Ethnomathematics-based traditional games as a pedagogical approach to enhance logical-mathematical intelligence

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Abstract

Research on ethnomathematics-based traditional games that focus on students' mathematical logistic intelligence has not been conducted widely. The purpose of this study was to analyze ethnomathematics-based mathematical games as a learning approach to improve students' logical-mathematical intelligence. Qualitative research was conducted using an exploratory approach. The prospective subjects of this study were 50 students from five Elementary Schools in Pamekasan Regency. Of the 50 students, 10 were selected as research subjects, who were representatives of each traditional game in this study. From the questionnaire given, 10 traditional games that were often played in everyday life were obtained. Data collection techniques were in the form of interviews, observation, documentation, and literature studies as a form of triangulation to obtain data and determine the validity of the data. Data analysis techniques in ethnographic research include descriptions, analyses, and interpretation. The results showed that the integration of traditional games in mathematics learning requires the active role of teachers to link game elements with formal mathematical concepts. Traditional games based on ethnomathematics not only preserve local culture, but also become an effective tool for developing students' logical-mathematical intelligence.

Keywords: ethnomathematics; learning approach; logical mathematical intelligence; mathematical games

Introduction

Logical-mathematical intelligence is an important aspect of students' cognitive development (Arum et al., 2018; Sofwan et al., 2022). Logical-mathematical intelligence is intelligence related to the ability to use numbers and logic effectively, such as that of mathematicians, scientists, and programmers (Satyawati, 2011). Students' logical-mathematical intelligence is the ability to process numbers and use logic in solving problems (Isnani et al., 2023). Logical mathematical intelligence is when children show talent in the fields of numbers, reasoning, and problem solving. Indicators of logical mathematical intelligence concern number patterns, numbers, and the logic of decision-making and problem solving. Logical mathematical thinking is an ability that is very much needed in the problem-solving process so that students can carry out the problem-solving process well (Nurlaily et al., 2018; Utami, 2021).

Logical mathematical abilities are important for students to have because they are one of the basic abilities in solving various daily problems and in decision making (Aminah et al., 2018; Lanya et al., 2023). However, it is still often found that mathematics is considered a difficult and uninteresting subject by most students, which ultimately has an impact on low logical-mathematical abilities. Therefore, a more interesting and contextual learning approach is needed. One, an interesting and contextual learning approach requires cultural integration in learning. Culture in everyday life is one of the means of developing students' thinking. This approach also allows students to appreciate local culture more while understanding mathematical concepts more deeply. Therefore, ethnomathematics is needed to link mathematical concepts with students' culture and daily lives.

Ethnomathematics is a branch of mathematics that studies the relationship between mathematics and culture (Aini et al., 2019; Zayyadi et al., 2018; Zayyadi & Halim, 2020). Ethnomathematics is about the ways in which a particular culture influences the understanding, use, and development of mathematics in society. Ethnomathematics views mathematics as a cultural product that is shaped by the social, historical, and environmental contexts of society (Maryati & Indra Prahmana, 2018; Rosa & Orey, 2011). Ethnomathematics is the learning of mathematics that is found in cultural cultures, ethnomathematics can also be used to apply mathematics in dealing with the natural environment and also in existing cultural systems (Brandt & Chernoff, 2014; Presmeg, 1998). Ethnomathematics provides space for the integration of cultural elements in mathematics learning, allowing students to learn mathematics through contexts that are closer to students' experiences. One method that can be used in an ethnomathematics approach is through mathematical games.

Math games are one of the right ways to provide an interesting learning experience (Suripatty et al., 2019). Math games to explore, discover, and experiment, play provides an opportunity to develop and use many learning experiences . Games help students develop themselves in all basic areas, physical, intellectual, social, and emotional (Utama, 2011). Playing helps children get something that can develop and optimize their potential, one of which is thinking skills (Hairiyah, 2019; Pratiwi, 2017). With interesting and fun games, it will help optimize children's logical-mathematical intelligence. Efforts to preserve local wisdom in the

form of traditional kite games in fun mathematics learning (Kamid et al., 2022), mathematical elements found in traditional Indonesian games, namely engklek (Zuhri et al., 2023).

