

## Natural Physics Laboratory: Ethnoscience Perspective on the Simbang Batu Game of the Rokan Hulu

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### ABSTRACT

This research aims to describe the ethnoscience values contained in the traditional Simbang Batu game of the Rokan Hulu community, identify the physics concepts that appear in the game, and explain its potential as a source of physics learning based on local culture. Research with qualitative methods of ethnographic research. Data were obtained through participatory observation, in-depth interviews, documentation, and literature studies. The research informants were selected using *purposive sampling techniques*, namely community leaders, cultural actors, and people who understand the Simbang Batu game. The data analysis uses the interactive model of Miles and Huberman, while the validity of the data is by triangulation of sources and techniques. The results of research on the traditional Simbang Batu game contain various physics concepts, including the equilibrium of rigid objects, center of mass, gravitational force, frictional force, pressure, and system stability. This shows that society has applied the principles of physics in culture without using formal scientific terminology. In addition, the Simbang Batu game has the potential to be a source of contextual physics learning that connects abstract concepts with students' cultural experiences

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## INTRODUCTION

Science education emphasizes the importance of contextual, meaningful, and relevant learning to students' lives. The integration of local culture into learning is one of the effective approaches to improve science literacy while building students' cultural identity. The ethnoscience approach views that local communities have empirical knowledge that develops through life experiences and is passed down from generation to generation. And contains scientific values that are studied academically in modern science learning. Ethnoscience-based learning not only helps students understand science concepts through real experiences, but also contributes to the preservation of local culture amid the current of educational modernization (Parmin et al., 2020; Rahmawati et al., 2022).

Physics as part of ethnoscience is often considered abstract because it contains many mathematical concepts and phenomena that are difficult for students to understand if they are not associated with the surrounding environment. The low connection between physical concepts and everyday experiences causes students to have difficulty understanding concepts in depth. Therefore, learning innovations are needed that connect the concept of physics with the culture of the local community. One form of implementation of contextual learning is through the use of traditional games as a learning resource based on local culture. Traditional games contain various scientific concepts such as style, motion, balance, energy, momentum, coordination of motion, and interactions between objects that can be analyzed through a physical perspective (Dewi et al., 2021; Sumarni et al., 2023).

Traditional games are cultural heritage that represents the social values, skills, and local knowledge of the community. However, the development of digital technology and changes in people's lifestyles have caused the existence of traditional games to decrease among the younger generation. This condition not only has an impact on the fading of local culture, but also leads to the loss of actual contextual learning resources that are full of educational and scientific value. Local culture has an important role in the development of continuing education, in traditional knowledge that can be integrated into the modern education system (UNESCO, 2022).

The traditional game of the Rokan Hulu people that is still known in life is *the Simbang Batu* game. The game is performed by arranging and maintaining the balance of the stones using movement skills, precision, and body coordination. The game phenomenologically shows the existence of physical concepts such as the balance of rigid bodies, center of mass, gravitational force, frictional force, pressure, and system stability. In an ethnoscience perspective, the *Simbang Batu* game represents the local knowledge of the community that develops empirically through cultural experience without formal scientific formulation, but has a close relationship with the principles of modern physics. The study of this game is interesting because people have indirectly applied physics concepts in their daily cultural activities.

Research on ethnoscience in science learning has developed in recent years, particularly in the study of local culture as a source of science and physics

learning. Previous research has shown that ethnoscience-based learning is able to improve science literacy, concept comprehension, critical thinking skills, and student involvement in learning (Khoiri et al., 2021; Putra et al., 2022). However, most of the research still focuses on cultural exploration in general and has not specifically examined the traditional games typical of the Malay community in Riau, especially the Simbang Batu game of the Rokan Hulu community. In addition, studies that link the traditional Simbang Batu game with physical concepts from an ethnoscience perspective are still very limited, so it shows that there is something important to study further.

