

# EXPLORATION OF PHYSICS CONCEPTS ON LOCAL WISDOM IN THE TRADITIONAL GAME OF ANGKLE (ENKLEK) AS TEACHING MATERIALS FOR SMA STUDENTS

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## ABSTRACT

Local wisdom is a characteristic or culture that develops within the local scope from generation to generation in a certain area or region that has cultural values. Engklek is a game that is carried out by making a crank, ankle, or angkling movement, namely walking, jumping using one leg. This study aims to explore and analyze the relationship between physics concepts and hopscotch games. This research method uses a qualitative research method in the form of literature study. Data collection techniques in this study were observation and documentation. The data sources used in this study are observation as primary data and literature review as secondary data. The data that has been obtained will be reduced according to the needs to be achieved. The results of this study found that there are physics concepts that exist in the crank game, namely parabolic motion, Newton's laws, and the equilibrium of rigid bodies. That way, it can be an alternative learning media with concrete examples in the surrounding environment. That way, we can find physics concepts in the surrounding or closest environment to be used as a more meaningful learning resource.

**Keywords:** Local wisdom, physics concepts, traditional games, engklek games

## INTRODUCTION

Today, the development of science continues to grow along with the development of technology. One of the most rapid developments that can be felt is in the education sector. The existence of the Covid-19 pandemic changed the education system, which was originally face-to-face to virtual face-to-face [1]. Learning at the high school level is equivalent, there is one subject that must have concrete examples to be understood, namely physics. Physics is a branch of natural science that studies the nature, laws of nature, and their application in everyday life [2]. Abstract physics concepts are difficult to visualize, thus

making it difficult for students to study and understand them [3]. This creates a stigma for students that physics is a difficult subject to study, even though various events in everyday life are inseparable from the concept of physics. Daily activities in the environment where students live are used as a means or source of learning so learning physics will become more meaningful. In this case,

Local wisdom is a characteristic that develops in a local scope in a certain area or area that has cultural values [5]. In general, the meaning of local wisdom is an idea that can be understood as local ideas that are wise, full of wisdom, of good value, and

embedded and followed by members of the community [6]. The existence of local wisdom will be an alternative that can be used as media or teaching materials in schools. The development of teaching materials based on local wisdom can be one of the learning media that has a significant impact on students' knowledge and skills.[7]

One form of local wisdom is regional games. Traditional games are one of the elements of local culture that are often found from various parts of the archipelago and are common in rural communities. In addition, this traditional game is not just playing, but can have an influence on the psychology and nature of social life [8]. Traditional games have many benefits including being able to train children's creativity, being able to control emotions, social intelligence, bringing children closer to nature, being able to develop children's motor skills, being useful for training health, sharpening children's sensitivity, and so on [9]. That way, it is very appropriate to integrate physics concepts in games into teaching materials so as to get concrete examples and more meaningful learning.

There are so many local wisdoms in Indonesia, one of which is the City of Sidoarjo. The city of Sidoarjo has many cultures, special foods, and characteristics[10]. One of the traditional games that still exists is the game "Angkle" or Engklek. This crank game is a game that is done by doing the crank, angklek, or angkling movement, namely walking, jumping using one leg.[11]

Based on how to play the game, the researcher is interested in exploring the physics concepts contained in the game. In addition, it can also be used as a learning medium based on local wisdom in the Anglek game. The specific purpose of writing this article is to explore the concept of physics and serve as teaching material

and at the same time preserve the culture in Sidoarjo.

## RESEARCH METHODS

This research was conducted using qualitative methods. In the form of literature study. By using the literature study method, data is collected for analysis and then presented in the results of the discussion so that conclusions can be drawn. [12]

Data collection techniques in this study consisted of observation and documentation. Observations were made by directly observing the anglek game and then documenting it.

There are two sources of data used in this study, namely primary data and secondary data. Primary data is in the form of data obtained when making observations while secondary data is obtained by conducting literature studies through journals and books.

