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Exploration of Physics Concepts in Games at the Night Market

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ABSTRACT

This study aims to show that learning physics or understanding physics concepts is not only done in the classroom, but can be done outside the classroom even at fun playgrounds. The methods used are field case studies and literature case studies. In this study, it can be concluded that learning physics or understanding physics concepts is not only done in the classroom, but can be done outside the classroom even at fun playgrounds such as the centripetal force on the Ferris wheel and merry-go-round as well as the concept of simple harmonic motion on the Kora rides. -kora. Exploration of physics concepts on game vehicles can be an innovation in learning when students are getting bored in learning physics in theory, teachers can connect physics materials and concepts with game vehicles around us or even if possible can invite students to study outside the classroom so that learning can take place. become more meaningful, fun and easy to remember by students.

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INTRODUCTION

The rapid development of science and technology in the world of education requires us to be more innovative in learning, especially in learning Physics. The large role of physics in supporting technological development requires physics teaching to be oriented towards achieving optimal learning outcomes (Dewa et al., 2020). Physics is a natural science that can explain observable phenomena based on human experience, rational thinking, and detailed experimental activities (Makheasy et al., 2019), so that it can prove that physics is very close to everyday life. Every phenomenon that exists in everyday life, whether it ever happened. or is happening, related to physics learning. To achieve physics education which should be expected to be a vehicle for students to learn about themselves and the environment. The learning process emphasizes more on providing direct experience to develop basic competencies in order to explore and understand the natural environment scientifically (Rahmadhani & Rifai, 2020).

The development of science, technology and culture is growing rapidly along with the times that are increasingly sophisticated, including Indonesia (Pratiwi, 2021). So that there are more and more games that take advantage of advanced technology. Modern games that use technology are often found in several rides, such as in Jatim park, Dufan, Transmart, and games at the night market. The game is not only a means to play but can also be used as a medium of learning. The function of learning media in conveying messages or information about well-

designed materials and media will greatly help students achieve their learning goals (Ikbal et al., 2020).

Technological developments are increasingly advanced, starting with the rapid advancement of information and communication technology and the increasingly complex future challenges marking a new era called the industrial revolution era 4.0 (Simamora, 2021). When science and technology are developing very rapidly, students can learn where, when and anything, according to their interests and learning styles (Gunawan et al., 2020). Students must be equipped with the ability to find out, learn from various sources, construct knowledge based on natural phenomena that occur around them and use information and communication technology (Wahyudi, 2017). To improve the efficiency and effectiveness of learning. One of the effective learning resources used is tourist attractions, one of which is the night market. The night market is a simple edupark or educational park. The educational park (edupark) is a location that has entertainment and educational value (Sari & Rifai, 2019). This is in line with the opinion (Sari Ayu et al., 2021) which states that learning by utilizing edupark can be applied to all subjects at the elementary, middle, and upper levels, one of which is physics learning at the high school level equivalent.

Physics is one of the subjects that are considered very difficult to understand by most students in school (Erlangga et al., 2018). Students always assume that the material studied in physics is too abstract so they have difficulty understanding it. This is because the physics learning process is too monotonous so students are lazy to listen and understand (Paudi, 2019). In accordance with the current facts, teachers tend to use the lecture method, without first conducting the initial knowledge analysis stage (Afkarina, 2021). To achieve science education which should be expected to be a vehicle for students to learn about themselves and the environment. The learning process should place more emphasis on providing direct experience to develop basic competencies in order to explore and understand the natural environment scientifically (Rahmadhani Nudiya., 2021). Tourist attractions can be a means to learn through every game or object in tourist attractions as contextual learning. Not only do tours just for fun and capture vacation moments without knowing the meaning of every game or object they observe.

Contextual learning is learning that helps teachers connect the content of subject matter with real-world situations that are useful for motivating students to make connections between knowledge and applications with their lives as members of the family, community and work environment (Sari & Rifai, 2019). Contextual learning can be applied, one of which is physics learning, because high school physics learning is a lesson that studies natural phenomena through a series of scientific processes that are built on scientific attitudes and the results are scientific products, both artificial and natural. In the problems that have been presented above, the purpose of this research is to explore the concepts of physics in the rides on the games in the night market.