Traditional games are closely related to ethnomathematic, mathematical concepts in traditional games can be a medium for learning (Kamid et al., 2022; Zuhri et al., 2023). Traditional games based on ethnomathematics are one of the learning methods that can be applied to improve students' mathematical logistic intelligence. Ethnomathematics-based math games are one of the learning methods that can be applied to improve students' logical-mathematical intelligence. However, research on ethnomathematics-based traditional games that focus on students' mathematical logistic intelligence has not been widely conducted. Therefore, research is needed to analyze ethnomathematics-based math games as a learning approach to help students' mathematical logistic intelligence. The novelty of this research is that ethnomathematics-based math games can be a means to stimulate students' logical-mathematical interests and abilities. From the background above, this study aims to analyze ethnomathematics-based math games as a learning approach to help students' logical-mathematical intelligence.

Methods

Type and subject of research

The type of research used is qualitative with an exploratory approach. Research with an exploratory method is an initial study that aims to obtain an overview of a research topic that will be studied further (Morissan, 2017). The prospective subjects in this study were 50 students spread across 5 Elementary Schools in Pamekasan Regency. There were 22 male students and 28 female students. The students were given a questionnaire about traditional games that are often played in everyday life. From the 50 students, 10 students were taken as research subjects who were representatives of each traditional game in this study. From the questionnaire given, there were 10 traditional games that were often played in everyday life. The traditional games are *congklak, bekel, jump rope, umbul wayang cards, penteng, gobak sodor, marbles, dam-daman, jingklak and engklek*.

Data collection technique

The data collection techniques used in data collection are 1) Observation, namely by conducting direct observation of research subjects, namely several students with elementary school education level who are playing traditional games. However, not all research subjects were observed while playing traditional games. 2) Interviews, namely by asking several questions to several students after playing traditional games. Researchers ask questions about traditional games that are played with the aim of finding out the extent of mathematical knowledge and concepts in the game. 3) Documentation, namely by taking pictures of children playing traditional games. 4) Literature study, namely by analyzing various books and journals that are relevant to the research. Researchers relate the existing findings and relate them to literature studies in the form of sources from journals and books. Data collection techniques include

interviews, observation and documentation, and literature studies as a form of triangulation to obtain data and to determine the validity of the data.

Data analysis techniques

Data analysis techniques in ethnographic research include description, analysis, and interpretation. At the description stage, researchers try to describe in detail the mathematical concepts contained in traditional games. At the analysis stage, researchers can compare the mathematical concepts contained in the game with concepts in mathematics, draw relationships between existing concepts and a broader theoretical framework, and describe the mathematical concepts. At the interpretation stage, researchers draw personal conclusions and make them a theory based on interpretation.

Results

This study aims to analyze ethnomathematics-based mathematical games as a learning approach to helping students' logical-mathematical intelligence. The subjects in this study were 50 students spread across 5 Elementary Schools in Pamekasan Regency. The students were given a questionnaire about traditional games that are often played in everyday life. The data was used as initial data in this study. From the questionnaire given, there were 10 traditional games that are often played in everyday life. The traditional games are *congklak, bekel, jump rope, umbul wayang cards, penteng, gobak sodor, marbles, checkers, jingklak and engklek*. The traditional games are *congklak, bekel*, jump rope, *umbul* puppet cards, *penteng, gobak sodor*, marbles, checkers, *jingklak* and *engklek*.