The data analysis technique used is to reduce the data and then draw conclusions. Using data reduction can enable researchers to analyze the initial data into data that is more relevant to the research objectives.[13]

## RESULTS AND DISCUSSION

### a. Exploration of Physics in the Traditional Game of Cranks

Many traditional games contain sportsmanship, togetherness, hard work, and fun. One such game is engklek [11]. Ashar (2017) explains that a game that is carried out by making a crank, angklek, or angkling movement or walking and jumping using one leg is the definition of a crank game. Fuad et al (2018) also explained that the game of hopscotch or baingkaan is a game that requires players to do tangka or walk on one leg.[2] Therefore, it has become a choice how the game of hopscotch

should be a game that is defended. Preserving it is something that must be done so that traditional games are not lost in the midst of the onslaught of modern games that have developed at this time [14].

This crank game has several types of playing areas. According to Simanjuntak and Tambunan (2021) there are three types of area shapes, namely ordinary cranks, helicopter cranks, and airplane cranks. The shape of the area that is often used is the plane shape. In this area the shape of the area is a cube net [15].

Each game has its own rules. Before starting the game, all players hompimpa to determine who will do the game first and the order after. Player 1 throws the gaco into box 1. The gaco in question is a piece of unused house tile.



Figure 1. Gaco image

The rules of the engklek game are not to step on the box that has the gaco in it. So the first player has to jump to box 2 then to box 3, 4, 5, 6, 7 using one foot. Then the first player jumps to box 7,6,5,4,3,2 and then ducks to take gaco in box 1 while still using one foot and then gets out of the game box. Then the first player continues the game by throwing gaco into box 2 and so on.

If the player can throw the gaco correctly in each box up to the last box, then the player will place the gaco on the back of his hand with his back to the game box then throw the gaco backwards. If the gaco falls right on one of the boxes, then the box

becomes "house orhomethe player. The advantage of having a "house" is that players can stop using both feet and the other players are not allowed to step on the square.

A crank player is said to fail or make a substitution when several things occur, namely the player cannot throw the gaco at the box correctly or the gaco is on the line between the boxes. Then when the player jumps and steps on the line between the boxes it can also be said to have failed. Players step on another player's "house", and players use two feet when passing through the box.



Figure 2. Image of gaco coming out of the box



Figure 3. Throw gaco

The concept of physics that exists when a player stands before throwing gaco is Newton's First Law, which explains that all objects tend to maintain their state. An object at rest will remain at rest and an object in motion will remain in motion with a constant speed [16]. Newton's 1st Law equation is:

$$\Sigma F = 0$$

$$W - N = 0 \quad (1)$$

Where F (N) is the force, W (N) is the object's weight, and N (N) is the normal force of the object.



Figure 4. Players jump from 1 box to another

In Figure 2, when a player jumps with 1 foot from one box to another, there are several concepts, namely Newton's Third Law and Equilibrium. When a player jumps, Newton's third law applies, namely:

$$\mathbf{f_{action}} = -\mathbf{F_{reaction}} \quad (2)$$

[17]

The action force (Faction) is given by the foot jumping on the ground or to the center of the earth, and the reaction force (Freaction) is given when the ground exerts a force in the opposite direction, so that the body can be pushed up. If it has the same magnitude of force in the opposite direction and acts on different objects then Newton's Third Law can occur [16]. Therefore, Newton's Third Law works when players jump from one box to another.

Then, when the player is still standing on one foot when he is going to take the gaco, there will be an equilibrium so that he does not fall, namely

$$\Sigma \tau = 0 \quad (3)$$

[16]



Figure 5. Throw gaco with his back to the box

In Figure 5, when a player throws a gaco, the gaco will experience a parabolic motion. As when calculating the distance of the farthest path, it can be used by using the equation

$$\Delta X_{\max} = \frac{v_0^2 \sin 2\theta}{g} \quad (4)$$

[16]

Meanwhile, when the gaco is thrown, the gaco will be at its maximum height, so it can be studied on the Y axis so it can be calculated using the equation

$$\Delta Y_{\max} = \frac{v_0^2 \sin^2 \theta}{2g} \quad (5)$$

[16]

Then, when the gaco returns to the ground, it takes time from the time it was thrown to landing, so it can be calculated using the equation

$$t_{X \max} = 2 \times t_{Y \max} \quad (6)$$

$$t_{Y \max} = \frac{v_0 \sin \theta}{g} \quad (7)$$

[16]