RESEARCH METHOD

The research method used is descriptive research, this research is related to data collection to provide a systematic and accurate description of a symptom (Nuriyanah et al., 2021). Data collection techniques were obtained from the results of field case studies and literature case studies. Field case studies are one form of collecting data in research methods by going directly to the field to make observations. While the literature study is a series of activities related to the methods of collecting library data, reading and taking notes, and managing research materials (Pilendia, 2020).

The method of collecting field case study data was obtained from a direct survey to the location of the object of the night market around the researcher's house. The method of collecting data is case study literature obtained through the internet, or several related articles.

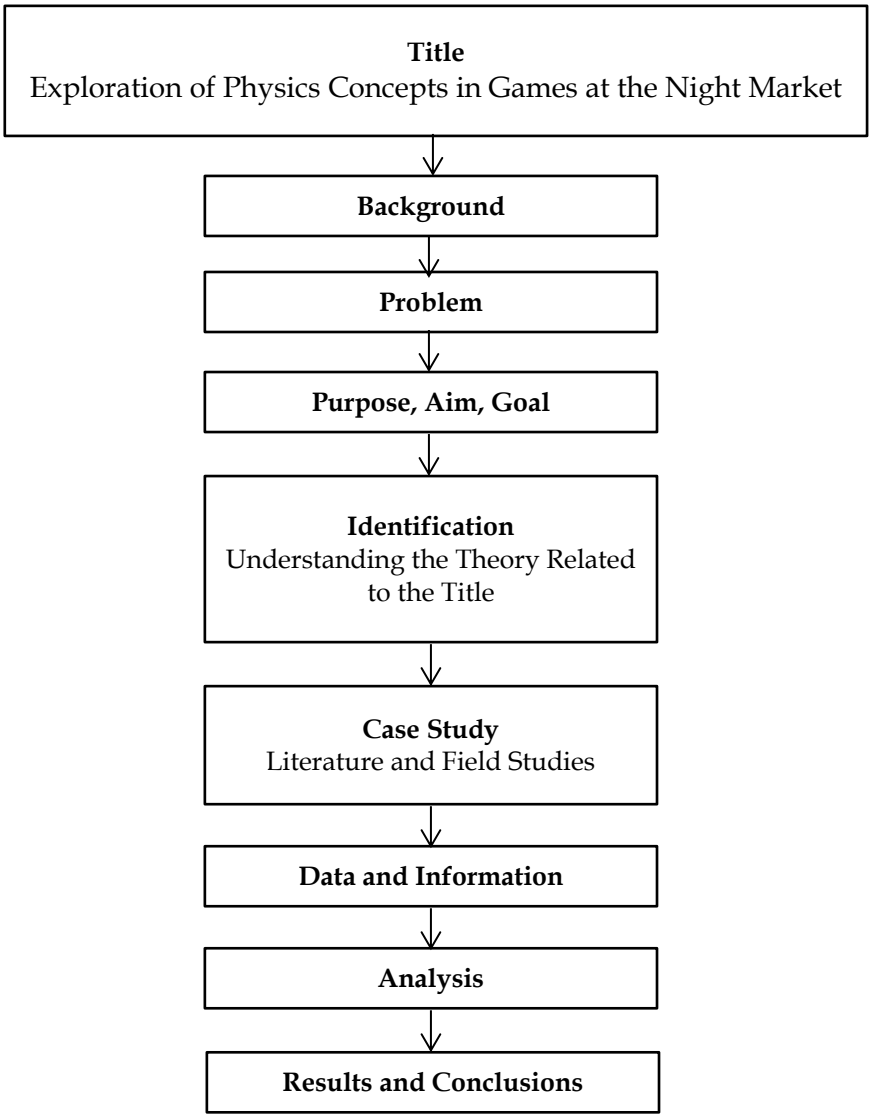


Figure 1. Methodology diagram

RESULTS AND DISCUSSION

Physics is the study of various physical events that exist around our environment. Physics also requires facilities and infrastructure that can support the learning process. Therefore, studying physics now is no longer like memorizing formulas, but a learning process with an understanding of factual processes and their application in everyday life (Sholahuddin & Admoko, 2021). Every subject in physics requires proper and effective perception in interacting with students so that learning messages are easily conveyed and accepted by students (Rosadi et al., 2019). As a support for learning physics so that students are interested in learning, namely exploring the concept of physics on the rides at the night market.

The research that we have done at the night market uses 2 methods, namely field case studies and literature studies. The results of this study, found many vehicles related to the concept of physics. These rides include the ringleader, tong devil, Kora-kora, and the Comedy Play. Each ride has its own uniqueness and has different physics concepts, which we will discuss in detail. The following is an exploration of the concept of physics in the game at the night market:

1. Ferris wheel

   The word Ferris wheel actually means rainbow. However, this colorful giant Ferris wheel was inspired to use the words "Rainbow" or "Fierrist" in pronouncing its name. Originally the Ferris wheel was in Chicago and it was called the *Ferris Wheel*. Ferris wheel or commonly called the big wheel is one of the toys in the night market, this ride

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invites visitors to turn around and enjoy the view from up high. The speed of this vehicle is the longer the Ferris wheel will move faster. The following is a photo of the Ferris wheel in Figure 2 at the night market:



Figure 2. Ferris wheel game

