

Ethnomathematics Exploration through Traditional Madurese Games in Elementary School Mathematics Learning

Moh. Zayyadi^{1*)}, Septiyadini Misriyana², Dewi Ratnadi³
^{1,2,3} Universitas Madura
*) zayyadi@unira.ac.id

Abstract

This research aims to determine the principles of ethnomathematics in elementary school mathematics learning through traditional Madurese games and what mathematical concepts are contained in traditional Madurese games. The traditional games referred to in this research are engklek (bhisek), hide and seek (rem-ngerreman), and ball bekel (bal bleken). This research uses qualitative research with an ethnographic approach. The instrument in this qualitative research is a human instrument, the researcher is directly related to the research and acts as a data collector through library data collection, interviews, observation and documentation. Data analysis techniques are carried out by data reduction, data presentation, data analysis, and data exposure. The results of this research are ethnomathematics principles in traditional Madurese games which can be seen from the preparation before playing, how to play and the rules of the game. Mathematical concepts contained in the game engklek (bhisek): the concepts of addition and subtraction, numbers, lines and angles, flat shapes, and comparisons, in the game hide and seek (rem-ngerreman): the concepts of addition and subtraction, and numbers, and in bekel ball game (bal bleken): concepts of addition and subtraction, number patterns, multiplication and division and comparison..

Keywords: Ethnomathematics, Elementary School , Traditional Madurese Games

Introduction

Indonesia's cultural diversity can be said to have advantages compared to other countries. Indonesia has complete and diverse cultural dimensions. Indonesia's cultural diversity cannot be denied. One of the Indonesian cultures that has existed for a long time is traditional games. Traditional games have grown and developed since ancient times (Azizah, 2016). Each region has different traditional games. These traditional games must be preserved because traditional games currently find it difficult to adapt to developments in time and technology (Saputra, 2017). Traditional games can be used as a learning medium so they need to be maintained and preserved. Several traditional games contain elements of mathematics learning (Muzdalipah, & Yulianto, 2015; Zayyadi, et al, 2018).

One thing that can bridge the gap between culture and mathematics learning is ethnomathematics. Ethnomathematics is a form of mathematics that is influenced or based on culture (Agustin, et al, 2019; Zayyadi, 2019). The aim of ethnomathematics is to recognize that there are different ways of doing mathematics by taking into account the

academic mathematical knowledge developed by different sectors of society (Fajriah, 2018) as well as by considering the different ways in which different cultures negotiate mathematical practices (ways of grouping, calculating, measuring, designing buildings or tools, playing, etc.). Apart from that, ethnomathematics is a means of connecting culture in society with mathematical concepts (Zayyadi & Halim, 2019). Ethnomathematics as social interaction in learning (Zayyadi, et al, 2018).

The presence of mathematics with cultural nuances (ethnomathematics) will make a huge contribution to mathematics learning, this is because formal education will give rise to social interactions that are different from others, thus allowing for intercultural socialization (Zayyadi, et al, 2018). It is also said that all formal mathematics education is a process of cultural interaction and every student experiences various cultural conflicts in this process. Mathematical ideas that emerge naturally without formal education, through the knowledge and views of a particular tribe, community group, or individual (Zayyadi, 2017).

Kangenan 1 State Elementary School is one of the schools where students sometimes play traditional games during recess. Teachers as facilitators should be able to see the relationship between traditional games and mathematics so that it can make it easier for students to learn, by conveying material to elementary school students through games, playing while learning without leaving out the core of the material presented based on understanding basic mathematical concepts. Basic mathematics learning is a mathematics learning activity in basic education which is directed at personality formation and the formation of thinking abilities based on the nature of mathematics. This formation can be done through ethnomathematics learning using traditional games (Prastowo, 2018; Tika, 2021; Tia, 2022). Several types of traditional Madurese games that can be used as mathematics learning include: engklek/bhisek, hide and seek/rem-ngerreman and bola bekel/bal bleken. Engklek (Bhisek) is a game of engklek that can be played on the ground, in the yard, and on tiles or asphalt. The crank area is usually in the form of boxes or squares. Hide and Seek (Rem-Ngerreman) as a game is very popular, more than 2 people play it, the more people participate, the more exciting the game will be. How to play it is very easy, one person is made a guard whose job is to look for other friends who are hiding nearby. Bekel Ball (Bal Bleken) to play bekel ball, apart from needing the bekel ball itself, we also need bekel seeds (kececek), usually made from shells. A real bekel bekel is an

object in the form of a miniature Japanese rickshaw pulled by humans, made of brass, lead or plastic, and has four different sides.

