



# Exploration of Ethnomathematics in *Umpet Batu* Game

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## Abstract

Ethnomathematics is an interesting learning resource because it connects the surrounding culture with mathematical concepts. This research focuses on exploring ethnomathematics in one of the games from DKI Jakarta, namely the game of *umpet batu*. The ethnographic approach is used to reveal the mathematical concepts in the game of *umpet batu* with data collection techniques through observation, interviews, and documentation, then further discussion related to mathematical concepts with mathematics teachers who know the game of *umpet batu*. The results showed that the game of *umpet batu* has simple mathematical concepts, namely basic arithmetic, probability, and flat geometry at the elementary and junior high school levels in different phases. The existence of learning resources with traditional games can help students understand math concepts in a real form and can preserve the traditional game itself.

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## 1. Introduction

Currently, learning mathematics is considered difficult and less fun for students in the world, even though mathematics is dubbed as the Queen of Science (Soebagyo, 2016). Students should be able to consider learning math as a fun activity but, in reality, math is considered a difficult and scary subject, especially in Indonesia (Husnah et al., 2021). According to (Ndraha et al., 2022) in PISA Indonesia's ranking in the field of mathematics is ranked quite low, which is ranked 39 out of 41 countries. One of the main factors that make math less attractive in Indonesia is the lack of interesting learning resources and examples of math learning that apply directly to daily life (Astuti et al., 2024). In journal (Irwandi & Fajeriadi, 2019) the states that one of the causes of the low quality of education is the use of learning resources that have not been maximized.

One of the interesting learning resources is learning while playing (Panjaitan & Suriadi, 2023). In Indonesia itself, there are traditional games that can provide good benefits for children's development both physically, emotionally, and cognitively (Pratiwi & Pujiastuti, 2020). Many studies have shown that traditional games have a big role in learning and bring positive impact during math learning (Rohmatin, 2020). Traditional games contain positive local cultural wisdom values that must be maintained and preserved (Rohmatin, 2020). Learners not only enjoy traditional games, but they also have the probability to learn about culture and improve their numeracy and thinking skills (Merliza, 2021). In addition, the environment can help students become more capable of understanding new contexts independently, the best way to use the environment in learning is to make it a learning resource (Irwandi & Fajeriadi, 2019).

Traditional games have many benefits ranging from learning resources, emotional management, and even character education, because these traditional games can be called games that contain positive cultural values of each region with their own learning (Helvana & Hidayat, 2020). According to experts in journals (Hasanah, 2016) Play is used as a medium to improve certain skills and abilities in children that are used as a bridge from informal learning to formal learning. Traditional games can be an innovative learning

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resource, especially in math learning which is considered boring, traditional games can basically be closely related to mathematics ranging from game concepts, basic arithmetic operations, and even geometry (Ummaroh et al., 2023).

Traditional games that contain mathematical concepts are authentic to ethnomathematics (Liberna et al., 2023). Innovative and interactive mathematics learning can be done through a cultural approach that is already familiar in the community, commonly known as ethnomathematics (Zulaekhoh & Hakim, 2021). According to Fitriana in a journal (Soebagyo et al., 2021) ethnomathematics is a study of mathematics in the form of a study of the form of culture (ideas, activities, or cultural objects) that has become a characteristic of a particular community group and the study is carried out by someone who has knowledge / expertise in the field of mathematics. According to D'Ambrosio ethnomathematics comes from the word "ethno", which means a broad socio-cultural context, which includes language, jargon, behavioral codes, myths, and symbols, and "matema", which means explaining, knowing, understanding, and performing activities such as coding, measuring, clarifying, inferring, and modeling. "Tics" comes from the word *techné* which means technique. The term "ethno" refers to what makes a culture unique, such as its language, specific codes or symbols, values, *jargon* or trademarks, beliefs, food and clothing, customs, and physical traits (Kristial et al., 2021).