Mathematical concepts in the *Kartu Wayang Umbul* game

One of the traditional games in this study is the Umbul puppet card game. Umbul is by using cards with pictures of cartoon characters, comics, puppet characters and so on. The Umbul image is one of the icons of original Indonesian toys, the result of adaptation or metamorphosis of cigarette cards or puppet cards. In addition to being used for playing, it turns out that Umbul cards can also be used as a medium in learning. This game can be played again or preserved and at the same time has a positive value when used in teaching and learning activities. The traditional Umbul card game is one part of the traditional game in the form of paper and has pictures and numbers that can be used as a medium of learning to help or facilitate students in learning. The mathematical concepts in this game are rectangles, positive integers, probability, comparison, division operations, and congruence. The cultural values in this game include critical thinking, cooperation and creativity. In detail, the mathematical concepts in this game are as in Table 1 below.

Table 1. Description of the mathematical concept in the Umbul puppet card game

Traditional Games	Mathematical Concept	Description
	Rectangle	In the game of wayang umbul cards, the tools or materials used are rectangular.

Traditional Games	Mathematical Concept	Description
Kartu wayang umbul	Positive integer	On each wayang umbul card there is a positive integer.
	probability	When playing, players can choose one of the piles of wayang cards.
	Comparison	When the wayang card is opened, a comparison of the numbers between the piles of wayang cards is made.
	Division operation	At the beginning of the game after being shuffled, the pile of wayang cards is divided as many as the number of players.
	Congruence	After the pile of wayang cards is divided, the height of the pile must be the same.

Figure 1. The Kartu Wayang Umbul game

Mathematical concepts in the game of *lompat tali*

The jump rope game is a jumping game using knotted rubber ropes. The name of this game is related to the behavior or actions carried out by the player himself, especially in the last jump. In this jump (the last), the rope is stretched by the holder to the level of the fist raised in the air. The mathematical concepts in this game are circles, rays and lines, probability, distance, height, and probability. The cultural values in this game include cooperation, perseverance, and thinking in how to jump over the rope. In detail, the mathematical concepts in this game are as shown in Table 2 below.

Table 2. Description of mathematical concepts in the game of skipping rope

Traditional Games	Mathematical Concept	Description
Lompat tali	Circle	The materials and tools used are rubber which describes a circle
	Ray Line and Line	In connecting rubber to a rope, there is one side as a base and the other side can be extended (ray line).
	Probability	But some string from both sides or extend from 2 directions (lines)

Traditional Games	Mathematical Concept	Description
	Distance	Before starting the game, the game begins with hompimpa to determine who the jumper is and who the rope holder is. This reflects the concept of opportunity in mathematics.
	Height	The person who is in charge of holding the rope stretches the rope between the two rope holders by squatting. For those who jump, they must estimate the distance of the jump with the height of the rope.
	Probability	For the rope holder, they will raise the rope from the lowest height, which is parallel to the sole of the foot, then as high as the ankle, knee, waist, chest, ear, head, and freedom. This reflects the mathematical concept of measuring height with non-standard units.

Figure 2. The game of lompat tali

Mathematical concepts in the game *dam daman*

Dam-Daman is a type of traditional brain teaser game. Dam-Daman can be played by two people or two groups facing each other. The arena of this game is played on a board that has been given a playing area and as pieces using stones or gravel with a predetermined number of Game components. *Dam-Daman* or *Damdas* can be developed with media in the form of a game board and game pawns. The game board can even be developed using several places such as on the ground, wall floor, wooden boards, and cardboard.

How play *Dam-Daman* or *Damdas* is like chess but with much simpler equipment and methods. Pawns or pieces for both parties playing dam-daman must be the same number and must be an even number. All pieces only have the same actions, namely horizontally, vertically, and diagonally, and are only given one chance to move. In addition, there is no checkmate rule like chess, there is only the rule of eating or being eaten. The mathematical concept in this game is that there are several two-dimensional figure, points, lines and angles, congruence, integer operations, and relationships between lines. The cultural value in this game is that it trains logical thinking, increases creativity in developing game strategies and problem solving. In detail, the mathematical concept in this game is as in Table 3 below.