Ferris *wheel* is a wheel-shaped structure that hangs passenger cabins that are installed in such a way in the rim so that when the wheels rotate, the cabin is permanently in an upright position, usually thanks to gravity. The concept of physics contained in the Ferris wheel, the first is the force of gravity. The gravitational force on the Ferris wheel occurs when the Ferris wheel rotates but the seat on the wheel is still upright. Gravity itself is one type of force that is influenced by the attraction of an object to the center of the object (Ginoga, 2020). So the understanding of the earth's gravitational force is the attractive force that attracts an object towards the center of the earth.

The second physics concept in this Ferris wheel game is the centripetal force. When an object rotates about its axis or axis, every part of the object is involved in a sphere centered on the axis. Centripetal acceleration is the acceleration that occurs in uniform circular mobility whose direction is always towards the center of the circle. If an object moves with a permanent speed around a circle, then the direction based on the object's mobility has a permanent change. Where the centripetal acceleration is the direction always towards the spherical center. According to Newton's rules, the cause of an object can move using an acceleration is a force. The force that causes the centripetal acceleration is called the centripetal force. The centripetal force is not an independent force. This force is basically a resultant force acting on an object in a radial direction (Ristiani et al., 2018).

The third concept of physics is circular motion. The Ferris wheel moves in a circular path around a fixed point (the axis of rotation). In the circular motion that occurs in this wheel, the distance from the cabin to the center of rotation will always remain, but the position of the cabin to the center of the circle changes. Based on the angular velocity, this circular motion is divided into 2, namely, uniform circular motion (GMB) and uniform circular motion (GMBB). This Ferris wheel belongs to uniform circular motion (GMB). Uniform circular motion is the motion of an object whose trajectory is a circle

with a constant angular velocity and zero acceleration (Raharja et al., 2020). The equation of circular motion in the Ferris wheel game is:

- Angular Velocity Formula:

$$\omega = v/r$$

Angular velocity can also be obtained from the equation:

$$=2\pi f$$

Or

$$= 2\pi/T$$

Description: ω = Angular Velocity; v = Linear Velocity (m/s); r = radius of the track (m) = 3.14 or 22/7; f= frequency (Hz); and T= Period (s)

- Centripetal Acceleration Formula

$$a_s = \omega^2 r \ = \frac{v^2}{r}$$

Description: a_s= Angular Acceleration (m/ s^2); a= Angular Velocity; v = Linear Velocity (m/s); and r = radius of the track (m)