This research contributes to the enrichment of ethnoscience studies in physics education through the exploration of physics concepts contained in the traditional Simbang Batu game of the Rokan Hulu community. The novelty of research on the disclosure of local traditional games has not been widely researched as a source of physics learning based on Malay culture.

## **LITERATURE REVIEW**

### **Ethnoscience**

Ethnoscience is a learning approach that integrates local knowledge and community cultural practices into the science learning process. The concept of ethnoscience emphasizes that local communities have empirical knowledge that develops through interaction with nature and its environment, which can then be reconstructed into scientific concepts in formal education (Parmin et al., 2020). In science learning, ethnoscience functions as a bridge between modern scientific knowledge and cultural experiences that are close to students' lives so that learning becomes more contextual, relevant, and meaningful (Rahmawati et al., 2022).

In physics learning, the ethnoscience approach is widely applied to explore scientific concepts contained in traditional games, local technologies, cultural rituals, and community activities. Ethnoscience-based learning is able to improve concept understanding, science literacy, and student learning motivation because students can relate physics concepts to real experiences in daily life (Khoiri et al., 2021; Putra et al., 2022). In addition, ethnoscience also contributes to preserving local wisdom and strengthening students' cultural identities in the midst of globalization and modern technological developments (UNESCO, 2022).

Traditional games are seen as an important form of local wisdom that contains hidden scientific principles. Activities involving balance, motion, style, and coordination in traditional games can be analyzed using physical concepts such as balance, gravity, momentum, friction, and motion (Afkarina & Sudarti, 2021). Therefore, the exploration of the traditional Simbang Batu game from an ethnoscience perspective is important as an effort to preserve culture, and as a form of enrichment of contextual physics learning resources that are relevant to students' lives.

Several previous studies support the effectiveness of ethnoscience integration in science learning. Dewi et al. (2021) found that ethnoscience-based physics learning is able to improve students' understanding of concepts and involvement in the learning process. The integration of local wisdom in science

learning is able to strengthen students' contextual thinking and scientific reasoning skills.

### **The Relationship of Physics with the Traditional Game of Simbang Batu**

Traditional games are part of the cultural heritage of the community which not only has social and cultural value, but also contains educational elements that can be used in the learning process. In science education, traditional games are beginning to be studied as a source of contextual learning because they allow students to understand scientific concepts through real-life experiences that are close to everyday life. The local culture-based learning approach is considered to be able to increase student involvement in understanding science concepts in a more meaningful way because learning is associated with cultural experiences that are familiar to students (Parmin, 2017; Sudarmin, 2014).

One of the traditional games that has a connection with the concept of physics is Simbang Batu, which is a game of arranging stones in stages to form a balanced arrangement without the use of adhesives or additional tools. This activity requires precision, skill, and good observation of the shape and position of the stone so that the arrangement can survive and not collapse. Even though it is done traditionally, this game actually shows the application of physics principles in daily life, especially in the aspects of object mechanics and structural stability (Haryadi & Pujiastuti, 2020; Serway & Jewett, 2019).

The most fundamental relationship between physics and the game of Simbang Batu lies in the concept of the equilibrium of objects. In physics, equilibrium refers to the conditions when an object can maintain its position without experiencing a change in motion or loss of stability. In the Simbang Batu game, players must place stones in a certain position so that the entire arrangement remains standing and does not fall. The process of finding the right position indicates the intuitive application of the concept of balance by the player (Halliday et al., 2018).

When arranging stones, players usually try several positions until they find the arrangement that is considered the most stable. This phenomenon shows that the stability of an object is greatly influenced by the way it is arranged and the relationship between the parts that support each other. In the context of physics learning, this phenomenon can be used as a concrete example to explain the concept of the balance of objects that has often been considered abstract by students (Giancoli, 2014; Young & Freedman, 2020).