Table 3. Description of mathematical concepts in the game of dam daman

Traditional Games	Mathematical Concept	Description
Dam-daman	Two-dimentional figure	In the game consists of several two-dimentional figure, namely square, triangle and circular pawns.
	Line points and angles	There is a straight line connecting one point to another so that it forms an angle.
	congruence	In the playing field there are the same shapes and sizes.
	Integer operations	Where when player one succeeds in eating the opponent's pawn, the number of player one's pawns will increase and the opponent's pawns will decrease. in the review above, it can be proven that there are number operations, namely addition and subtraction.
	Relationships between lines	The relationship between horizontal and vertical lines in the playing field forms parallel lines, perpendicular and intersecting.

Figure 3. The game *dam daman*

Mathematical concepts in the *jingklak* game

The *jingklak* game is a traditional game that is known by various names in various regions. *Jingklak* is a game for all ages, this game uses several stones (pebbles/black stones), a predetermined number of stones are played by throwing stones at the back of the hand then the palm of the hand catches as many as possible. If one of the players drops the stone, then that player is deemed to have lost and the player who can collect as many stones as possible is the winner. The minimum number of players in this game is 2 people. The mathematical concepts in this game are counting, whole numbers, subtraction, comparison and probability. The cultural values in this game are values such as solidarity, thinking to win the game, and responsibility. In detail the mathematical concepts in this game are as shown in Table 4 below.

Table 4. Description of mathematical concepts in the *jingklak* game

Traditional Games	Mathematical Concept	Description
Jingklak	Counting	We use 10 stones and then count them all one by one.
	Integers	Count all the stones from 1-10 (whole numbers are not from 0 onwards, not negative).
	Subtraction	Because in this game we only use 6 stones, we reduce the 10 stones to 6 stones.
	Comparison	Then we compare which stones we use more and which stones we reduce.
	Probability	We jump the stone, then how many chances do we have to catch the stone and how many stones do we not.

Figure 4. The *jingklak* game

Mathematical concepts in the *congklak* game

Congklak game is a traditional game that uses a wooden board with 14 to 16 round holes from the total holes on the *congklak* board, 2 of which are larger and located at the end of the board. In Indonesia it is more often called *congklak* or dakon, especially for Javanese people. The mathematical concepts in this game are circles, half balls, numbers, sets, opportunities, comparisons. The cultural values in this game include strategy and problem solving, pattern development and prediction, and cooperation. In detail, the mathematical concepts in this game are as in Table 5 below.

Table 5. Description of mathematical concepts in the *congklak* game

Traditional Games	Mathematical Concept	Description
Congklak	Circle	The *congklak* board hole has a circular top that can be used as an example of a flat shape, a similar circle, and a symmetrical shape.
	Half Ball	The *congklak* board hole is shaped like a half ball and can be used as a material for a spherical space shape to find the volume.
	Number	In playing *congklak*, players put one *congklak* seed into each hole on the *congklak* board to train players (children) to count.

Traditional Games	Mathematical Concept	Description
	Set	Players count the *congklak* seeds that are put into the hole and each hole must contain 7 seeds.
	Probability	This concept of opportunity occurs when players do rock, paper, scissors to take their first turn in the game.
	Comparison	By counting the final number of *congklak* seeds in each barn, players will unintentionally learn about the value of larger and smaller numbers.

Figure 5. The *congklak* game

Mathematical concepts in the game of *bekel*

Bekel ball is a game that originated in the Netherlands with the name Bikkelen. This game can be played by 2 or more. The rules of this game are heterogeneous, different in each region in Indonesia. These rules can also be changed according to the agreement of the players. The tools used in this game consist of 2 types, namely balls and 6-10 *bekel* seeds made of metal or according to the agreement of the players. *Bekel* is a traditional game that is often played by girls. Usually played by two to ten people alternately. The tools used are *bekel* balls and *bekel* seeds. The traditional *bekel* ball game is carried out to increase student motivation and learning outcomes in mathematics learning, especially in the material on integer arithmetic operations. The mathematical concepts in this game are subtraction, addition, multiplication, and division. The cultural values in this game include Cooperation and Social Interaction, thinking in calculating and sequencing, and problem solving. In detail, the mathematical concepts in this game are as in Table 6 below.

