



# Analysis of Mathematical Concepts in the Traditional *Palak Babi* Game of Bengkulu Province

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### Abstract

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Analysis of Mathematical Concepts in the Traditional *Palak Babi* Game of Bengkulu Province. Culture is the identity of a nation that is formed from values, beliefs, customs, and norms that are held firmly and passed down from generation to generation. The culture of a region is reflected in various aspects of people's lives, one of which is through traditional games in Bengkulu Province. The traditional game is the traditional *Palak Babi* game, which effectively contributes to building mathematical concepts. Mathematical concepts appear in society and culture. Ethnomathematics is the study of mathematical concepts in traditional games as a culture. The purpose of this research was to analyze the mathematical concepts that were naturally involved in the traditional *Palak Babi* game. The method used in this research was the descriptive qualitative method. The concepts include measurement, comparison, addition, multiplication, and angles. Thus, the traditional *Palak Babi* game as part of culture contains valuable ethnomathematical values. Therefore, it can provide new insights into developing more contextualized mathematics learning strategies and expand understanding of mathematics.

## 1. Introduction

Culture is customs that contain important values that are passed down from generation to generation. Culture is diverse and rich with various traditions and customs (Juliana et al., 2023). The customs contained in culture become a habit in society (Wondo et al., 2020) and a developed way of life shared by society (Antara & Yogantari, 2018). Culture is also a certain level of historical development of society, creativity and human abilities which are expressed in various aspects of society's life and activities (Makhmudova, 2022). One aspect of society's life that is reflected in culture is through traditional games.

Traditional games are games that come from the culture of society. Traditional games are a means of entertainment played by the society, both children and adults (Gandasari, 2019; Mudzakir, 2020). Traditional games have a variety of forms and variations and tend to utilize tools or objects in the environment without buying them (Gultom et al., 2022), so traditional games are played without expensive and complicated equipment, but utilize simple objects in the surrounding environment. The tools or objects are usually handmade equipment that can develop creativity. Culture is closely related to traditional games which are ancestral heritage and a reflection of the culture of a region. One of the regions that has traditional games is Bengkulu Province.

Traditional games in Bengkulu Province offer opportunities to integrate mathematical concepts into cultural activities. This game is not only a source of entertainment but also rich in learning mathematical concepts. In essence, traditional games not only provide fun for players, but also indirectly reflect the application of mathematical concepts (Pratiwi & Heni, 2020). The incorporation traditional games in mathematical concepts has been shown to improve problem solving in society (Iswinarti & Suminar, 2019). Through traditional games, people express their ideas and understanding of various concepts, including mathematical concepts. Traditional games that contain cultural values and are related to mathematical

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concepts are reflected in the traditional *Palak Babi* game. The traditional *Palak Babi* game is a traditional game of gouging wood using wooden sticks. The traditional *Palak Babi* game effectively contributes to building simple mathematical concepts. The traditional *Palak Babi* game can be a valuable resource for learning mathematical concepts, growing social skills, and improving character values. People in Bengkulu do not realize that the game in their daily life has applied mathematical concepts.

Mathematics as a result of society culture formed from society activities in the form of making patterns, designing and calculating in solving various life problems faced (Masamah, 2019). Mathematical concepts are something that is interconnected with the cultural context (Loviana et al., 2020; Merliza, 2021). Mathematical concepts can be learned through culture (Suhartini & Martyanti, 2017). Mathematical concepts are closely interrelated with culture found in various practices and traditions (Anisa et al., 2023; Hariastuti et al., 2021). Thus, mathematical concepts have appeared in people's lives since ancient times. Various kinds of mathematical concepts such as points, lines, angles, triangles, rectangles, circles, and patterns (Haji et al., 2022). Mathematical concepts that grow naturally in culture and daily life are what then known as ethnomathematics.