- Centripetal Force Formula

$$\Sigma F = m.a_s$$
$$\Sigma F = m\,\omega^2$$
$$\Sigma F = m\,\frac{v^2}{r}$$

Description: F = Centripetal force (N); M = Mass of object (Kg) ω= Angular Velocity; v = Linear Velocity (m/s); and r = radius of the track (m)

2. Carousel

Ferris wheel is often called a merry-go-round. Ferris wheel is a wheel-shaped structure where passenger cabins are hung on the rim so that when the wheel rotates, the cabin remains upright, and is assisted by gravity (Adetyas et al., 2018). Carousels are one of the games that are often found at night markets. The merry-go-round game most people only understand or know is an entertainment game, without realizing it there are many concepts of knowledge, especially on the concept of physics. Here is the merry-go-round in Figure 3.



Figure 3. Comedy play games

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This merry-go-round game, the bigger the size of the merry-go-round, the bigger the moment of inertia, the higher the torque required, the higher the power generated by the engine automatically. The torque equation is as follows:

$$\tau = r\ F\ sin\theta$$

Description: τ = torque or moment of force (Nm); r = force arm (m); F = force applied perpendicular to style sleeve (N)

When the carousel moves, there will be a physics concept in the game, which has an angular velocity of, there is also a moment of inertia and has angular momentum.
Judging from the structure, the merry-go-round is supported by several pillars centered on its axis of rotation. This is done because the center of gravity is on the axis. When we ride the game, the seats in this carousel game are arranged, so that it is evenly distributed in all parts of the merry-go-round, so it can be concluded that the merry-go-round officer takes into account the balance of the equipment.

Carousel (carousel) is a clear example of the combination of balance of motion and force. Each horse in the game rotates a complete circle in the same time interval. During the same time interval, the horses on the outside (edge) of the merry-go-round traveled a longer distance than the horses on the inside of the merry-go-round. This means that the horse that is located on the outside has a greater linear speed than the horse that is located on the inside. In a normal merry-go-round, each piggyback experiences a constant (constant) acceleration (centripetal), trajectory radius, and linear speed. If we want to make the piggyback move back and forth while turning, then we need to take into account the amount of force required to do so. In this case, it is necessary to consider the mass of the horse and the mass of the prospective passengers. The merry-go-round game performs motion in a circular trajectory orbit. In order for an object to move in a circle it needs a force that always bends it towards the center of the circular path. This force is called the centripetal force. With the following equation:

$$F_c = \frac{mv^2}{r}$$

Description: Fc = centripetal force; m = mass; v = speed; and r = radius

3. Kora-kora

Kora-kora is a type of ride based on a pirate ship, consisting of a gondola with an open bench that swings back and forth. Kora-kora rides are no stranger to people's lives, because they are often found in tourist attractions and in natural markets. The kora-kora ride is one of the rides that tests your mentality when you ride it, because the ride swings fast and high. The working principle of this vehicle is almost the same as riding a swing. However, the kora-kora swing can reach a deviation angle of more than ninety degrees (90^0). The following are kora-kora in the night market in **Figure 3** :



Figure 3. Kora kora game

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Kora-kora move back and forth like a pendulum. At the bottom of the track on the kora-kora there is a tire that pushes the kora-kora so that it can always swing perfectly. The larger the angle, the faster the kora-kora oscillates. And at the end of the kora-kora will experience free motion with maximum acceleration.

Because the theory that underlies the game of kora-kora is the pendulum theory, the physical quantities involved are:

a) Mass (*m*)
b) Gravity Force (*Fg*)
c) Hanger Length (*L*)
d) Period (*T*)
e) *Angle* Deviation
f) Kinetic Energy (*Ek*)
g) Potential Energy (*Ep*)

In principle, the movement of the kora-kora vehicle is a pendulum swinging motion. If a motion occurs repeatedly in the same time interval, it is called periodic motion. And if a motion occurs regularly then the motion is referred to as harmonic motion (Wahid et al., 2020). A simple *pendulum* is a system that moves periodically with simple harmonic motion. Simple harmonic motion is a back and forth motion that passes through its equilibrium point regularly (Lere, 2019).