In addition to equilibrium, the Simbang Batu game is also related to the concept of the center of mass or the point of balance of an object. Each object has a specific point that greatly affects its stability. In the Simbang Batu game, players naturally look for the position of the stones that allow the weight of the stones to be evenly distributed so that the arrangement remains solid. The more precise the position of the stone, the more likely it is that the arrangement can last for a long time (Tipler & Mosca, 2015).

Stones that have an irregular shape are usually more difficult to arrange than stones that have a flat surface. Therefore, players often do repeated experiments before finding the best position. This activity shows that the balance

of an object is highly dependent on the proper weight distribution and position of the support. Experiential learning like this is considered to be able to help students understand physics concepts more concretely than learning that is only theoretical (Sudarmin, 2014; Serway & Jewett, 2019).

The Simbang Batu game also shows the influence of gravity in daily life. All objects on earth are affected by the gravitational pull which causes objects to tend to move downwards. In the context of this game, gravity is the main factor that causes stones to fall if the position of the arrangement is unstable or unable to support the weight of other stones (Halliday et al., 2018).

Players must indirectly consider the influence of gravity when composing stones. The improper position of the stone will make the arrangement easy to collapse because the weight of the stone is not distributed properly. Instead, a balanced arrangement indicates that the player managed to set the position of the stones so that the influence of gravity did not directly cause the collapse of the structure. This condition shows that physical phenomena can be studied through simple cultural activities that are close to people's lives (Giancoli, 2014; Young & Freedman, 2020).

In addition to gravity, the Simbang Batu game is also related to the friction force that occurs between the surface of the stone that touches each other. Rough rock surfaces tend to provide better stability because they can reduce the chance of rocks shifting. In contrast, rocks with slippery surfaces are more difficult to arrange because they are more prone to slipping so that the arrangement collapses quickly (Serway & Jewett, 2019).

This phenomenon shows that the material characteristics of objects also affect the stability of the system. In physics learning, the concept of friction force is often understood as an obstacle to motion, but in the Simbang Batu game, friction actually helps maintain the position of objects so that they remain stable. Therefore, this game can be used as a contextual example to explain the function of friction force in everyday life (Halliday et al., 2018; Tipler & Mosca, 2015).

The stability of the stone arrangement in the Simbang Batu game is not only influenced by one factor, but is the result of the interaction of various conditions such as the shape of the stone, the size of the stone, the position of the placement, and the area of the focus field. Players usually choose larger or flatter stones as the base because they are considered to be able to support other stones better. The better the foundation of the arrangement, the higher the level of structural stability produced (Young & Freedman, 2020).

In physics, system stability has to do with the ability of an object to maintain its position when it receives minor disturbances from the environment. The Simbang Batu game shows that stability is affected by a harmonious arrangement between all components. This phenomenon can be an effective learning medium to help students understand that balance and stability are the result of various interconnected factors (Giancoli, 2014; Serway & Jewett, 2019).

The study of ethno-physics or ethno-physics explains that various cultural activities of the community actually contain physical principles that can be used as a source of scientific learning. The ethno-physics approach seeks to connect local culture with modern science concepts so that learning becomes more

contextual and meaningful. In this context, the Simbang Batu game can be seen as a representation of cultural practices that contain elements of mechanics and balance of objects (Sudarmin, 2014).

The use of traditional games in physics learning not only helps students understand scientific concepts, but also supports the preservation of local culture that the younger generation is beginning to abandon. Cultural integration in learning is considered to be able to increase learning motivation, student involvement, and conceptual understanding of physics materials because students learn through phenomena that are close to their social environment (Parmin, 2017; Haryadi & Pujiastuti, 2020).

## METHODOLOGY

This research uses a qualitative approach with the type of ethnographic research. This approach was chosen because the research aims to examine in depth the ethnoscientific values and physical concepts contained in the traditional Simbang Batu game of the Malay community in Rokan Hulu. Ethnographic research allows researchers to understand the cultural activities of the community naturally through direct observation of traditional game practices that are inherited from generation to generation.