Ethnomathematics is mathematics that emerges as a result of knowledge built from the surrounding culture (Kusuma et al., 2019). This shows that mathematics and culture in a region must have condition, namely that the culture in that region is related to mathematics (Khairunnisa et al., 2022) so ethnomathematics can also be interpreted as mathematics practised by a particular society. In line with this, ethnomathematics can be said to be a way of studying mathematics by involving local cultural activities to make it easier to understand mathematical concepts (Sarwoedi et al., 2018). Ethnomathematics is an alternative to bridging understanding related to mathematical concepts through culture and daily life in the surrounding environment (Kurniawan et al., 2019). Ethnomathematics has revealed mathematical concepts in traditional games, such as number operations, plane geometry, congruence, and comparison (Syarmadi & Izzati, 2020; Zulviansyach et al., 2023). Ethnomathematics explores the relationship between mathematics and culture that mathematics emerges from daily activities (I. Wahyuni et al., 2023).

This research aims to analysis of mathematical concepts in the traditional *Palak Babi* game. This research will analyze how the game is reflected in mathematical concepts. The mathematical concepts represented in the traditional *Palak Babi* game expected to provide new insights in development of more contextualized mathematics learning strategies, especially in formal education. The integration of local cultural heritage with mathematics learning has great potential in enriching learning experiences and broaden understanding of mathematics, but also as an inseparable part of daily life. By exploring the traditional *Palak Babi* game through an ethnomathematics lens, it is hoped that this research can provide a broader picture of how mathematical concepts are embedded in local culture, as well as how they can be integrated into the broader context of mathematics education.

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## 2. Methods

The research method used descriptive qualitative to analyze the mathematical concepts involved naturally in the traditional *Palak Babi* game. The research was carried out in one of the regencies in Bengkulu, namely Rejang Lebong Regency. The research subjects were children who played the traditional *Palak Babi* game in Rejang Lebong Regency. Data collection was carried out by direct observation and interviews.

Direct observations were conducted during the traditional *Palak Babi* game. The researcher was actively involved in the game, pay attention to the interaction between players, record the processes and strategies used in the game. Meanwhile, interviews were conducted with the traditional *Palak Babi* players and people who have in-depth experience related to the traditional game. The interview aims to gain a deeper understanding of how mathematical concepts are reflected in the game.

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## 3. Result & Discussions

The research shows that the traditional *Palak Babi* game is a cultural wealth reflected in the game originating from Bengkulu Province. This game is played simply by utilizing objects around you and

naturally, without realizing it, mathematical concepts have been found. The following is a detailed interview excerpt regarding the traditional *Palak Babi* game:

- Researcher : *Apo yang mbah tau dari Permainan Palak Babi?. (What is known about Palak Babi Game?).*
- Source : *Permainan Palak Babi tuh permainan pas mbah kecil yang awalnya nyongkel kayu anak di lubang. (Palak Babi is a childhood game that initially gouged the child's wood on the hole).*
- Researcher : *Mbah kapan terakhir mainnyo?. (When did you last play Palak Babi?).*
- Source : *Itu sekitar tahun yang nampak bejalan itu tahun kecilnyo mbah tahun 60an sampai 70an tu masih ado, setelah 70an tu lah langkah nian. (When I was a kid around 1960-1970. After 1970 it was rare).*
- Researcher : *Untuk mainnyo ado berapa orang mbah?. (How many people are there to play?).*
- Source : *Mainnyo itu biso 2 orang, bisa jugo lebih dari 2 orang. (Can be played with 2 or more people).*
- Researcher : *Mainnyo pakek kayu apo mbah?. (What wood to use when playing?).*
- Source : *Main pakek kayu apo bae biso, rotan biso, kayu pucuk ubi biso yang besekat tuh samo yang penting kayunyo lurus lah. (The wood used is any wood, it can be rattan wood or yam wood that is insulated and most importantly straight).*
- Researcher : *Ukuran kayunyo cakmano mbah?. (What is the size of the wood?).*
- Source : *Yang anaknyo tuh paling 15 cm, sejengkal lah, yang tongkat panjangnyo kiro-kiro setengah meter, paling idak 3 jengkal lah. (The size of the child's wood used is about 15 cm/1 span and the wooden stick is about 1/2 meter/3 spans).*
- Researcher : *Cakmano sistim mainnyo mbah?. (How is the playing system?).*
- Source : *Jadi sistimnyo tuh, awalnya suit dulu lah siapa yang deluan dulu, cuman awalnya main tuh kan di congkel, sudem di congkel, anaknyo telemparkan, pas nyo jatuh dilempar lagi ke lobang, kagek siapa yang dekek lobang, itulah yng main pertama. (The playing system is initially suit first to determine who is the first to gouge. At the beginning of the game, the child's wood is gouged until it falls down and thrown back towards the hole and whoever is near the hole will play first).*
- Researcher : *Lobangnyo cakmano mbah, untuk apo?. (What is the hole used for?).*
- Source : *Posisi lobangnyo tuh kiro-kiro 10-15 cm lah kedalamannyo, yo supaya mudah nyongkel kayu tuh. (The hole is about 10 until 15 centimeters deep to facilitate prying the wood).*
- Researcher : *Kan tadi udah tau siapa yang main pertama, laju mbah cakmano?. (Now that you know which player is playing first, what's next?).*
- Source : *Kayu anak tuh diletak di ate lubang agak masuk ke dalam laju dipukul kek tongkat kayu induk tadi yang panjang, sudem dipukul melentingnyo kan, kalo cuma satu kali reken bisa di hantam langsung, kalo nak hitungannyo 2, itu 2 kali dilentingkan baru di hantam, misal melenting sampe 5 kali baru dipukul kuek ke arah depan, kagek hasilnyo tu dari tongkat 1 ukuran itu kalo kito 5 kali dilentingkan sebelum dipukul jauh itu 5 kagek dikalikan.. (The child's wood is placed on the hole and then hit until the child's wood bounces up, if the wood bounces once, it can be hit immediately, if you want 2 counts then the wood is bounced twice then hit. Suppose the child's wood bounces 5 times and then is hit strongly towards the front so that the result of a child's stick of 1 size will be multiplied by 5).*
- Researcher : *Nah kan mbah ngecek tadi nyo dikalikan sesuai berapa kali kayu tuh melenting, ukuran apo yang dikalikan tuh mbah?. (Earlier it was said that it will be multiplied when the number of times the wood bounces, what size is multiplied?).*
- Source : *Ukurannyo tuh jarak sampe dimano dio jatuhnya kayu anak atau kayu kecil. Cuman misal ukuran jaraknyo 10, kalo satu kali melenting, dapek 10 poin nyo, kalo 2 kali melenting kalikan bae kek 2 jadi 20 poin nyo dapek. (The distance at which the child's wood falls. Suppose the distance size is 10, if one bounce will get 10 points, if two bounces will be multiplied by 2 to get 20 points).*
- Researcher : *Jarak pas kayu anak jatuh tuh diukur kek apo mbah?. (What is the distance when the child's wood falls?).*
- Source : *Diukur kek tongkat kayu induk, kayu yang panjang tuh, seberapa jengkal kayu ke arah lubang terus di itungkan, abis di hitung kalikan yang cak tadi mbah kecek. (Measured*

- using a long main wooden stick, counted according to how many inches in the direction of the hole, summed up and then multiplied as described earlier).
- Researcher : *Peran yang main tu apo ajo mbah?. (What roles do you play?).*
- Source : *Ado yang nyongkel, ado yang nangkok jugo. Nah yang nangkok tu kelak kalo nyo dapek nangkok nyo harus lempar ke arah lobang, yo ngelemparnya dimano dio dapek, laju geknyo dapek tambahan poin tu dari nyo lempar, ngitungnyo samo cak tadi tula. (Some gouge and some stand guard to catch the wood. If the wood is caught then it will be thrown back towards the hole, the throw is made where the wood is caught and will be an additional point for him).*
- Researcher : *Mainnyo dimano tuh mbah?.(Where to play?).*
- Source : *Mainnyo di biso taman, lapangan, biso di jalan, yo jalan yang masih berupa tanah, mainnyo khusus di tanah itu kan mainannyo orang desa. (The game can be played in the park, field, street. The road is dirt because the game is specialized in dirt and is a village game).*