Table 6. Description of the mathematical concept in the game of *bekel*

Traditional Games	Mathematical Concept	Description
Bekel	Subtraction	It can be learned every time a player spreads *bekel* seeds on the floor and then takes the *bekel* seeds, for example when *bekel* seeds are spread, players can take the seeds one by one, namely six taken one,

Traditional Games	Mathematical Concept	Description
		taken one, taken one, taken one so the remaining 4 *bekel*.
	Addition	6 - 1 - 1 = 4, then the next four seeds want to be taken two, so 4 - 2 - 2 = 0, etc.
	Multiplication	It is done when a player wants to take seeds that have been spread first. For example, a player wants to take seeds one by one, then the addition concept used is 1 + 1 + 1 + 1 + 1 + 1 = 6 or 2 + 2 + 2 = 6 and 3 + 3 = 6.
	Division	It occurs when a player takes *bekel* seeds one by one, where the number of *bekel* seeds when taken is multiplied by the number of taking processes. If a player has spread 6 *bekel* seeds on the floor and then wants to take them back, by throwing the ball up once, the player can take all six seeds with several options. If you want to take 2 seeds in each draw, then the player needs to take three draws. It can be written as 3 x 2 = 2 + 2 + 2 = 6. This means that two *bekel* seeds are taken three times without replacement or other options. If the player wants to take three *bekel* seeds with two draws, then it can be written as 2 x 3 = 3 + 3, which means that three *bekel* seeds are taken twice without replacement.

Figure 6. The game of *bekel*

Mathematical concepts in the game of *penteng*

Penteng game is a traditional game played by two teams, namely the hitting/picking team and the catching/guarding team. This game is often found in various regions in Indonesia with different terms, such as gatrik in West Java, benthink in Central Java and Yogyakarta, tak tek in Bangka Belitung, *patok lele/penteng* in Madura and gatik, tal salju and betruk in other regions. In general, it can be determined that in the *penteng/patil lele* game, a stick made of wood or bamboo measuring approximately 30 cm and 10 cm is needed. Players must also make a hole first to install the stick that will be thrown using another stick. Players must be able to lift a stick that is placed in the hole so that it can be thrown far. The mathematical concepts in this game are cylinders, division, measurement, units of length, addition, multiples, and comparison. The cultural values in this game include cooperation, leadership, thinking in

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developing strategies and problem solving. In detail, the mathematical concepts in this game are as in Table 7 below.

Table 7. Description of mathematical concepts in the game of *penteng*

Traditional Games	Mathematical Concept	Description
Penteng	Cylinder	*Penteng* is a game that uses a wooden tool in the form of a cylinder with different sizes, one short and one long.
	Division	The game is played by 6 people divided into 2 groups.
	Measurement	The activity of playing *penteng* when using wood to measure shows skills in measurement.
	Unit of length	The traditional *penteng* game can be used to introduce the concept of units of length. short and long wood that is used as a game tool can be modified to the appropriate size so that children who play can convert certain units of length.
	Addition	The score is obtained by calculating the number of hits on the shorter wood, as well as the number of calculations of the distance and height of the shorter wood from the hole to where the short wood is thrown.
	Multiples	Every 2 hits count as 2 points, 3 hits 3 points and so on. so that multiples apply each time calculating the distance of the wood hit depending on the points obtained.
	Comparison	To determine the winner by comparing the points that have been collected by the two groups after one group has successfully collected the set points. The game is considered complete.