The research location was carried out in Rokan Hulu Regency, Riau Province, with a focus on people who are still preserving the traditional Simbang Batu game. The research subjects consist of community leaders, cultural actors, traditional game players, and several community members who understand the history and procedures of the Simbang Batu game. The selection of informants was carried out using *the purposive sampling technique*, which is the selection of samples based on certain considerations according to research needs. The criteria for informants include individuals who have knowledge, experience, and direct involvement in the traditional Simbang Batu game.

Data collection techniques were carried out through participatory observation, in-depth interviews, documentation, and literature studies. Participatory observation is used to directly observe the Simbang Batu game process, including player activities and interactions that occur during the game. In-depth interviews were conducted with informants to obtain information about the cultural meaning, rules of the game, and public understanding of the game. Documentation is used to collect data in the form of photographs, field notes, and game activity recordings as supporting data for research. In addition, literature studies are conducted to strengthen theoretical analysis related to ethnoscience, ethnophysics, and physics learning based on local culture.

The main instrument in this study is the researcher himself as a human instrument that plays a role in collecting, analyzing, and interpreting research data. The supporting instruments include observation guidelines, interview guidelines, documentation sheets, and field notes. Observation guidelines are used to identify game activities that contain physics concepts, while interview guidelines are used to explore information about cultural values and local knowledge of the community related to the Simbang Batu game.

The data analysis technique in this study uses the Miles and Huberman interactive analysis model which includes data reduction, data presentation, and

conclusion drawing or verification. Data reduction is carried out by selecting and simplifying data from observations, interviews, and documentation according to the focus of the research. The presentation of data is carried out in the form of narrative descriptions, tables, and interpretations of physics concepts found in the Simbang Batu game. Furthermore, conclusions are drawn through a data interpretation process to identify the ethnoscience values and physics concepts contained in the game as well as its potential as a source of physics learning based on local culture.

The validity of the data in this study was tested using source triangulation and triangulation techniques. Source triangulation is carried out by comparing information from various informants, while technical triangulation is carried out by comparing the results of observations, interviews, and documentation. This technique aims to increase the validity and credibility of the data so that the results of the research can be scientifically accounted for.

## RESEARCH RESULT

The results of the research based on participatory observations, in-depth interviews, and field documentation, obtained that the Simbang Batu game functions as a community entertainment activity, but also contains various scientific concepts that are relevant to the learning of contextual physics based on local culture in Figure 1.



Figure 1. Children Play Simbang Batu (TGR, 2020)

Figure 1 explains that when playing Simbang batu, stones are arranged from the widest surface to the smallest to the top, usually many stones have odd numbers, namely 5, 7, and 11.

The Simbang Batu *game* is by arranging several stones in tiers and maintaining their balance in a certain position (Asra & Akmal, 2021; Kesumah et al., 2025). Players must pay attention to the shape of the stone, the fulcrum point, the mass distribution, and the stability of the arrangement so that the stone does not fall. This states that there is a physical concept in the local cultural practices of the Rokan Hulu Community (Afkarina & Sudarti, 2021; Astuti et al., 2022).

Simbang Batu also has strong social and cultural values in the life of the Rokan Hulu Malay community (Suryani & Agung, 2021; Zulkarnaen & Handayani, 2023). Based on the results of interviews with community leaders, this game teaches the values of precision, patience, cooperation, and the ability to think strategically. These values are part of local wisdom that is inherited from generation to generation through community cultural activities.

## Physics Concepts in the Simbang Batu Game

Based on the results of ethnophysical analysis, several main physics concepts contained in *the Simbang Batu* game were found, namely:

### Balance at Simbang Batu

The equilibrium of rigid objects is seen when the stone arrangement is able to survive in a stable position without displacement or falling (Yusuf & Fitriani, 2024). In *the Simbang Batu* game, players indirectly apply the principle of balance by placing stones in a certain position so that the resultant force and the moment of style are in a balanced state. The concept of equilibrium can be explained through the equation:

$$\sum F = 0 \text{ and } \sum \tau = 0$$

That is, an object will be in a balanced state if the resultant force and the resultant moment of force acting on the object are equal to zero.