Indonesia ranks fourth in the world with the largest population, this causes ethnic and cultural diversity in Indonesia, one of which is in traditional games which is one of Indonesia's wealth (Harahap & Jaelani, 2022). In UU No. 5 of 2017 Article 1 paragraph 1 says that, Culture is everything related to copyright, taste, *karsa*, and the work of the community, and traditional games are one of the cultures in Indonesia (Undang - Undang RI Nomor 5, 2017). Unfortunately, despite Indonesia's rich cultural heritage, it has not been widely utilized as a learning resource, particularly in mathematics education (Rudyanto et al., 2019). The lack of mathematics learning resources in schools that involve familiar contexts in everyday life is one of the problems. Traditional games, for example, can enrich mathematics learning resources that can be used by teachers and students in mathematics learning. One of the traditional games in Indonesia is the game of *umpet batu*, *umpet batu* is a game from the DKI Jakarta area that has another name *sekolah batu*, This game is played by 2 teams with the number of each team must be the same which amounts to at least 3 people from each team, this game can be said to be quite simple because it only requires a small stone that functions to guess where the stone is hidden (Saputra & Nopianti, 2022). This game has several positive values for child development such as discipline, honesty, and motor development (Rahmah & Zirmansyah, 2019). The purpose of this study is to explore the traditional game of *umpet batu* by tracing its history and origins, describing how it is played in detail, and revealing the positive values it embodies. Additionally, this study aims to identify and analyze the connection between the game of *umpet batu* and mathematical concepts from an ethnomathematics perspective.

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## 2. Methods

Based on the research problem, the ethnographic approach was used to reveal the game of *umpet batu* related to mathematical concepts. The ethnographic approach is a method that combines experimental and theoretical approaches, with the aim of obtaining an in-depth description and analysis of the game *umpet batu* from DKI Jakarta through field research. This research aims to describe the findings related to the mathematical values found in the game of *umpet batu* from DKI Jakarta

The steps of the ethnographic method according to John W. Creswell in the book (Creswell, 2013) suggests 7 steps, namely: 1) determine whether ethnography is the most appropriate design for studying the research problem, 2) identify and locate a group that has a culture to study, 3) choose a cultural theme, issue, or theory to learn about the group, 4) to understand the concept of culture and determine the type of ethnography to be used, 5) collect information in the context or environment where the group is active or lives, 6) from the various sources that have been collected, ethnographers analyze the data to describe groups that have the same culture, 7) make a set of rules or generalizations about how culture-sharing groups work as the final result of this analysis.

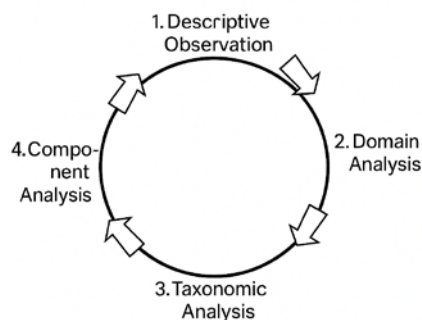
Data collection and analysis were carried out simultaneously and continuously with the resource person, Mr. Yahya Andi Saputra as a Betawi cultural figure who knows the game of *umpet batu*, by applying different data collection techniques to obtain the desired information ranging from observation, interviews, and documentation. Observation activities were carried out directly to observe the methods and

characteristics of this game of *umpet batu*. Furthermore, interviews were conducted to obtain history and information related to the *umpet batu* game, and documentation was conducted on the *umpet batu* game and the sources as evidence. The interview questions were carefully designed to be relevant to the current context and developments. Before use, the list was verified by a mathematics education lecturer from a renowned university in Jakarta to ensure its validity and suitability.

**Table 1.** Interview item

No	Interview Item
1	Are there any special rules for playing <i>umpet batu</i> ?
2	What mathematical concepts are used in this game?
3	How can this game be used as a tool for teaching mathematics to students?
4	What distinguishes <i>umpet batu</i> from other traditional games?
5	What social and cultural values are contained in this game?
6	Does this game have different rules in different regions?
7	Who invented the game of <i>umpet batu</i> ?
8	When was the game <i>umpet batu</i> invented?
9	What is the brief history of the discovery of the game of <i>umpet batu</i> ?
10	What distinguishes the game of <i>umpet batu</i> from other regional games?
11	Are there any positive values in playing <i>umpet batu</i> ?

