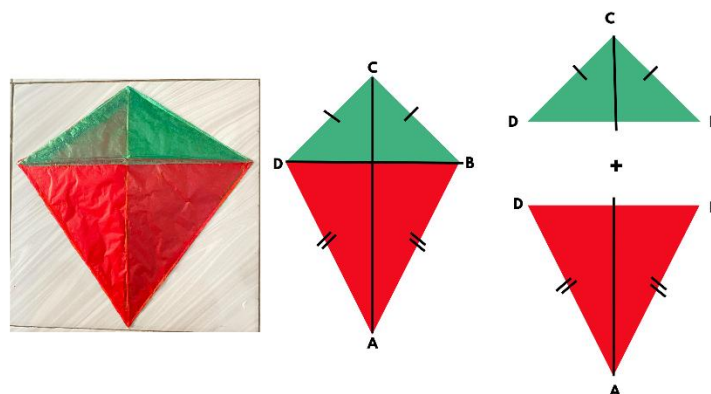
Picture 5.
Illustration of the properties of a kite from a skeleton.

Based on the information in the figure above, the kite frame can be used as a medium in learning mathematics as an introduction to the properties of kite flat shapes such as having: 1. Four angles ($\angle A, \angle B, \angle C,$ and $\angle D$), 2. Two pairs of sides that are equal in length, 3. A pair of angles that face the same size, namely angle B which is equal to angle D, 4. Two diagonals, namely diagonals AC and BD, 5. The AC diagonal divides the BD diagonal equally and is perpendicular to BD, 6. One folding symmetry and one rotary symmetry.



Picture 6.
Illustration of a congruent kite

Figure 6 shows that the kite is formed by two congruent or equal triangles, namely the red triangle or ACD triangle and the green triangle or ACB triangle. It can be seen that the kite flat shape is a flat shape formed by two isosceles triangles, namely isosceles triangle BCD and isosceles triangle ABD. Therefore, in finding the formula for the area of the kite flat shape can be found with the area of the two isosceles triangles.



Picture 7.
Kite with two isosceles triangles

Based on the results of the analysis, traditional kite games have mathematical elements, so traditional kite games can be utilized as a medium for learning mathematics, especially on the material of kite flat shapes. The kite flat shape has its own uniqueness compared to other flat shapes, which are not symmetrical and have angles that are not the same size. This makes this flat shape often used in various math and physics

applications as an example of interesting calculation cases. In addition to instilling mathematical concepts in students, the use of kites as a medium for learning mathematics can also help foster character values in students. By introducing kite games as a medium for learning mathematics, students are indirectly taught and familiarized to love and preserve the culture of traditional games.

Marbles'

The traditional game of marbles is a game that is often played by children in rural areas because this game is carried out on a flat field. The game of marbles is usually played in the field because it requires drawing a circle on the ground or asphalt as a boundary place for collecting the results of marbles that have been played by pairs of game participants (Pratiwi & Pujiastuti, 2020). According to research (Mei et al., 2020), not only circular flat shapes can be used as an arena for playing marbles, but can use other flat shapes such as squares, rectangles, and triangles. Draw the flat shapes as you wish. The size of the arena depends on the number of marbles from the player participants. The more marbles of the pair, the bigger the arena is made and vice versa, the fewer marbles from the pair of participants, the smaller the arena is made. The number or lack of marbles used as pair marbles depends on the agreement of the player participants. This game is usually played by boys, and can be done with two people to five people. The way to play this game is simply to flick the marbles that are used as attacking marbles (Astanti & Fitroh, 2022).

The game of marbles can be found in various regions in Indonesia, it's just that the mention in each region is different, for example in Java this game is called the game 'neker', in Betawi called 'gundu', while in Palembang it is called 'ekar'. The game of marbles has a round shape and is made of glass, clay, or agate, the size of the marbles generally has a diameter of $\frac{1}{2}$ inch or 1.25 cm from end to end.



Picture 8.
Marbles that have a ball-like shape



Picture 9.

A playground of marbles that are flat shapes

According to (Silfiana & Widyastuti, 2021), there is ethnomathematics in the preparation stage and how to play marbles, including the concept of mathematical geometry in the form of spatial and flat shapes and measurement. It can be concluded that this marbles game has ethnomathematics concepts such as marbles in the form of balls and playgrounds in the form of circles, rectangles and triangles. In addition, in this game there is an element of subtraction operation for integers, namely when the player succeeds in flicking the marbles out of the circle, meaning reducing the number of marbles in the circle with marbles that have been successfully removed from the circle. After the marbles in the circle run out, the players count the number of marbles, meaning that the process of counting is happening.

CONCLUSION

Ethnomathematics is a method of learning that links elements of local culture in mathematics learning. Based on the results of data analysis and discussion that has been carried out on Ethnomathematics Exploration of Geometry Concepts in Traditional Games in Karanganyar Regency, it can be concluded that traditional games in Karanganyar Regency not only contain cultural elements, but also contain geometry concepts. The geometry concepts obtained include: The geometry concepts contained are flat shapes (square, rectangle, triangle, kite, semicircle and circle), space shapes (tube and ball), geometry transformation (reflection), and congruence.

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