The position of the gaco at any time can be expressed in 2 points, namely from the X and Y axes. On the X axis the speed of the gaco is constant. The position of an object is the result of multiplying the velocity on the X axis by the time, so it can be formulated

$$X_{\text{gaco}} = v_0 \cdot \cos \theta \cdot t \quad (8)$$

[16]

Meanwhile, the speed of the gaco varies on the Y axis, this is due to the influence of the acceleration due to gravity. Then the gaco position on the Y axis can be formulated by

$$Y_{gaco} = v_0 \cdot \sin \theta \cdot t - \frac{1}{2}gt^2 \quad (9)$$

[16]

The hopscotch game also has the concept of momentum and impulse. The concept of momentum occurs when gaco is still or moving. When the gaco is stationary or ( $v = 0$ ) and when the gaco is moving or ( $v \neq 0$ ), difficulty in stopping the movement of an object is known as momentum [16].

$$P = mv \quad (10)$$

With P (kg.m/s) is gaco's momentum, m (kg) is gaco's mass, and v (m/s) is gaco's speed.

When a player changes, it is possible to have 2 or more gacos in the same box. So, if when throwing the gaco hits another player's gaco, then there will be an impulse concept. The player exerts an average impulse force in a short time interval. So it can be formulated

$$I = F \Delta t \quad (11)$$

[16]

Based on equation 11, it can be seen that the impulse value is proportional to the average impulse force and the time interval. Impulse can also be interpreted as a change in momentum, this can be seen from the change in gaco movement speed. So the equation can be written

$$I = \Delta P \quad (12)$$

[16]

Because P is momentum which is the product of mass and velocity, then

$$I = m (v_2 - v_1) \quad (13)$$

Where I (kg.m/s) is the impulse that occurs in the gaco, m (kg) is the mass of the gaco, and  $v_1$  (m/s) is the initial velocity and  $v_2$  (m/s) is the final velocity.

### b. Crankshaft Game Exploration as a teaching material for physics learning

Based on the results of the analysis above, the concepts of physics in crank games can be integrated into learning physics according to the basic competencies (KD) according to K13 which are presented in Table 1.

**Table 1.** The relationship between the concept of physics in hopscotch games with KD K13

The concept of physics in the hopscotch game	Basic competency K13
Newton's laws	3.7 Analyzing the interaction of forces and the relationship between force, mass, and straight motion of objects and their application in everyday life.
	4.7 Carry out experiments along with presentation of the results related to force and the relationship of force, mass, and acceleration in straight motion of objects by applying the scientific method.
Rigid body balance	3.1 Apply the concepts of torque, center of gravity, and angular momentum to rigid bodies (static and dynamic) in everyday

life, for example in sports.

4.1 Make a work that applies the concept of center of gravity and equilibrium of a rigid body.

Parabolic motion

3.5 Analyzing parabolic motion using vectors, along with their physical meaning and their application in everyday life.

4.5 Presenting data from parabolic motion experiments and their physical meaning.

Momentum and Impulse

3.10 Applying the concepts of momentum and impulse, as well as the law of conservation of momentum in everyday life

4.10 Presenting the results of testing the application of the law of conservation of momentum, for example a ball falling freely from the floor and a simple rocket

science in everyday life and can appreciate nature more [19].

## CONCLUSION

Based on the results of the analysis above, it can be concluded that Engklek is a traditional game that is carried out by carrying out the Engklek, Angklek, or Angkling movements, namely walking, jumping using one leg. In this hopscotch game, several physics concepts are used, such as parabolic motion, Newton's law, equilibrium of rigid bodies, as well as momentum and impulse. That way, the concepts obtained can be used as teaching materials based on local wisdom so that students better understand and experience concrete and meaningful learning. Suggestions for future researchers are expected to further deepen the concepts of physics and even other subjects found in traditional hopscotch games.

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Physics concepts in hopscotch gamesK13 basic competencies can be integrated into learning physics. In addition to understanding the concepts of physics, students also do not forget the local wisdom of their region. Students think it is easy to solve physics concepts which are considered difficult because they are associated with the existence of culture in the learning process [18]. learning with an ethnosience approach can provide students with understanding regarding the use of

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