This research used an interactive analysis model that refers to the Spradley model. Spradley's model shows that the research process takes place in a cycle, which is better known as a cyclical research process (Spradley, 2016) starting from domain analysis, taxonomy analysis, to component analysis. The following is a chart of data analysis according to Spradley:



**Figure 1.** Research and analysis process

To prevent errors or mistakes in the data that has been collected, it is important to verify the validity of the data. Data validity is a standard of truth of the research results that emphasizes more on data or information than on attitudes and numbers of people (Atkinson & Hammersley, 2007). Several data validity techniques are needed to verify the accuracy of the data in this study including observation persistence and triangulation (Denzin & Lincoln, 2018). More clearly, the researcher conducted further discussions related to mathematical concepts in the game of *umpet batu* with Mr. Jiddan Fakhri Sunni, S.Pd. from Bakti Idhata High School, South Jakarta and Mrs. Latifa Clara Noya, S.Pd. from SMK Kencana 1 North Jakarta, as mathematics teachers who have researched related to ethnomathematics and know the game of *umpet batu*.

### 3. Results & Discussions

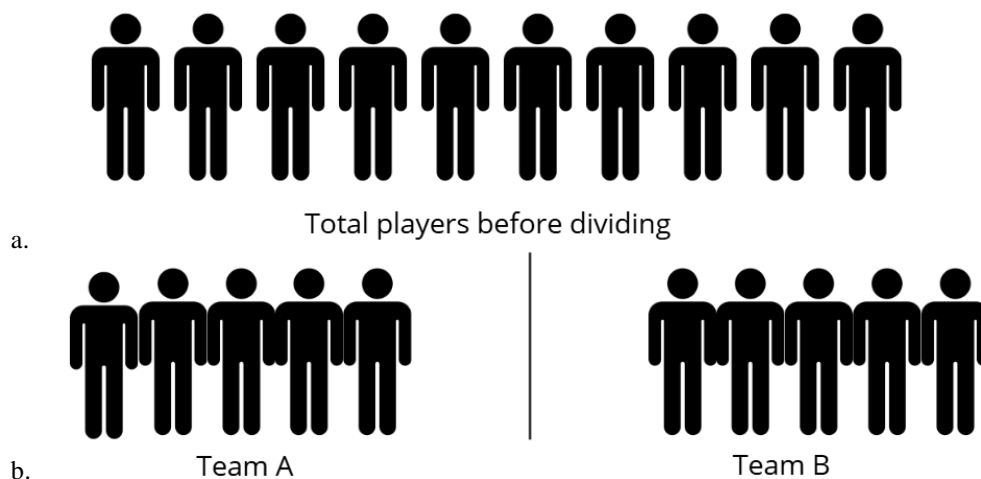
The game of *umpet batu* originated in DKI Jakarta, which has several other names such as *tebak batu* and *sekolah batu*. Based on the results of interviews with Mr. Yahya Andi Saputra, this game began to be played around the end of the 18th century to the early 19th century, this game is considered quite easy to play because it only uses small stones to hide and is played with 2 teams with the same number between the two teams ranging from 3 to 10 people between teams, if the number of players who want to play is odd then one person must wait for the next turn to play. This game is usually played outdoors because it requires a large enough place to play, where later they form a dividing line between the two teams to become the final goal of the two teams, when one team reaches the dividing line first, the team is declared a winner and the other team loses. The losing team will be penalized by the winning team according to the agreement at the

beginning of the game. This game has an advantage when played, because it does not require items that are difficult to find, does not require a specific place to play in the yard or open field, and has a very easy way to play. In addition, this game has many positive values when played, according to Mr. Yahya Andi Saputra, the positive values of this game start from honesty, discipline, mutual help, friendship, sportsmanship, and a sense of fun. According to Mr. Yahya himself, there are also mathematical concepts from this *umpet batu* game, such as counting, division, probability, and flat shapes. Meanwhile, from the researcher's own observations, there are mathematical concepts that can be seen such as basic arithmetic, probability, and basic geometry.

The game of *umpet batu* has several steps to play such as 1) they make a dividing line that divides between the two teams, 2) they divide the number of players between the two teams with the same number of total who want to play, 3) each team chooses a team leader who is in charge of hiding the stone in one of his teammate's hands, 4) they must face each other to the dividing line with the position of the hands behind and the team leader goes around behind his team while hiding the stone in one of his teammates and if it is the team leader asks the opposing team "who holds the stone?" then the opposing team has the right to guess where the stone is hidden, 5) when the opposing team answers correctly they advance one step closer to the boundary line and if it is wrong the team that hides the stone advances one step closer to the boundary line, 6) the team that reaches the boundary line first has the right to determine the penalty to the opposing team and the opposing team must follow the penalty of the winning team.