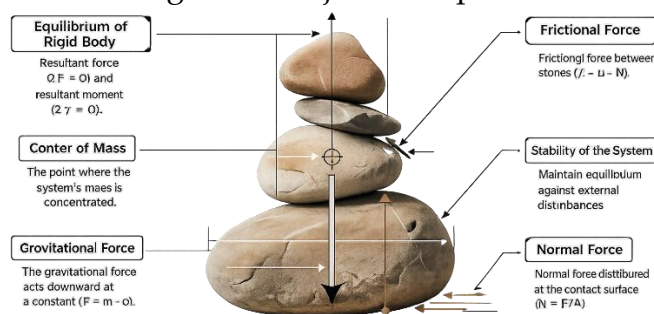


Figure 2. Anatomy of Balance in Simbang Batu

Figure 2 explains the traditional game of stone balance, it can be seen that the arrangement of stones seems simple, only in the form of several stones stacked until they stand balanced. However, it requires precision and a natural understanding of balance. In the picture, it can be seen that each stone is arranged in a certain position so that it can support the other stones without falling. When the stone arrangement is able to survive in a stationary state because the forces at work balance each other.

The stone is arranged, there is a concept of a center of mass factor that determines whether the stone can remain standing or not. A person who plays simbang stone will usually try to place the stone in the right position so that it does not collapse easily. Indirectly, it is related to the location of the center of the mass which must be in a safe position above the focus plane. If the position of the stone is too tilted or the center of weight shifts too far, then the balance will be disturbed and the stone arrangement will fall. Therefore, the game trains patience, precision, and the ability to estimate the right position even if players may not realize that they are applying the principles of physics.

The force of gravity also affects the game of Simbang batu, which is always pulling the stone downwards. Each stone has a weight that makes the rock underneath it press. The arrangement can still survive because there is a holding force from other stones that helps maintain balance. In real life, players usually choose stones with a certain shape to make them easier to arrange. Stones that have a flatter surface are generally more stable than stones that are too slippery

or unbalanced in shape. This shows that traditional play experiences also teach a practical understanding of how objects work in nature.

The frictional force between the surfaces of the stone also helps to keep the arrangement stable. The surfaces of the stones that come into contact with each other create small obstacles that prevent the stones from shifting easily. If the surface is too slippery, the stone will move faster and the arrangement will be difficult to maintain. Therefore, in the game of stone balance, players often have to try several times to find the most solid position. The process of trying, failing, and then fixing the stack becomes a natural part of the game while also showing how the principle of stability works in real life.

### Law of Equilibrium of Rigid Objects

When someone stacks stones in a game of stone balance, often players have to try several times until they find a position that fits perfectly so that the stones do not fall. This process actually shows the existence of the principle of rigid equilibrium in physics. To make it easier to understand, the following figure shows how an arrangement of stones can collapse when the forces are unbalanced and how the arrangement can remain solid when all the forces work in a balanced manner as Figure 3.

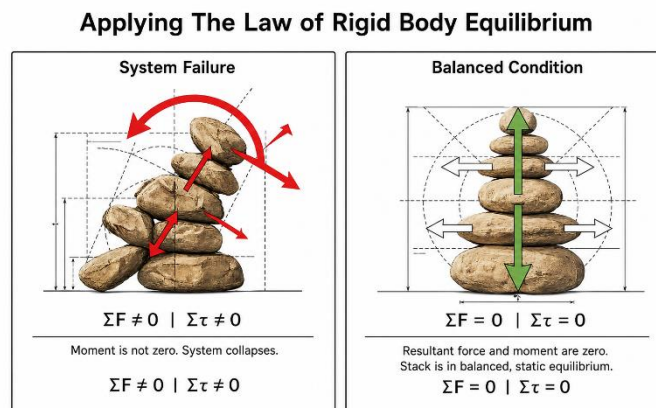


Figure 3. Locking the Stone Junction to Be Balanced with the Legal Concept of Rigid Object Equilibrium

