

Analysis of Science-Physics Concept According to The Independent Curriculum in the Traditional Boi Game

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Abstract: An ancient game that has often been played from generation to generation in the Maluku region is the boi game. The boi game can be used as science-physics learning material according to the curriculum in force at school in the hope that it can make the learning process effective and efficient. This research aims to analyze the science-physics concepts found in the traditional Boi game in Allang Village, Leihitu District, Central Maluku Regency, Maluku. The research was conducted using descriptive methods with a qualitative approach. Data collection was carried out through interviews, observations, and document studies. The results of the analysis show that when the player applies force to the ball so that the ball moves and touches the stone structure and/or touches the body of the opposing player, the concepts of kinetic energy, elasticity, momentum, impulse, collision, work, force, and displacement are identified. The position of these concepts in the independent curriculum is at the junior high school phase D and high school phase F.

Keywords: Independent Curriculum; Science-Physics Concepts; Traditional Boi Games.

Introduction

Traditional games are a form of cultural values and traditions in people's lives to create a fun and joyful atmosphere (Nadlir, 2016; Oktarina & Ribuwati, 2018; Windi Wahyuni & Muazimah, 2020; Afkarina, 2021), developed by a group of people which originates from a deep understanding of the local environment and has been formed from generation to generation (Atiqah & Deskarina, 2020). Traditional games tend to be forgotten, there are even some children in urban areas who have never played traditional games.

Implementation of traditional games based on regional geographical needs as well as children's talents and potential in learning (Ministry of Education and Culture, 2015), including science-physics learning, can improve learning outcomes, motivation, science process skills, scientific literacy, and student creativity (Pamungkas et al., 2017; Nasution et al., 2018; Sangaji, 2018; Kusumaningsih & Suryanti, 2019; Toharudin &

Kurniawan, 2019). Apart from that, it is also a form of support for the implementation of new paradigm learning, to implement the independent curriculum. Things that need to be considered in integrating traditional games as a form of culture in science-physics learning are awareness and ability to understand culture; good understanding of concepts; sufficient insight to link culture and the concepts to be taught; careful planning; appropriate and interesting media used; appropriate cultural references.

One of the traditional games of the Maluku region that can be implemented in science-physics learning is the Boi game. The boi game is played by children in Maluku, including in the Allang country, Central Maluku Regency. Several literature studies show that this game is also played in several places outside Maluku province. Thus, apart from being implemented in science-physics learning in Maluku, it can also be implemented in other areas. For it to be implemented in learning, it is necessary to analyze the relationship

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between the boi game and the concepts of science and physics first.

This research aims to analyze science-physics concepts in the traditional Boi game found in Allang Village, West Leihitu District, Central Maluku, and carry out concept mapping to classify these concepts into several levels of education according to the independent curriculum.

Method

The research was conducted using descriptive methods with a qualitative approach because it describes symptoms or events that are temporarily occurring (Lestari et al., 2022). This research was carried out in Allang Village, Leihitu District, and Central Maluku Regency. Data was obtained through observation interview techniques and document studies. Interviews were conducted with community figures who were residents of the research location and who had in-depth knowledge of the research object. The interview was conducted on Saturday, November 12 2022 using a previously prepared interview guide. Observations were carried out on the same day using observation guidelines by directly witnessing children in Allang village playing the boi game. Document studies are carried out using document study guidelines, namely by reviewing literature such as scientific articles, books, and other literature that can be used to answer research problems without requiring direct field research (Khoiri & Sunarno, 2018). This document study is related to the history and physics concepts that exist in the traditional Boi game.

The data that has been collected is then analyzed using qualitative descriptive data analysis techniques, which in the process involves activities to obtain the meaning of each variable that can be used to answer the problem being studied. The first step taken was that the researcher examined the data collected from field notes and recorded interviews. The next step is for researchers to categorize and adjust the data needed by researchers to answer the problem. After that, the researcher carried out data analysis using descriptive and narrative reviews, namely by describing everything related to the research object based on the objectives. In the final stage, the researcher concludes according to the results of data processing to answer the problems and research objectives.