Figure 7. The game of *penteng*

Mathematical concepts in the game of *gobak sodor*

Gobak sodor is a traditional group game. The existence of the gobag sodor game in society has been around for a long time, but now it seems to be declining. This game is no longer widely found in everyday life, especially among children. This is in addition to the influence of

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advances in knowledge and the socioeconomics of society, and also because it is increasingly difficult to find an adequate arena to play gobag sodor. There are two opinions about the origin of the *gobak sodor* game. First, saying that the gobag sodor game comes from abroad, namely from the foreign language go back to door. Because the Javanese tongue has difficulty pronouncing it, so that it is easier to remember and pronounce, it finally became *gobak sodor*. While the second opinion, says that the game comes from within the country which consists of two words, namely gobak and sodor. *Gobak* means moving freely then becomes nggobak which means walking in circles, while sodor means watang which is a kind of spear that has a sharp spearhead. However, in this game, sodor is the guard of the axis line or sodor line which is in the middle of dividing the playing arena. The line is used by the traffic of the odor to narrow the opponent's movement space so that it is easy to kill. The mathematical concepts in this game are two-dimentional figure, congruence, number operations (division), number operations (addition and subtraction, relationships between lines. The cultural values in this game include cooperation, honesty, thinking in strategic analysis and problem solving. In detail, the mathematical concepts in this game are as in Table 8 below.

Table 8. Description of mathematical concepts in the game of *gobak sodor*

Traditional Games	Mathematical Concept	Description
Gobak sodor	Two-dimentional figure	Rectangular field.
	Congruence	The same shape and size on the playing field. and have the same size.
	Number operations (division)	The playing field in the *gobak sodor* game is divided into 6 squares with the same size by measuring the area and circumference.
	Number operations (addition and subtraction)	There are addition and subtraction activities, in determining the general number of players, the number of members who want to play, the number of points/points obtained by each team, and the number of cities that must be passed by the player's team. as well as reducing players who have left the playing field/lost.
	Relationships between lines	The relationship between these lines is formed on horizontal lines and vertical lines on the playing field, such as perpendicular and intersecting parallel lines.

Figure 8. The game of *gobak sodor*

Mathematical concepts in marble games

Traditional marble games are a culture that can be a child's hobby in playing which gives the impression of direct experience in real situations on various aspects of child development. Marble games are one type of traditional game that can be used as a medium to train children's abilities. Marble games are usually played by boys, but some girls are also interested in playing the game. The mathematical concepts in this game are geometry of solid shapes, probability or chances, addition and subtraction, geometric concepts of flat circles, flat triangles, and the concept of distance. The cultural values in this game include honesty, togetherness, thinking in terms of distance calculations, and problem solving. In detail, the mathematical concepts in this game are as in Table 9 below.

Table 9. Description of mathematical concepts in marble games

Traditional Games	Mathematical Concept	Description
Kelereng	Geometry of solid shapes	It can be seen from the shape of the marble itself, the marble is in the form of a solid ball with a certain volume
	Probability or chance	When throwing marbles into a circle or a certain area, players can estimate the chances of the marbles landing in a certain location. This involves an understanding of the probability and possible outcomes of each circle
	Addition and subtraction	In the marble game, players need to calculate the number of points or scores obtained based on the location of their marbles. This involves addition and subtraction.
	Geometric concept of circle plane shapes	It appears that in the preparation stage of the game, children draw a circle as a place to collect the player's marbles.
	Triangle plane shapes	Children draw a triangle as a place to collect the player's marbles.
	Distance concept	These results are seen at the stage of determining which player will play first.

Figure 9. Marbles games

Mathematical concepts in the game of *engklek*

Engklek is a traditional game played on a field in the form of a picture of eight squares and one picture of a mountain. The picture as the playing field is made on the floor, street, field, and other flat places and is drawn using chalk, charcoal and wood if made on the ground. This game is generally played by girls. The history of the game of *engklek* is not known for sure. Because there is no authentic evidence about it. However, there are two opinions about the history of the game of *engklek* that are quite well known until now. *Engklek* is played by jumping with one foot on the boxes that have been made. For boxes that are adjacent like wings, players are allowed to put their feet on both boxes at the same time. Each player has a gaco, which is a stone or piece of tile that is used as a throwing tool. The mathematical concepts in this game are two-dimentional figure, similarity and congruence, number operations (division), and counting. The cultural values in this game include social interaction togetherness, thinking in calculating distances, and problem solving. In detail, the mathematical concepts in this game are as in Table 10 below.