The conditions for a motion to be said to be harmonic vibrations include:

- The movement is periodic (back and forth).
- The movement is always past the balance position.
- Acceleration or force acting on an object is proportional to the position / displacement of the object.
- The direction of acceleration or the force acting on an object always leads to a position of equilibrium.

In performing harmonic motion, a pendulum will have a period and a frequency. Period is the time it takes to travel a full path, while frequency is the number of vibrations per unit time. Mathematically the period and frequency of the pendulum are expressed in the equation:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$f = 2\pi\sqrt{\frac{g}{l}}$$

With,

T = Period(s)
f = Object Frequency (Hz)
l = Rope Length (m)
g = Gravity Acceleration (m/s^2)

When the ship is swinging at its highest position, its potential energy will be maximum and its kinetic energy will be zero. Meanwhile, when the ship moves down, its potential energy decreases and its kinetic energy increases due to changes in altitude and speed. When the ship rises or swings behind the passengers will feel a state of weightlessness while at the end of its height. The state of weightlessness experienced by passengers is not due to a decrease in the gravitational force of the earth, but due to the force on the seat or on other external objects that push the passenger's weight. The forces from these external objects will neutralize the earth's gravitational force or downward force. Although the kora-kora did not cross a full circle, it was as if the passengers had experienced a full circle of motion. That's because the kora-kora swing back and forth on a semicircular curved trajectory. This swing movement creates a sensation of feeling.

Related research

In this research we are doing, to analyze any physics concepts and explain in detail about each physics concept contained in the rides on the night market. analyzing previous articles from both national and international journals with a range of 2018-2022, the following is the latest related research:

Table 1. Literature Review of the last five years

Author	Destination Study	finding _ Interesting
Rumiati et al., 2021	The purpose of this study was to analyze the physics concept of mechanical energy in the traditional game of stilts.	The concept of kinetic energy is found in the motion of the stilts while the concept of potential energy is found in the position of the footrest and the lifting of the stilts.
Supriyanto, 2020	The purpose of this study is to increase student activity and achievement in circular motion material through *outbound activities* carried out by schools	The results of this study indicate that the outbound approach is appropriate to use in learning circular motion material which can increase student activity and achievement.
Lestari, 2019	The purpose of this study was to use the "Bicycle Assisted Fun Bike" learning method to increase motivation and learning outcomes of circular motion physics.	The results showed that the use of the learning model "Bicycle Assisted Fun Bike" theoretically and empirically can increase motivation and success in learning circular motion physics.
Raharja et al., 2020	The purpose of this study was to create a module to determine the feasibility of exercises and the use of circular motion materials by high school students	This shows that the module made is feasible to be used as a medium for learning circular motion material, besides that the module also contains examples of circular motion applications in everyday life.
Arifi et al., 2021	The purpose of this research is to explain the analysis of physics concepts about the use of hoes by farmers and then describe the design of physics teaching materials	The results of this study, one of the physical concepts that exist in the use of the hoe is the moment of force (torque), besides that there is also the concept of equilibrium of rigid bodies and matter, work and energy,
Maspupah et al., 2020	The purpose of this research is to create an electrical energy storage system generated from children's games by connecting the mechanical energy of the rotating bowl on the playground to the generator.	The result of this research is that the resulting current and voltage can be stored in the *accumulator* by increasing the voltage using a *step up* . The magnitude of the voltage and current generated by the generator is proportional to the speed at which the rotating bowl rotates.
Nuryantini, 2020	The purpose of this study is to increase students' understanding of the concept of simple harmonic motion through experiments using a magnetometer	The results of this study indicate that the use *of smartphones* can be one of the solutions and innovations in learning Physics as in simple harmonic motion experiments. The value generated in the experiment using *a smartphone* shows conformity with the theoretical simple harmonic motion concept.