Figure 3 shows a comparison between an unstable rock arrangement and a balanced rock arrangement. On the left side of the image is shown the condition of system failure, which is an arrangement of stones that is unbalanced so that it has the potential to collapse. The red arrows pointing to different sides illustrate that the forces acting on the stone do not balance each other. As a result, the stone arrangement loses its stability and begins to move from its original position. This condition shows that if the stone is not located correctly or the load distribution is uneven, the system will easily collapse because it is unable to maintain its balance.

In the context of the traditional game of stone balance, the conditions on the left side of the image illustrate a situation when the player is not precise in arranging the stones. Stones that are too tilted or the position of the pile that are not suitable cause the weight of the stone to not be distributed properly. As a result, the center of mass tends to exit the pews area so that the arrangement

becomes unstable. This often happens when players are in a hurry or are not careful in placing stones. In other words, the success of the game depends not only on the shape of the stone, but also on the player's ability to estimate the safest position for the array to survive.

The right part of the image shows a balanced condition, which is a state when the stone arrangement can stand stably without displacement. The vertical green arrow indicates the balance of forces up and down, while the horizontal arrow represents the balance of forces from the left and right sides. In this state, all the forces working cancel each other out so that the arrangement stays in place. This explains that balance can be achieved if the position of the stone is arranged correctly and the center of mass remains above the focus plane. This shows that the stability of the stone arrangement does not occur by chance, but is the result of careful positioning arrangements. In the practice of the game of stone balance, players usually try repeatedly to find the most balanced position. The process involves observation, patience, and experience in understanding the different shapes of the stone. Therefore, this traditional game indirectly teaches the physics concept of the balance of rigid objects through real experiences that are easy for players to understand.

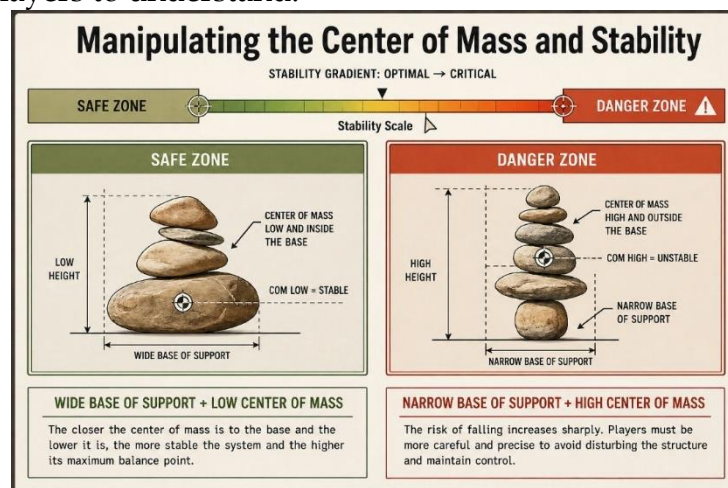


Figure 4. The Concept of Manipulation of the Center of Mass and Stability in Simbang Batu

Figure 4. Draw the concept of manipulation of the center of mass and stability in the arrangement of stones in the game or activity of arranging stones (balancing stones). Visually, compare two conditions, namely the safe zone and the danger zone based on the position of the center of mass, the area of the focus field, and the height of the rock arrangement. This analysis emphasizes that the stability of a system is greatly influenced by the relationship between the center of mass and the field of support.

In the safe zone, the stone arrangement has a wider support plane with the position of the center of mass being lower and close to the base. This condition makes the weight distribution more even, so that the gravitational force remains within the focus area. As a result, the rock arrangement becomes more stable and has a smaller risk of falling. In the concept of physics, the lower the center of mass of an object and the greater the area of its support plane, the better the balance of

the system will be because it is more difficult for the object to experience the moment of force that causes it to fall.