Table 10. Description of the mathematical concept in the game of *engklek*

Traditional Games	Mathematical Concept	Description
Engklek	Two-dimentional figure	The *engklek* has a geometric concept, namely a flat shape. seen from the shape of the square which consists of several two-dimentional figure such as squares, rectangles, and semicircles.
	Congruence and congruence	The hopscotch has the concept of similarity and congruence. there are 4 square boxes, 4 rectangular boxes, and a semicircle.
	Number operations (division)	The playing arena in the gobak sodor game is divided into 6 boxes with the same size by measuring the area and circumference.
	Counting numbers	There is a deep mathematical concept that is passed during playing the mathematical concept on the hopscotch. from the following squares: 1, 2, 3, 4, 5, 6, 7, 8, 9 until reaching square 1.

Figure 10. The game of *engklek*

Discussion

Ethnomathematics is an approach that connects mathematics with mathematical concepts that exist in local culture. In this study, in traditional games there are mathematical concepts that can be integrated in mathematics learning. Through the ethnomathematics approach, students can learn mathematics in a more contextual context in traditional games. The mathematical concepts in traditional games in this study, such as *congklak*, *bekel*, jump rope, and others, contain mathematical elements that can support the development of students' logical-mathematical intelligence. This is in line with the results of the study which states that traditional games have an influence on students' logical-mathematical intelligence (Lestariningrum, 2018).

In the *congklak* game, there are mathematical concepts such as circles, half balls, numbers, sets, opportunities, comparisons. In addition, this game involves strategic calculations and predictions of opponent's moves and mathematical concepts can support students' logical mathematical thinking skills. The *congklak* game can develop logical thinking skills through calculating seed distribution (Lestariningrum & Handini, 2017), through the rules in the *congklak* game (Ramadhani, 2018).

In the *bekel* game, there are mathematical concepts that can be integrated into mathematics learning, namely subtraction, addition, multiplication, and division. In this game, the concept of multiplication occurs when the player takes one *bekel* seed, where the number of *bekel* seeds when taken is multiplied by the number of taking processes. If the player has spread 6 *bekel* seeds on the floor and then wants to take them back, by throwing the ball up once, the player can take all six seeds with several options. This game requires the ability to predict and count the number of balls and seeds taken. The *bekel* game can help improve children's motor skills and mathematical logic (Sudiarta et al., 2023).

In the game of gobak sodor and jump rope, there are several mathematical concepts that can be integrated into mathematics learning. In the jump rope game, the mathematical concepts in this game are circles, rays, lines and lines, opportunities, distance, height, and opportunities. The mathematical concepts in the gobak sodor game are two-dimentional figure, congruence, number operations (division), number operations (addition and subtraction, relationships between lines. In this game, the involvement of mathematical concepts and strategies for movement in space, which are related to geometry and distance calculations. This game can support students' logical mathematical thinking skills. This game is to hone children's ability to think logically and mathematically (Sari et al., 2018). With the gobak sodor game, student learning outcomes can be improved (Jariono et al., 2023)

In the marbles and jingklak games, there are several mathematical concepts that can be integrated into mathematics learning. The mathematical concepts in the marbles game are the geometry of spatial shapes, probability or chance, addition and subtraction, the concept of the geometry of the circle, the triangle, the concept of distance. In the marbles game, when throwing marbles into a certain circle or area, players can estimate the chances of the marbles landing in a certain location. This involves an understanding of the probability and possible outcomes of each circle. These mathematical concepts can be used to introduce and understand the concepts

of geometry and distance through local culture With this, games can be used to support students' logical mathematical intelligence. Meanwhile, in the jingklak game, the mathematical concepts in this game are counting, whole numbers, subtraction, comparison, and probability. In this game, it can support students' abilities in the cognitive and psychomotor domains. The construction of mathematical concepts that link value education with traditional games, especially jingklak, is the basis for understanding and applying local wisdom values in learning (Muliadi & Asyari, 2024).