Author	Destination Study	finding _ Interesting
	sensor on *a smartphone* .	
Afkarina, 2021	The purpose of this research is to analyze the physics concept in the traditional game, namely kereweng kereweng and used as teaching material in physics learning.	The results of this study indicate that in the traditional game, Kerapan Kereweng, there are several related physics concepts. The physical concepts are centripetal force, frictional force, Hooke's law and Newton's law.
Wati & Misbah, 2021	The purpose of this study was to analyze the effectiveness of physics teaching materials by applying *authentic learning* to the concept of circular motion physics.	The results of this study indicate that physics teaching materials by applying *authentic learning* to the concept of circular motion physics are effectively used in the learning process and to improve learning outcomes.
Nugraha et al., 2019	The purpose of this study was to analyze students' answers about the concept of simple harmonic motion and determine problems experienced by students on the concept of harmonic motion.	The results of the study showed that most of the students only understood some of the concepts. The most difficult concept is about the relationship between displacement, velocity, and acceleration.
Hamdi Rifai et al., 2019	The purpose of this research is to integrate the physics concepts that exist in the Geopark's natural rides Ngarai Sianok and Mifan Water Park Padang Long into the learning of physics.	The results of the study show that natural tourism objects (Canyons Sianok) and artificial ones (MiFan Water Park Padang Panjang) can be used as learning resources and as a means of using the stages of the learning model as in the discovery learning model
Rini Anggraini et al., 2019	The purpose of this study was to determine the mathematics learning outcomes of third grade students of SD Negeri 4 Srikaton after the Ferris wheel was applied, it was significantly complete and active.	The results of the study show that after getting learning using the Ferris wheel media students become more active
Nurullaeli et al., 2018	The purpose of this research is to create a Graphic User Interface (GU) which is used as a concept analysis tool math swing	The results of the study show that the use of a GUI minimizes calculation errors and saves time in mathematical swing analysis
Uranti Amba Lembang et al., 2021	The purpose of this study was to determine the effect of Virtual Problem Solving learning Laboratory on the mastery of students' physics concepts on the subject of Twisting Swing	The results of the study show that there is an effect of virtual laboratory problem solving learning on students' mastery of physics concepts on torsional swing material
Dina Afkarina et al.,	The purpose of this study is to	The results of the study show that the

Author	Destination Study	finding _ Interesting
2021	analyze the concept of physics in the traditional game often kereweng as physics teaching material	frequency of rattlesnakes has a relationship with physical concepts including Newton's law, Hooke's law, frictional force and centripetal force.

From Table 1, there are many researchers who use games as a medium of learning in physics learning, both traditional and modern games. In addition to the game vehicle, the concept of physics is also found in the Kereweng Traditional Dance. The concepts applied include Newton's law, Hooke's law, frictional force and centripetal force (Afkarina, 2021). The physics concept of centripetal force is also applied to the rides we discussed, namely Ferris wheel and merry-go-round. In addition to the traditional game of stilts, there are also physics concepts that can be used as interesting learning media for students, the concept studied is potential energy as well as the kora-kora game vehicle which also applies the concept of physics to potential energy.

CONCLUSION

This research shows that learning physics or understanding physics concepts is not only done in the classroom, but can be done outside the classroom even at fun playgrounds. Places that can be visited don't have to be far and expensive, there are many nearby playgrounds such as the night market which is usually held in residential areas and the prices are affordable. So there is no reason not to learn, learning can be done anywhere, even while playing. The physics concepts applied in the night market games include centripetal force on the Ferris wheel and merry-go-round as well as the concept of simple harmonic motion on the kora-kora ride. Exploration of physics concepts on game vehicles can be an innovation in learning when students are getting bored in learning physics in theory, teachers can connect physics materials and concepts with game vehicles around us or even if possible can invite students to study outside the classroom so that learning can take place. become more meaningful, fun and easy to remember by students.

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