Result and Discussion

Traditional games are games that developed over one generation in certain areas where traditional games contain cultural values and provide pleasure for the

players (Putri & Nugrahanta, 2021). Traditional games are a legacy passed down through generations that contain meaning and have educational and cultural value in Indonesian culture (Rosramadhana et al., 2020: 170). *Boy's Game* better known as *Boy-boyan* is a traditional game that is played in groups consisting of two groups, that is the guard group and the attack group, each group consisting of 5-10 children (Lestari, 2017). Furthermore, Lestari, (2017) explains that in the *Boy-Boyan* game, a ball is used with the aim of the game to destroy targets in the form of piles of bricks, shards of roof tiles, or shards of floor tiles and is played on the field.

Boy's Game has different names in each region. In West Java Province it is known as *Boy-boyan*, in Central Java it is known as *Gaprek Kempung*, and in other areas this game is even called *Gebokan* or *Gembatan* (Saleh, et al., 2017). Through the *Boy-Boyan* game, children are taught to make sturdy buildings, a strong and balanced foundation is needed so that the building will not collapse, so this becomes a reflection in life that to achieve success, we must have a solid religious, moral, and educational foundation (Lestari, 2017).

The traditional *boy* game is one of the traditional games in Allang Village. The tools and materials needed are baseball balls which can be replaced with rolls of paper tied with rubber and woven coconut leaves in the shape of balls with weights placed inside them as well as stones consisting of 5 to 7 pieces which can be replaced with broken tiles or floor tiles. The function of the baseball is to throw stones that have been arranged and throw the opponent, while the stones function as a fort.

The way to play the *Boy's* game is, first, 2 groups of 5 - 7 people each are formed, then play suits to determine which group has the right to throw the ball first into a pile of broken roof tiles or stones. After that, the winning group will throw the ball first toward the rock, while the losing group will be on guard duty. If the pile of roof tiles is successfully destroyed, the group that threw it must immediately run to avoid the ball being caught and thrown at them by the guard. The guard must block the group of throwers who are required to reassemble the pile of crushed stones while avoiding the ball thrown by the group on guard. If the throwing group succeeds in arranging the pile before all its members are hit by the ball, then they are the winners and have the right to throw the ball again into the pile of stones. If all the winning groups are hit by throwing balls or fail to destroy the pile of stones, then the guard group changes to throw the ball at the stones.

The difference in how to play the *Boy* game in Allang village and other villages lies in the time, so the group that wins is given a certain time to be able to successfully arrange the pile of stones if they don't

succeed by the specified time then the group that is declared the loser will change positions to become the guard. The benefit of playing *Boi* is that children are expected to master various concepts such as color, size, shape, and direction and can develop children's motor skills, namely that children can train their muscles to be strong by moving the child's entire body and train children to be patient when waiting for their turn.

The results of the analysis of the relationship between the boi game and the science-physics concept through interviews, observations of the implementation of the boi game, and document studies show that in the boi game, the concepts of kinetic energy, elasticity, momentum, impulse, collision, work, force, and displacement are identified.

Kinetic energy

When a baseball is thrown by a player with a ball mass of m , the ball will move with a speed of v (Figure 1).