According to Mr. Jiddan Fakhri Sunni, the *umpet batu* game is considered to have mathematical elements that can be learned at the elementary and junior high school levels. According to the math teachers above, the game has some simple math concepts that can be used as learning resources in schools, namely basic arithmetic, probability, and geometry. From further discussion with the two math teachers above, the concept of basic arithmetic can be found during the initial gathering process of players and divided by the same number for both teams, for probability can be found at the beginning of determining the turn by *suten* and also when guessing the location of the hidden stone, and basic geometry is found in the shape of the stones used during the playing process.

### 3.1. Arithmetic



**Figure 2.** (a) Total players before being divided; (b) Total players after being divided

The concept of basic arithmetic here occurs during the initial process of playing as in the example figure above, where when players gather, they need to count the total players and then divide by the same number for both teams. According to Mrs. Latifa Clara Noya, there is the concept of basic arithmetic in grade 3 SD in phase B with learning outcomes that they can perform addition and subtraction operations of integers up to 1,000 and can perform multiplication or division operations of integers. An example of its application is as shown above, in figure 2 (a) before starting the game there are 10 total players who will be divided into 2 teams. In figure 2 (b) illustrates when the players have been divided into 2 teams with the same total number of players for both teams. The formula that can be used to divide the total into 2 teams is as below.

$$\text{Number of people each team} = \frac{\text{total players}}{2}$$

It is known that the total players in figure 2 (a) are 10 people who will be divided into 2 teams, if you follow the formula above, the application is as follows:

$$\text{Number of people each team} = \frac{10}{2} = 5$$

Which means the total number of players on each team is 5, because there are 10 total players who must be divided equally into 2 teams. The results of the exploration of ethnomathematics on the concept of basic arithmetic can also be found in the game of *congklak* at the beginning of the game or at the end of the game to continue the next round (Halimah et al., 2024). In addition, the concept of basic arithmetic that focuses on division also exists in the traditional game of *kempren* which is found when the player wants to know how many times the player will play to collect the maximum score (Susanti, 2020).

### 3.2. Probability



**Figure 3.** (a) *Suten* finger shape; (b) Rules in the *suten* process

In addition to basic arithmetic, there is another math concept which is probability. There is a concept of probability in this game from the beginning of playing to the end. Like during the process of determining which team goes first to hide the stone, the team leaders of both teams need to do the *suten* process. *Suten* is a way to draw two people by pointing fingers to determine who wins. (Salamah et al., 2024). In the process of *suten* with variations (scissors, stone, paper) there will be probability to win, draw and lose, the probability of winning is  $\frac{1}{3}$ , the probability of losing is  $\frac{1}{3}$ , and the probability of a tie is  $\frac{1}{3}$ . This happens because each result has a probability, the *suten* rule will be won when paper against stone, stone against scissors, and scissors against paper, if during the *suten* process the same shape is issued it will be considered a draw, and it will be considered a loss when stone against paper, paper against scissors, and scissors against stone (Mustofa et al., 2025). The concept of this probability can be seen in the sample space and sample points, where there are 3 sample spaces for each team leader and there are 9 sample points of possibilities that will occur during the *suten* process, the following discussion.

The sample space of *suten*:

(S) = {scissors, stone, paper}

Sample point *suten*:

(T) = scissors scissors, rock scissors, paper scissors, paper paper, paper scissors, paper rock, rock rock, rock scissors, paper rock.