On the other hand, in the danger zone, the stone arrangement appears higher with a narrow base and a higher mass center. This condition causes the system to become more unstable as the slightest disturbance, such as vibration or change of position, can shift the heavy-force working line out of the focus plane. When this happens, the moment of force will increase and cause the stone arrangement to collapse easily. Therefore, arrays with a high center of mass tend to have a low level of stability.

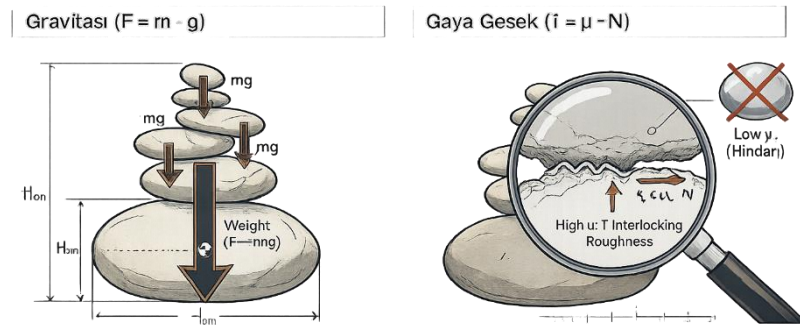


Figure 5. The Relationship Between Gravitational Force and Stone Friction Force

Figure 5. Explain the relationship between gravitational force and friction in maintaining the balance of the stone arrangement in the game or stone balancing activity. Visually, the image is divided into two main parts, namely the influence of gravity on the left side and the role of friction force on the right side. These two physics concepts work simultaneously to create stability in the rock arrangement so that it does not easily shift or collapse.

In the gravitational part ( $F = m \cdot g$ ), it is shown that each rock experiences a heavy force whose direction is always downward due to the influence of the Earth's gravity. A larger stone arrangement placed at the bottom serves as a foundation to support the weight of the stone on it. This aims to keep the center of mass close to the focus plane so that the balance of the system can be maintained. The lower the position of the center of mass and the more precise the distribution of weight between the stones, the more stable the arrangement will be and the smaller the risk of collapse.

In the friction force part ( $f = \mu \cdot N$ ), the image shows that the rough surface of the rock has an important role in preventing shifting between the rocks. The high coefficient of friction ( $\mu$ ) in coarse-textured stones allows for interlocking roughness, which is a condition when the surface of the stone locks into each other, increasing the static frictional force. As a result, the stone does not shift easily despite receiving pressure or a small change in position. In contrast, slippery stones have a low coefficient of friction that makes them easier to move around and potentially cause the array to lose balance.

## DISCUSSION

The results of the study show that the traditional *Simbang Batu* game contains various physics concepts that can be used as a source of contextual learning based on local culture (Rahmawati et al., 2022; Sumarni et al., 2023). These findings support the ethnoscience theory that local communities have empirical knowledge that develops through life experiences and interactions with the surrounding environment (Parmin et al., 2020; Snively & Corsiglia, 2020). The Rokan Hulu Malay community has indirectly applied the principles of physics in traditional games without using formal scientific terms.

The concept of rigid equilibrium found in the *Simbang Batu* game shows that players understand the importance of mass distribution and fulcrum position to keep the stone arrangement stable. This finding is in line with the research of Afkarina and Sudarti (2021) who stated that traditional cultural activities contain physical concepts that can be explained through an ethnophysical approach.

In addition, the concept of mass center and system stability in the *Simbang Batu* game shows that people have empirical abilities in determining the position of objects so that they do not fall easily. This knowledge is acquired through repeated playing experiences and passed down from generation to generation. These findings reinforce the view that local culture can be a source of scientific learning that is relevant to students' lives.

The *Simbang Batu* game also has great potential to be integrated into physics learning in schools (Prasetyo & Widiyatmoko, 2021; Haryanto & Nugroho, 2022). The use of traditional games in learning can help students understand abstract concepts in a more concrete and contextual way. This is in line with the research of Khoiri et al. (2021) which states that ethnoscience-based learning is able to improve students' understanding of concepts and critical thinking skills.