In connection with this background, the author wants to conduct research with the aim of exploring the concept of ethnomathematics in elementary school mathematics learning through traditional Madurese games and what mathematical concepts are found in traditional Madurese games.

Method

In this research, researchers used qualitative research with an ethnographic approach. Ethnography is used to describe, explain and analyze the cultural elements of a society or ethnic group (Moschkovich, 2019; Maden, 2022). In determining research subjects, researchers pay attention to the conditions that must be met in order to obtain research subjects who are able to work together well. Fulfilling the criteria or subject requirements in this research is very important because not everyone at the research location can be determined to be a research subject.

As qualitative research with an ethnographic approach, this research instrument is a human instrument (Ejimabo, 2015), namely the researcher acts as the main instrument that cannot be replaced/represented to other people. In this case, the researcher is directly related to the research and acts as a data collector through library data collection, interviews, observation and documentation.

The data analysis technique is carried out in steps: data reduction is a step to convert recorded or image data into written form and select necessary and unnecessary data, data presentation includes compiling data and organizing data from the information that has been collected so that it can be well organized and meaningful. After the data is presented based on the results of data reduction, the next step is the process of interpreting the data through data analysis. Next are the research findings, where all the results of the data analysis will be presented which are a representation of the results of the answers to the research questions studied.

Results and Discussion

The concept of ethnomathematics in elementary school mathematics learning through traditional Madurese games. Based on the research results, it can be seen how to play traditional games where the explanation is as follows:

1. Madurese Traditional Game: Engklek (Bhisek)

The game of engklek (bhisek) can be played by more than one player, depending on how the players agree. Before playing, the players choose stones/tiles to throw and the players also have to draw a engklek plot (bhisek) which consists of 8 square/rectangular shaped boxes and 1 mountain in the shape of a semicircle. After that, the players do a hompimpah to determine the order of the players.



Figure 1. Overview of the Engklek (Bhisek) Plot

How to play the engklek (bhisek) game: (a) Place the stone/tile shard in the first box; (b) Jump on one leg to the 2nd and 3rd squares; (c) Jump with two feet simultaneously on the 4th and 5th boxes; (d) Then jump with one foot on the 6th box; (e) After that, jump with two feet simultaneously in the 7th and 8th boxes; (f) Turn around with two feet still on the 8th and 7th boxes; (g) Jump with one foot on the 6th box; (h) Return to the starting box by jumping in the same way as above; (i) When you are in the 2nd box, take the stone/tile shard; (j) Jump out of the engklek (bhisek) plot; (k) Throw stones/fragments of tiles into the 2nd box (the jumping method is the same as above, but you cannot step on the 2nd box); (l) Stone throwing must be in sequence until throwing it at the mountain; (m) When throwing at the mountain, on the jump in the 8th and 7th boxes, pick up the rock/shards facing backwards; (n) Return to the first square and exit the square; (o) Throw stones by turning the palm of your hand, then face backwards and throw the stone; and (p) The stone that falls on any box will become the player's rice field/house.

Rules for playing the engklek (bhisek) game: (a) The player is said to have won if he gets the most rice fields and the player is said to have lost if he gets the fewest rice fields; (b) Players must be replaced by other players if they step on the line or do not jump according to the provisions; (c) The player who gets the rice field can step on the rice field with two feet, but other players cannot step on the rice field .

2. Madurese Traditional Game: Hide and Seek (Rem-Ngerreman)

The game of hide and seek (rem-ngerreman) can be played by more than one person. Before playing, the players must determine the task of each player by suit if there are only 2 players, if there are more then the players must do a hompimpah then the player who

loses the suit becomes the guard and seeker whose job is to close their eyes while counting to give time to the other players. to hide. After finishing counting, the seeker must look for other players who are hiding, while guarding the pal's place. If you find another player who is hiding, the seeker must immediately run to the pal's place and touch it so that the player loses. The player who is successfully found by the searcher then becomes the next searcher.