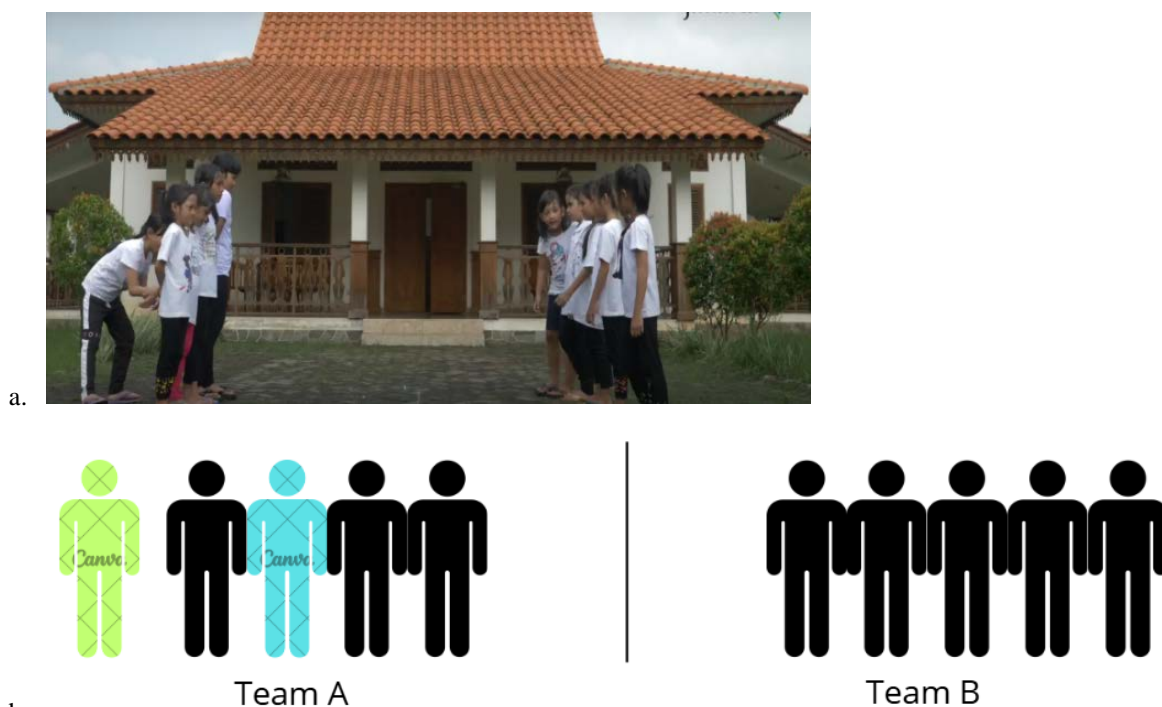
Then the probability of each sample point is  $= \frac{1}{9}$

While the odds of winning, drawing, and losing when *suten*  $= \frac{3}{9} = \frac{1}{3}$

For example, there are 2 people who are doing *suten*, namely team leader A and team leader B. In the first *suten* team leader A issued a stone shape while team leader B issued the same shape, a situation like this indicates a tie and repeats up to 2 times. Then during the third *suten* process, team leader A issued a scissor shape while team leader B issued a paper shape, here it can be seen that team leader A won in the *suten*

process. When the *suten* process experiences a tie continuously, there is no limit in doing the *suten* process until finding the winner.

The concept of probability is found at the junior high school level in grade 8 in phase D, with learning outcomes they can explain and use the notion of probability, relative frequency and expected frequency of one event in a simple experiment. The figure above is an example of a form of *suten* and its rules to determine which team hides the stone first.



b. **Figure 4.** (a) Process of stone hiding; (b) Illustration of hidden stone location on team A

In addition, the concept of probability is also found during the core game, because players must guess where the stone is hidden, this refers to the concept of probability because players must guess 1 stone from the number of opposing teams except the team leader, because the team leader is tasked with hiding the stone behind his team's hand and cannot hide it in the team leader's own hand. In figure 4 (b) there are team A and team B which amounted to 5 players including the team leader in each team, 1 team leader A is tasked with hiding the stone among 4 people in team A, which later team B must guess the location of the stone among 4 people in team A. Based on figure 4 (b), the blue person shows the location of the stone hidden in team A while the green one is the team leader who is certain not to hide the stone in his hand. Based on the figure 4 (b) the blue person shows the location of the stone hidden in team A while the green one is the team leader who certainly does not hide the stone in his hand, we can know that the probability of team B's correct guess is  $\frac{1}{4}$  because there is only 1 stone among 4 people in team A. The reason for only guessing 1 stone out of 5 players is because the team leader is prohibited from hiding the stone in his own hand, here's the discussion.