Through an ethnophysics approach, teachers can connect physics materials with local culture that students know so that the learning process becomes more interesting and meaningful. The integration of local culture in learning can also increase learning motivation, science literacy, and students' awareness of the importance of preserving regional culture (UNESCO, 2022; Rumiati et al., 2021).

In addition to contributing to physics learning, this research also contributes to the preservation of the local culture of the Rokan Hulu Malay community. Scientific documentation of the *Simbang Batu* game is one of the efforts to maintain the sustainability of traditional cultural heritage in the midst of modern technological developments and changes in people's lifestyles.

Based on the results of the research, the *Simbang Batu* game can be recommended as a source of physics learning based on local culture on the material of rigid body equilibrium, gravitational force, frictional force, pressure, and center of mass. Teachers can use these games in simple experiment activities or project-based learning to create a contextual and fun learning experience for students.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research, the traditional Simbang Batu game of the Malay community in Rokan Hulu contains various ethnoscientific values and physical concepts that can be analyzed through an ethnophysical approach. The game not only serves as a cultural activity and entertainment for the community, but also represents a form of local empirical knowledge that develops from generation to generation. The activity of arranging and maintaining the balance of stones shows the indirect application of physical principles in the cultural practices of the community.

The results of the study show that there are several main physics concepts contained in the Simbang Batu game, namely the equilibrium of rigid objects, center of mass, gravitational force, frictional force, pressure, and system stability. These concepts arise through the player's activities in determining the position of the stone, maintaining the balance of the arrangement, paying attention to the shape of the stone, and considering the area of the support plane so that the arrangement remains stable. These findings prove that local communities have empirically applied the principles of physics in everyday life even without using formal scientific terms.

In addition to contributing to the enrichment of ethnoscience and ethnophysics studies, this study also shows that the Simbang Batu game has great potential as a source of physics learning based on local culture. The integration of traditional games in physics learning can help students understand abstract concepts in a more concrete, contextual, and meaningful way because learning is directly linked to cultural experiences that are close to their lives. Thus, the Simbang Batu game is not only a medium for preserving the local culture of the Rokan Hulu Malay community, but can also be used as a physics learning innovation that supports the improvement of students' science literacy.

### Suggestions for Further Research

This research is still limited to a qualitative study on the identification of ethnoscientific values and physical concepts contained in the traditional Simbang Batu game. Therefore, further research is recommended to develop research at the stage of implementing learning in schools by integrating the Simbang Batu game as a media or physics learning model on balance, force, mass center, and basic mechanics.

The next research can also be carried out using a quantitative approach or mixed methods to test the effectiveness of the use of Simbang Batu games on improving learning outcomes, science literacy, critical thinking skills, learning motivation, and psychomotor skills of students. In addition, the development of learning media, teaching modules, or ethnophysics-based learning tools that adapt the Simbang Batu game is important to be carried out so that it can be applied more systematically in physics learning in schools.

In addition, future research can expand the study of other traditional Malay games in the Riau region to enrich local culture-based physics learning resources and strengthen efforts to preserve local wisdom through education. Comparative studies between various traditional games can also be carried out to identify more diverse physics concepts so as to produce physics learning

innovations that are more contextual, interesting, and relevant to the cultural characteristics of students.

### ADVANCED RESEARCH

This study has limitations because it only focuses on the identification of ethnoscience values and physics concepts in the traditional Simbang Batu game of the Malay community in Rokan Hulu using a qualitative approach. This study has not tested the implementation of the Simbang Batu game in direct physics learning in schools and its impact on student learning outcomes. Therefore, further research is recommended to develop learning models, teaching materials, or learning media based on Simbang Batu and test its effectiveness on science literacy, understanding of physics concepts, and students' critical thinking skills using a quantitative or mixed methods approach.

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