3. Madurese Traditional Game: Bekel Ball (Bal-Bleken)

Bekel ball (bal bleken) is a game played by more than one player. Before playing, the players first prepare a bekel ball and 6 kecek (the number of kecek according to agreement), then the players suit if there are only 2 people or hompimpah first if there are more than 2 people to determine the order of the players.

How to play bekel ball (bal bleken): (a) Throw the ball and kecek simultaneously on the floor, pick up the ball when it bounces; (b) Take the kecek one by one when throwing the ball again until the kecek on the floor runs out; (c) Take kecek two by two when throwing the ball again until the kecek on the floor runs out (taking many kecek sequentially up to six at once); (d) Throw the ball and hit it simultaneously on the floor, pick up the ball when it bounces; (e) Change all the pecks on the floor into all put shapes; (f) Then take the kecek one by one when throwing the ball again until the kecek on the floor runs out (taking many kecek sequentially up to six at once); (g) Throw the ball and hit it simultaneously on the floor, pick up the ball when it bounces; (h) Transform all the little things on the floor into spirit forms; (i) Repeat step (f); (j) Throw the ball and hit it simultaneously on the floor, pick up the ball when it bounces; (k) Change all the pebbles on the floor into chunks; (l) Repeat step (f); (m) Throw the ball and hit it simultaneously on the floor, pick up the ball when it bounces; (n) Change all the chips on the floor into ice form; (o) Repeat step (f); (p) Enter the final stage (hatam) by throwing the ball and hitting it simultaneously on the floor, picking up the ball when it bounces; (q) Change all the kecek on the floor into the form of put, spirit, klat then ice all and take them together; (r) Throw the bekel ball, turn the palm of your hand then throw the ball again and catch it.

Rules of play in the game of ball bekel (bal bleken): (a) The player is said to have won if the player gets the most hatams and the player is said to have lost if the player gets the fewest hatams; (b) A player must be replaced by another player if he cannot take the ball or is knocked and cannot reverse the knock.

Mathematical Concepts Found in Traditional Madurese Games

1. Madurese Traditional Game: Engklek (Bhisek)

a. Addition and Subtraction

The addition operation is carried out when calculating the number of players $1+1+1=4$ players. The subtraction operation is carried out when calculating the number of players who want to know the order $4-1=3$, $3-1=2$, the remaining 2 players suit up so that $2-1=1$, where the remaining 1 player gets the last playing order. The concepts of subtraction and addition can be used in learning in elementary schools (Priyanto, et al, 2023).

b. Number

The concept of *bilangan* is carried out by children when they start playing (throwing stones and jumping). In this case, the children start throwing stones/fragments from the first box, up to the 9th in sequence, the same goes for jumping.

c. Lines and Angles

The concept of lines can be seen when children draw *engklek* (*bhisek*) plots. The children began to measure the lines of the boxes to be made whether they were the same or not, whether they should be parallel or not so that corners would be formed. In the box image there are 4 corners, each of which is 90° and the mountain angle is 180° .

d. Two-dimensional figure

The concept of flat shapes can be seen when children draw *engklek* plots (*bhisek*). Where on the plot the shape of 8 boxes is depicted which is the same as a square/rectangle and a mountain which is the same as a half circle.

e. Comparison

The concept of comparison can be seen when children throw stones/shards of roof tiles at the *engklek* (*bhisek*) plot. When throwing rocks/fragments, players must estimate the distance to the box, because if not, the player is declared dead and replaced with the next player. The concept of comparison is also found in Javanese games (Risdiyanti, & Prahmana, 2018; Astuti, et al, 2023).