*Team A's sample space*

$(S) = \{\text{player 1, player 2, player 3, player 4}\}$

*Sample point*

$(T) = \text{player 1, player 2, player 3, player 4}$

Then the probability of guessing right =  $\frac{1}{\text{number of opposing teams except the team leader}} = \frac{1}{4}$

Similar to the *suten* process, the concept of probability is found at the junior high school level in grade 8 in phase D, with learning outcomes they can explain and use the notion of probability, relative frequency and expected frequency of one event in a simple experiment. The results of ethnomathematical exploration on the concept of probability can also be found in the *dengklaq* game when getting the territory (Fauzi & Lu'luilmaknun, 2019). In addition, there is also the concept of probability in some traditional games from



Lampung such as in the game *bedil betung* to determine the success of the shot, then in the game *pidak* when looking for probability to be able to win from pitting two rubber seeds from his side and the opponent, and the game *min sundung khulah* looking for probability to win and not be pinched (Merliza, 2021).

### 3.3. Geometry



**Figure 5.** (a) Example of stone shape; (b) Circle flat shape

In Figure 5 (a) there is an example of the shape of a stone that can be used when playing, according to Mr. Yahya there is no specific size and shape of stone to use, as long as it can still be grasped the stone is suitable for use, researchers estimate that stones that can be used with a diameter of 1 to 4 cm. In addition to arithmetic and probability, *umpet batu* also has the concept of flat geometry in grade 6 SD end of phase A, with learning outcomes that students can recognize various flat shapes (triangles, quadrilaterals, segments, circles) and spaces (blocks, cubes, cones, and spheres). Figure 5 (b) is an illustration of a circular flat shape that resembles the shape of a rock used in the game of *umpet batu*. Circles have the following properties: 1) has an infinite number of rotary symmetry and folding symmetry; 2) has one center point; and 3) the sum of the angles of the circle is  $360^\circ$ . The formula to find the circumference and area of a circle is.

$$\text{Circumference of a Circle} = \pi \times D \text{ or } 2 \times \pi \times r$$

$$\text{Area of a Circle} = \frac{1}{4} \times \pi \times D^2 \text{ or } \pi \times r^2$$

Where D is the diameter of the circle, r is the radius of the circle, and the value of  $\pi$  (phi) is always fixed which is  $\frac{22}{7}$  or 3,14. The results of ethnomathematics exploration on the concept of circular flat geometry can also be found in the *kelereng* game when making a place to collect marbles (Pratiwi & Pujiastuti, 2020). It can also be found in the calligraphy decoration at the Cut Meutia Mosque (Salsabila & Soebagyo, 2023), and also found on the fence of the Jami Cikini Al- Ma'mur Mosque (Soebagyo & Haya, 2023).

Based on the results obtained, we recommend that teachers and students implement the findings of this study in mathematics learning. The first result of the study in the game of *umpet batu* during team division found basic arithmetic concepts that can be implemented by teachers and students in grade 3 elementary school in phase B. The second research finding identified the concept of probability in the process of *suten*, concealing, and guessing the position of the stones when hidden, which can be utilized by teachers and

students in eighth grade at the junior high school level in phase D. The third research finding identified geometric concepts in the examples of stone shapes used in the game, which can be utilized by teachers and students in sixth grade at the elementary school level in phase A. In addition, making culture-based mathematics learning as a mathematics learning resource can help students to understand mathematics in the real world, the reason is because students can try and practice directly in understanding the material they want to learn. Making traditional games as a learning resource also has another positive side, namely that it can introduce students to the wealth and diversity of cultures that exist in Indonesia and can also instill positive values in it.

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#### 4. Conclusion

Based on the results of the exploration that has been carried out, it can be concluded that the game of *umpet batu* has benefits in learning mathematics or commonly referred to as ethnomathematics-based learning. The elements of ethnomathematics contained in the game of *umpet batu* include the process of dividing teams at the beginning of the game which can be related to basic arithmetic such as division. In addition, there is a concept of probability that is quite prominent from this game which is when doing *suten* to determine which team goes first to hide the stone and also during the playing process where teams discuss with each other to guess the location of the stone on the opposing team. There is also the concept of flat geometry contained in the stone that is hidden when played.

The mathematical concepts found in the game of *umpet batu* can be used as a source of mathematics learning at the elementary and junior high school levels, especially in the DKI Jakarta area, because mathematics learning will be more contextual, enjoyable, and conscious in accordance with the new learning approach in Indonesia, namely deep learning with three main elements, namely meaningful learning, mindful learning, and joyful learning. Through ethnomathematics, the culture around us can be utilized as a source of inspiration and knowledge, as well as an alternative source of mathematics learning. Additionally, ethnomathematics can serve as a form of cultural preservation, ensuring that it remains known and cherished by the Indonesian people.

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