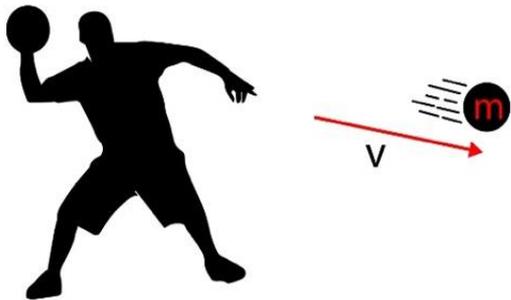


Figure 1. Player throwing the ball

Kinetic energy is the energy possessed by an object because of the movement carried out or experienced by that object. The concept of kinetic energy is found in the boi game, this is because the baseball that has a mass of m is then thrown by the group of guards towards the group of throwers, causing the ball to move with a speed of v . So the amount of kinetic energy a baseball has when it is thrown can be written in the Equation 1.

$$E_K = \frac{1}{2} m \cdot v^2 \tag{1}$$

Where E_K = the kinetic energy of a baseball (J)
 m = Mass of the baseball (kg)
 v = Speed of the bekleng fruit when thrown by the player (m/s)

Elasticity

When the baseball comes into contact with the opposing player's body, the baseball will be dented, and

when it finishes contacting, the ball will return to its original shape (Figure 2.)

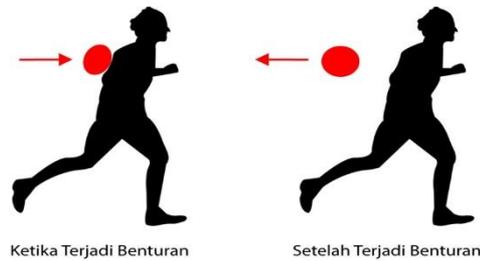


Figure 2. The baseball touches the player's body

The concept of elasticity in physics is the ability of an object to return to its initial condition when the force applied to the object is removed. The concept of elasticity in boys' games can be seen in the balls used for playing. The ball usually used by children in Allang village is the baseball. When the ball is thrown toward another player and the ball comes into contact with the other player's body, the ball will dent the surface of the ball in contact, in the concept of elasticity this is called tension. But when it finishes touching the player's body, the ball will bounce in the opposite direction to the direction it came from, and the ball will return to its original shape. So that mathematically it can be written.

$$\sigma = \frac{F}{A} \tag{2}$$

Where σ = Tension on baseball (N/m^2)
 F = Force exerted by a player when throwing a baseball to another player (N)
 A = Cross-sectional area of the baseball (m^2)

Momentum

Momentum is possessed by the ball in the game of bekleng when it is thrown toward the stones that are being arranged, or toward the opposing player. A ball has a mass of m and when thrown, the ball moves with a speed of v so that the ball has a momentum of p (Figure 3).

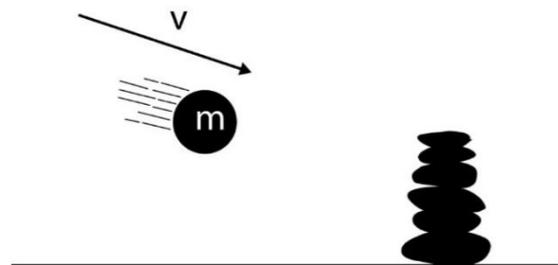


Figure 3. The ball is thrown towards the stone structure

Momentum is the tendency of an object to keep moving. Momentum is directly proportional to the mass and speed of the object, which means that the greater the mass and speed of the object, the greater the momentum and the more difficult the object is to stop. In the boy's game, momentum is possessed by the baseball when it is thrown toward another player or when the ball is thrown toward the stones that are being arranged. A ball has a mass of m and when thrown, the ball moves with a speed of v so the ball has a momentum of p . The momentum possessed by the ball can be written using the following mathematical equation.

$$p = m \cdot v \tag{3}$$

Where p = Momentum possessed by the ball when thrown (kg m/s)
 m = Mass of the ball (kg)
 v = Speed of the ball when thrown (m/s)

Impulse

When the ball is thrown towards an opposing player with a force of F , the ball will come into contact with the opposing player's body within a certain time interval, and at that time Newton's 3rd law works. This reaction force is an impulsive force that causes an impulse to occur on the ball and changes the initial momentum of the ball when it is thrown by the player (Figure 4).