2. Madurese Traditional Game: Hide and Seek (Rem-Ngerreman)

a. Addition and Subtraction

Children carry out addition and subtraction operations when performing *hompimpah* and *suit* to determine the order of the players. The addition operation is carried out to see the number of players $1+1+1+1+1=5$ players. The subtraction operation is carried out when knowing the player's assignment during *hompimpah* such as $5-3=2$ so that there are 2 remaining players who will *suit*.

b. Number

The concept of numbers is carried out by children when they start playing. The numbers that start counting start from numbers 1, 2, 3, 4, 5, 6, 7, . . . etc., where it can be seen that the number being calculated is a positive integer which is a natural number.

3. Madurese Traditional Game: Bola Bekel (Bal-Bleken)

a. Number Patterns

Number patterns are found when children make checks. Where the taking of keceek is done sequentially starting with taking one by one keceek until they run out, then taking two or two keceek, three or three keceek, four keceek, five keceek, until the last one takes six keceek. Followed by turning the keceek into put, spirit, klat, and ice where the method for taking it is the same.

b. Addition and Subtraction

Children carry out addition and subtraction operations when performing hopimpah and suit to determine the order of players, in addition to when playing and counting keceek.

The addition operation is performed when:

- Calculating the number of keceek used is $1+1+1+1+1+1=6$ keceek.
- Calculating the number of players, $1+1+1=3$ players.
- Count the number of keceek that have been taken, for example $2+2=4$ keceek when taking two by two at the 2nd time taking.

Subtraction operations are performed when:

- Determine the order of play.
- Calculate the number of keceek remaining on the floor, for example $6-3=3$ keceek remaining when picking up 3 keceek, $6-4=2$ remaining keceek when picking up 4 keceek.

c. Multiplication and Division

Multiplication and division operations are carried out when calculating the number of keceek taken, for example how many times 2 keceek are taken.

- Multiplication operation: $2+2+2=6$ ($3 \times 2=6$), means there are 3 keceek takes when taking 2 keceek, $3+3=6$ ($2 \times 3=6$), means there are 2 keceek takes when take 3 keceek.
- Division operation: $6-2-2-2=0$ ($6:2=3$), means there are 3 keceek taken when taking 2 keceek, $6-3-3=0$ ($6:3=2$), means there are Take 2 keceek when taking 3 keceek.

d. Comparison

The concept of comparison can be seen when children throw bekel and kecek balls on the floor. When throwing the ball and kecek to the floor, players must estimate the distance between the kecek, because if not the player will have difficulty in picking it up and can be replaced by the next player . The concept of comparison is also found in Javanese games (Pratiwi, et al, 2023).

In general, the mathematical concepts found in traditional Madurese games can be seen in table 1 below.

Table 1. The mathematical concepts found in traditional Madurese games

No	Traditional Madurese Games	Mathematical Concepts
1	Engklek (Bhisek)	Addition and Subtraction Number Lines and Angles Two-dimentional figure Comparison
2	Hide and Seek (Rem-Ngerreman)	Addition and Subtraction Number
3	Bola Bekel (Bal-Bleken)	Number Patterns Addition and Subtraction Multiplication and Division Comparison

The mathematical concepts in this game can be used as a medium for exploring ethnomathematics in elementary school mathematics learning through traditional Madurese games (Dhofir, et al, 2019; Maulida 2020), students learn through games, so that traditional games can be included in teaching materials (Hasanah, et al, 2019) to make it easier for students to understand learning material and enjoy learning mathematics (Halim et al, 2019).

Conclusion and Suggestion

Based on the results of the analysis and discussion above, it can be concluded that: The principles of ethnomathematics in traditional Madurese games are closely related to mathematics such as the game of engklek (bhisek), hide and seek (rem-ngerreman), and ball bekel (bal bleken). This can be seen from preparation before playing, how to play as well as the rules for playing. Traditional games can be implemented in the learning process so that they are easy to understand and fun for students, this is because in the exploration of ethnomathematics in elementary school mathematics learning can be done through traditional Madurese games, students play while learning to do it.

Mathematical concepts contained in traditional Madurese games, such as the engklek (bhisek) game, namely: the concepts of addition and subtraction, numbers, lines and angles, plane figures, and comparison; in the game of hide and seek (rem-ngerreman), namely: the concept of addition and subtraction, as well as numbers; in the bekel ball game (bal-bleken), namely: the concept of number patterns, addition and subtraction, multiplication and division, and comparison.

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