Based on the results of interviews with *Mbah* Sugiono, who is known as a 70 year old community elder in the Curup area of Rejang Lebong Regency, the traditional *Palak Babi* game is a childhood game of villagers that has existed since 1960, which is played by gouging child's wood using the main wood in the hole. The beginning of the game is done by suit first, then each player gouges the wood and throws it back towards the hole and the wood near the hole will play first. The hole is used to make it easier for players when pry child's wood. The traditional *Palak Babi* game can be played in the yard, field and on the road. The road in question is made of land because this traditional game is specifically played on the ground. The tools used to play the traditional *Palak Babi* game are two sticks, namely the main wooden stick and a child's wood stick. The main wooden stick is a long wood used for gouging and measuring, while the child's wood is short wood that is gouged. The wood used for playing uses straight wood such as rattan wood and sweet potato wood. This traditional *Palak Babi* game can be played with 2 or more players.

The rules of the traditional *Palak Babi* game have two stages, in the first stage the player gouges the child's wood stick using the main wooden stick from the bottom towards the front. When the child's wood falls, the value will be calculated from the distance where the child's wood falls towards the hole and then measured using the main wooden stick. The first stage is done alternately, then the second stage is done with the child's wood placed obliquely in the hole on the ground, then the player hits the wood with the main wooden stick. When the child's wood bounces upwards, the player must hit it towards the front where the other players stand guard and get ready to catch the child's wood. If a player who is new to playing this traditional game will bounce the child's wood once upwards and then hit it immediately while experienced players can bounce the child's wood more than once and then hit it. The child's wood that is not caught by the guard will be calculated based on the distance where the child's wood falls towards the hole using the main wooden stick. If it is caught by the guard, it will be thrown back towards the hole, which is thrown at the place where the child's wood was caught. When the child's wood enters the hole, the guard gets an additional value, when it does not enter the hole, the player gets an additional value calculated from the distance of the throw back towards the hole. The second stage is carried out alternately for players and guards.

In the rules of the traditional *Palak Babi* game there is a way when there are more players. This can be done in groups, where groups are formed as a team of players and a team of guards who play alternately. The stages carried out are the same as the rules of the traditional *Palak Babi* game. The difference with the group way is that when one player in the group fails to perform in the second stage of the game, it will be replaced by another group member and when the player group cannot perform the second stage, players will switch roles with the guard team. The traditional *Palak Babi* game is carried out to collect the most value when playing to determine the winner of the game with players conducted individually and players with groups

The player who is declared the winner is the player who has the most points. The value obtained from the results of the furthest throwing distance calculated using the main wooden stick, then the value of the most bounce of the child's wood multiplied by the results of the throwing distance and additional value of the player or guard when successfully catching and then inserting the child's wood into the hole then when unsuccessful in inserting the child's wood. The value will be accumulated from the stages in the rules of the traditional *Palak Babi* game. According to research conducted, the traditional *Palak Babi* game found

a number of simple mathematical concepts that are naturally involved in this game. These concepts include measurement, comparison, addition, multiplication and angles. A more detailed analysis of each of these concept follows:

### 3.1 Measurement

Measurement is a process or event to identify the size, length, or weight of an object (Amalia et al., 2022). The concept of measurement using body parts is often done as a quick distance estimation technique without the help of measuring instruments. Length measurements can be done using non-standard units and standard units. One example of non-standard object measurement is the hand span, which is the distance between the tip of the thumb and the tip of the little finger when stretched out. The way to estimate the distance with spans is to measure how many spans are needed to reach the distance/length of the object you want to estimate. Measurements are made with spans using a main wooden stick in the traditional *Palak Babi* game.