Figure 4. The ball is thrown to the player

Impulse is a measurement of how much an external force changes the momentum of an object, or impulse is a change in the momentum of an object. In the boy's game, the impulse that acts on the ball occurs when the ball is thrown by a player and hits the stones that are being arranged. Apart from that, impulses are also found in the ball being thrown toward another player, and then hitting the player's body. So it can be concluded that the impulse in the boy's game occurs when the ball is thrown by a player with a force of F then hits the surface of an object within a certain time interval (Δt),

then an impulsive force (F) appears from the surface of the object that is hit by the ball against the ball when due to Δt that time Newton's 3rd law which states $F_{action} = -F_{reaction}$ works. This reaction force is an impulsive force that causes an impulse on the ball and changes the initial momentum of the ball when it is thrown by the player (Δp). So mathematically it can be written as follows

$$I = \Delta p = p_{end} - p_{start} \tag{4}$$

Or

$$F \cdot \Delta t = mv_{end} - mv_{start} \tag{5}$$

Where I = Impulse acting on the ball (N s or kg m/s)
 Δp = Change in Momentum experienced by the ball after the ball is subjected to a reaction force or impulsive force by the surface of another object (kg m/s)
 F = Average impulsive force exerted by the surface of another object on the ball at the moment of contact (N)
 Δt = Time interval when contact occurs between the ball and the surface of another object ($t_2 - t_1$) (s)
 m = Mass of the ball (kg)
 v = Speed of the ball when thrown (m/s)

Collision

When the thrown ball then hits the stones that are being arranged, the stones and balls will experience a partially elastic collision process which changes the mass and speed of the balls and stones (Figure 5).

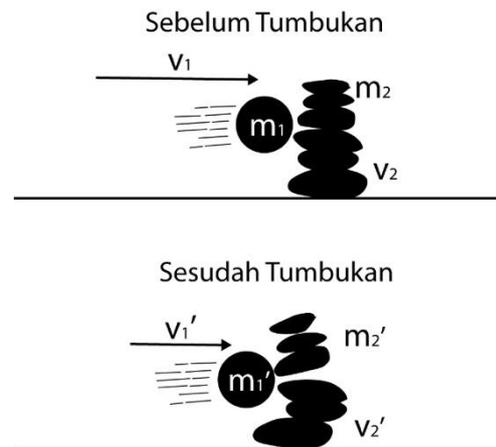


Figure 5. Ball hits the rock

A collision in physics is the interaction of two or more objects that exchange forces within a certain time

interval and fulfill the law of conservation of momentum, meaning that the momentum before and after the collision is the same or constant if no external forces are acting on the object. In the concept of collision, there is also something called impact elasticity, or simply elasticity is the reflection of two objects after experiencing a collision. The concept of collision is one of the physics concepts in boys' games because, in boy's games, the ball will collide with an arrangement of stones. The type of collision experienced by the ball in the boy's game is a partially elastic collision.

A partially elastic collision occurs when a ball with a mass of m is moving with a speed of v , and the rock is stationary before the collision. After the collision occurs, the ball and stone will move but the total speed between before and after the collision is reduced or not the same, and the equation for the partially elastic collision that occurs on marbles in the boy's game is

$$m_1 \cdot v_1 + m_2 \cdot v_2 = m_1 \cdot v_1' + m_2 \cdot v_2' \tag{6}$$

- Where
- m_1 = Ball mass (kg)
 - m_2 = Mass of the stones arranged (kg)
 - v_1 = Ball speed before impact (m/s)
 - v_2 = Speed of the rock formation before impact (m/s)
 - v_1' = Ball speed after impact (m/s)
 - v_2' = Speed of the rock formation after impact (m/s)

Effort

When a player throws the ball with a force of F , the baseball experiences a displacement from its starting point (Figure 6).