The concept of mathematics in traditional games, it shows that ethnomathematics can help students understand mathematical concepts better because of its relevance to contextual life. Local culture-based games, as explained above, provide a real context for students to develop logical-mathematical skills. In addition, other studies have shown that the use of traditional games in learning can increase students' motivation and learning outcomes to learn mathematics (Matulessy & Muhid, 2022), because students feel more comfortable with learning methods based on local culture (Sari & Widiastuti, 2020). Integrating traditional games into mathematics learning requires an active role for teachers to link game elements with formal mathematical concepts. With these results, traditional games based on ethnomathematics not only preserve local culture but also become an effective tool for developing students' logical-mathematical intelligence.

Understanding the relationship between logical thinking and the ability to draw conclusions correctly and carefully is the main key in the rational thinking process. Logical thinking is the process of someone using reasoning consistently to reach a conclusion (Yin et al., 2015). This can be seen from the students' process in completing the game played from the beginning to the end of the game, of course using their reasoning (strategic logic) in completing each stage in the game. Logical thinking explains 4 indicators of logical thinking ability, including classification, seriation, logical multiplication and compensation (Yin et al., 2015).

The four indicators appear in each game, namely classification is a process of classifying or grouping based on certain characteristics, for example in two-dimentional figure or spatial shapes (squares, rectangles, circles, triangles, cylinders and others) contained in the game, then the seriation indicator which is an activity of sorting based on order or size such as in the *congklak* game counting *congklak* seeds that are put into the hole and each hole must be filled with 7 seeds, another game is engklek by passing through engklek squares such as counting from squares 1, 2, 3, 4, 5, 6, 7, 8, 9 until reaching square 1. The logical multiplication indicator is a logical calculation process that includes calculation operations involving multiplication, comparison, subtraction and addition, this is reflected in the game. Finally, the compensation indicator is the effect or impact received by students in the game, for example, the emotional condition of being happy because they have succeeded in completing the game, motivation and interest in learning because it is done in a game setting. In line with what was expressed by (Sari & Widiastuti, 2020), students are more comfortable with traditional game-based learning. And the four indicators in the game are logical operations that are relevant to students' cognitive development based on Piaget's theory, namely at the concrete operational stage in children (aged 7-11 years) at the elementary school level.

Conclusion

The mathematical concepts in some traditional games can be integrated into mathematics learning. The mathematical concepts in traditional games show that ethnomathematics can help students understand mathematical concepts better because of their relevance to contextual life. Local culture-based games, as explained above, provide a real context for students to develop logical-mathematical skills. However, in implementing the integration of traditional games in mathematics learning, it requires an active role for teachers to link game elements with formal mathematical concepts.

With these results, traditional games based on ethnomathematics not only preserve local culture but also become an effective means to develop students' logical-mathematical intelligence. These traditional games are relevant to students' cognitive development based on Piaget's theory, namely at the concrete operational stage in children (aged 7-11 years) at elementary school level. This study has limitations, namely the scope of traditional games which are still on a small scale and have not shown an increase in students' logical-mathematical intelligence by using mathematical concepts in these traditional games. Therefore, further research is needed on whether there is an increase in students' logical-mathematical intelligence in the use of mathematical concepts in traditional games based on ethnomathematics. In addition, other studies can analyze the use of ethnomathematics-based learning media based on games and exploration of existing concepts and adjusted to the characteristics of the material in mathematics learning.

Acknowledgment

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding Statement

Author Contributions

Moh Zayyadi: Review & editing, formal analysis, methodology, interpretation data and supervision; **Ema Surahmi**: Conceptualization, writingthe original draft, and analysis and visualization; **Septi Dariyatul Aini**: Review & editing, formal analysis, methodology, and interpretation data; **Dayat Hidayat**: Review, interpretation data, and supervision.

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