The traditional *Palak Babi* game uses two types of wood of different sizes as tools used during the game. The main wooden stick is used not only as a tool to pry the child's wood but also as a tool to measure the distance from where the child's wood falls to the initial hole. This shows that one tool, namely the main stick, has multiple functions in the game. The use of the same stick for gouging and measuring distance shows how the game utilizes a simple tool with multiple functions. The traditional *Palak Babi* game contains the concept of measurement, where players must estimate the distance they must travel to achieve the goal in the game, which is to get the most scores and become the winner Through the measurement concept contained in the traditional *Palak Babi* game, it can be seen that players indirectly have measurement principles in the rules and process of playing.



**Figure 1.** (a) The players hitting a child's wood, (b) Measurement of throwing distance

The traditional *Palak Babi* game is played by prying the child's wood using the main wooden stick in Figure 1 (a). After prying, the wood will be thrown forward and fall to the ground. Then the distance of the throw from the hole to where the child's wood falls will be calculated. The size of the throwing distance determines the value obtained by the player when gouging, as well as when hitting a child's wood at an angle or slightly stuck to the ground, the wood will bounce up and then will be hit forward and fall to the ground as well. The distance of the throw will also be measured with the main wooden stick in the towards the hole.

The main wooden stick is used to pry, hit and measure the distance of the throw, while the child's wood functions as the wood to be pryed and hit and as a reference for measurement limits. The size of the distance will be calculated with a main wooden stick that measures about 3 spans. This will be done alternately according to the number of players. Measurement the main wooden stick towards the hole in Figure 1 (b).





### Figure 2. Gouging hole making

The hole made for playing the traditional *Palak Babi* game is to gouge out the child's wood in Figure 2. The hole is made in this game at an approximate depth so that when the child's wood is placed in the hole, it is still visible from outside the hole and does not sink. The size of the hole is approximately half an inch or around 10 to 15 centimeters which is made. This is used to make it easier for players when prying the child's wood and hitting the wood attached at obliquely to the hole.

### 3.2 Comparison

Comparison is comparing two or more quantities in simple form (R. Wahyuni & Prihatiningtyas, 2020). Comparison refers to the process of comparing two or more things to see similarities, differences, or relationships. The size of an object, and the number of players and guards are also included in the comparison. In the traditional *Palak Babi* game, one player picks the child's wooden stick and two other people as guards in Figure 3. This shows that there is a 1:2 ratio in the game between players and guards



Figure 3. Players and Guards

Players and guards take turns playing according to the player's agreement. The guard is also the player who gouges and will alternate positions until everyone has played. The process of the traditional *Palak Babi* game when the gouged child's wood is caught by the guard will be thrown back towards the hole. The throwing is done at the place where the child's wood is caught and then the distance will be measured using the main wooden stick.



Figure 4. Wood size comparison

The use of the main wooden stick (around 3 spans) and the child's stick (around 1 span) in the game is shown in Figure 4. It can thus be concluded that the size of the main wooden stick and child's stick have a ratio of 3:1. This shows a fixed proportion between the two wooden sticks used in this game. With the longer size of the main wooden stick, players can reach it when prying and hitting the child's wood. In playing the traditional *Palak Babi* game, the players must pry the child's wood to get a long throwing distance using the main wooden stick. A longer throwing distance does not mean the main wooden stick must be longer, it will not affect it because it depends on the strength of the player when playing.

### 3.3 Addition

The traditional *Palak Babi* game on the concept of addition appears especially in calculating the value obtained by the player. Addition is the addition of one or more numbers to the result of a number referred

to as the sum (Khirawati, 2017), so addition refers to the concept of combining or adding two things. The addition is done when the player gouges the child's wood using the main wooden stick and when the child's wood falls, it will be counted how many spans in the direction of the hole with the size of the main wooden stick. The result of the number of spans is the value obtained by the player. For example, a player succeeds in adding up the distance of 10 spans to the hole. Based on the game rules, the sum of the scores from each player determines the winner in the traditional *Palak Babi* game. The calculation process can be seen in Figure 5.