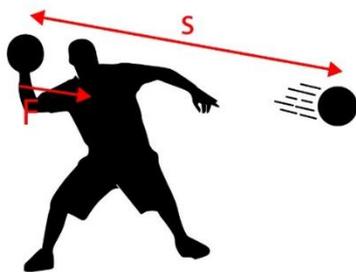


Figure 6. Player throwing the ball

Work in physics is the energy exerted by a force on an object so that the object experiences displacement from its starting point. The concept of effort in the boy's game occurs when the player applies a force of F against the baseball when throwing it. When a force is applied, the baseball experiences a displacement from its initial point to its final point when it comes into contact with another object. So it can be written mathematically as follows

$$W = F \cdot s \tag{7}$$

- Where
- W = Work done on the baseball (Joule)
 - F = Force exerted on the baseball (N)
 - s = Displacement of the baseball (m)

Force

When a player throws a baseball with a mass of m , which causes the baseball to move with an acceleration of a , then the force acting on the baseball is F (Figure 7).



Figure 7. Ball thrown

Force is a treatment given to an object and can influence the object's motion. The concept of force in the boy's game can be seen when a player throws a baseball with a mass of m towards another player or towards stones that are being arranged which causes the ball to move with an acceleration of a , then the force acting on the ball is F . Mathematically can be written.

$$F = m \cdot a \tag{8}$$

- Where
- F = Force acting on the ball (N)
 - m = Mass of the ball (kg)
 - a = Acceleration of the ball after a force is applied (m/s^2)

Displacement

When the baseball is thrown, the baseball experiences movement from its original position (Figure 8).

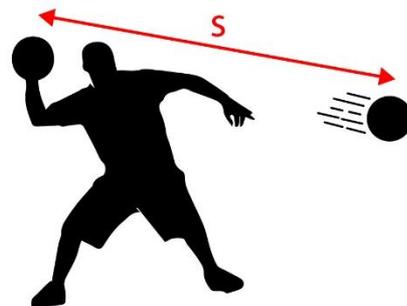


Figure 8. The ball moves when thrown

Displacement is a change in the position of an object if measured from the starting point to the end according to its direction. Displacement is different from a distance, this is because displacement has value and direction so displacement is a vector quantity. The movement in the boy's game can be observed on the baseball when the player throws the ball. When the ball is thrown, the ball will move from its original position to a position where the ball will come into contact with another object. The displacement experienced by the ball can be written as follows.

$$S = \sqrt{x^2 + y^2} \quad (9)$$

Where S = Displacement (m)
 x = Direction of first ball movement (m)
 y = Direction of movement of the second ball (m)

The value $y = 0$, if the ball moves only in the same direction

Mapping Learning Achievements of Physics Science concepts in the Boi game in the Merdeka curriculum

Learning Outcomes (LO) science-physics concepts according to the independent curriculum which are analyzed in the boi game are taught in Phase D and Phase F. The concepts in phase D are the concepts of kinetic energy, work, force, and displacement. The learning achievement of the kinetic energy concept and the concept of work is that students can understand the relationship between the concepts of work and energy. Meanwhile, the achievement of learning the concept of force and displacement is that students can make measurements of the physical aspects they encounter and utilize various movements and forces. All the concepts analyzed in the boi game, namely kinetic energy, elasticity, momentum, impulse, collision, work, force, and displacement, can be taught in phase F. These concepts are at the same learning outcomes, namely students can apply the concept of kinematics and movement dynamics.

Conclusion

The concepts of Physics Science resulting from analysis of the traditional Boi game found in Allang Village, West Leihitu District, Central Maluku are the concepts of kinetic energy, work, force, and displacement. In the independent curriculum, these concepts can be taught in phase D at the junior high school level and phase F at the high school level.

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Author Contributions

All research members contributed to this research starting from preparing proposals, carrying out research such as data collection, data analysis and reporting as well as writing articles.

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Conflicts of Interest

The funders had no role in the design of the study; in the collection, analysis, or interpretation of data; in script writing; or in the decision to publish the results

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