**Figure 5.** Counting with Span of Sticks

### 3.4 Multiplication

The concept of multiplication arises with the gradual calculations that players make when calculating values. Multiplication is the calculation of one number that will be multiplied by the multiplier number (Indriani et al., 2022). Therefore, multiplication is the basis for multiplying or combining two or more numbers into one number. The calculation is done when the player hits the child's wood that is placed at an angle in the hole and the child's wood bounces up, it will be counted as one number. If the wood bounces up more than once, for example, 2 times, it is counted as 2 numbers.



**Figure 6.** Wood being struck

The next stage of the child's wood will be hit towards the front as shown in Figure 6. When the child's wood falls to the ground, counting will be done with the main wooden stick. Just as with the concept of addition, the concept of multiplication shows that the calculation done with the number of spans will be multiplied by the size of the main wooden stick. For example, if the distance is 10 spans and once bounces, it will be count 1 times 10 spans, while when it bounces fifth it will count 5 times 10 spans to get 50 spans.

### 3.5 Angles

The traditional *Palak Babi* game contains the concept of angle when players gouges the child's wood. The concept of an angle is an area formed by two intersecting lines. It can be seen that the main wooden stick that gouges the child's wood is positioned at an angle to the ground in the hole and the main wooden stick that is used is straight. This shows that there is a slope to pry the child's wood in playing so that the child's wood is thrown, it must position the main wooden stick with a slope of less than 90 degrees. In general, an angle of less than 90 degrees is an acute angle (Marina & Izzati, 2019).



**Figure 7.** Position for prying

The angle required by the player aims to make it easier for the player when prying the child's wood in Figure 7. The main wooden stick if positioned too obliquely, the child's wood will be thrown up which makes it fall closer, while if it is in a comfortable position for the player, it will be easy to direct the force by the impulse resulting from the gouge will result in the distance the player estimates, which is a long throw.

The traditional *Palak Babi* game from Bengkulu Province is a cultural heritage rich in noble values and contains mathematical concepts that need to be preserved and developed. Steps that can be taken are to document in detail the procedures of the game, its history, and the values contained in it. Furthermore, this game can be digitized through video tutorials or playing guides that can be disseminated through platforms such as YouTube or social media that are attractive to the younger generation. To maintain its sustainability, it can be done by organizing tournaments or festivals of traditional games. In addition, schools can also be involved by holding an inter-class or inter-school Traditional *Palak Babi* Game Competition.

The traditional *Palak babi* game can be integrated into the educational curriculum. This can be done by developing a learning module that combines this game with the mathematical concepts contained in it. The game can also be used as an interactive learning medium in math lessons at school. Teachers are encouraged to use it as a teaching aid in explaining abstract mathematical concepts.

The involvement of the community and community leaders is also very important. Elders or community leaders can be involved to practice and teach the traditional *Palak babi* game to the younger generation. Cultural events or festivals where traditional games can be played and promoted can also be organized. Cooperation between communities, schools and government agencies in the preservation and development of traditional games should be encouraged.

Through these efforts, the traditional *Palak Babi* game will not only be preserved, but can also be an effective medium to convey mathematical concepts to the younger generation. They can understand math concepts in a fun and interesting way, and appreciate local cultural heritage as well as a medium to learn mathematical concepts practically and contextually.

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#### 4. Conclusion

The traditional *Palak Babi* game is part of the culture originating from Bengkulu Province that is played from generation to generation by the community which has links to mathematical concepts. The concept of traditional *Palak Babi* game implements natural mathematical concepts such as measurement, comparison, addition, multiplication. These concepts are involved in the rules of the game. This shows that the traditional *Palak Babi* game is part of ethnomathematics which is a reflection of mathematical activities that grow in culture. The traditional *Palak Babi* game from Bengkulu needs to be preserved and developed by documenting, digitizing, holding tournaments/festivals, integrating into the school curriculum, involving communities/community leaders, and holding cultural events. Cooperation is very important in the effort to preserve and develop the traditional *Palak Babi* game, so that it not only remains sustainable but can also be an effective medium to convey mathematical concepts to the younger generation.

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