Studies in Philosophy of Science and Education
Homepage: https://scie-journal.com/index.php/SiPoSE
Email: sipose@scie-journal.com

p-ISSN: 2722-3523; e-ISSN: 2721-9267
SiPoSE, Vol. 3, No. 1, March 2022: 22-29

Exploration of Physics Concepts in Several Game Rides at Surabaya Prestasi Park

***D A Pratama[1], A K Niza[1], B K Prahani[1], D Dwikoranto[1]**
[1]Department of Physics, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, Indonesia

Article Info

Article history:

Received January 28, 2022
Revised February 15, 2022
Accepted March 15, 2022
Available Online March 31, 2022

Keywords:

Energy
Force
Harmonic motion
Levers
Physics

ABSTRACT

The purpose of this research is to find out the concept of physics in the game rides in Surabaya Prestasi Park and provide information through photos taken directly to readers. In this article the experimental method used is direct observation, documentation, and analysis (literature study) as a form of data collection. In this article, four physics concepts are found in the game rides, namely swings, slides, and seesaws in the form of simple harmonic motion concepts, energy, force, and levers. When playing swing there is a concept of physics that occurs in the motion of the swing, namely simple harmonic motion and the energy contained therein. In the slide there are physics concepts namely frictional force, energy concept and inclined plane. On the seesaw there is the concept of a lever. From this article it can be concluded that the rides at Surabaya Prestasi Park have a lot to do with physics concepts, including the concepts of simple harmonic motion, energy, force, and levers through personal documentation with direct observation so that apart from playing, children indirectly have learned the concept of physics so as to increase knowledge and insight

https://doi.org/10.46627/sipose

INTRODUCTION

All activities that we do will always be related to the concept of physics. Generally, physics concepts are taught to better understand concepts rather than just memorizing them, because by understanding the concepts, the material received by students will be better stored and embedded in the brain's memory. The concept must stand out so that the physics learning process can take place optimally (Suprapto et al, 2021). Learning activities for students must really consider the experience gained by students, namely by obtaining it outside the classroom, it can develop various student activities and add new learning experiences outside the classroom (Corbeet, 2020; Windariyah, 2018). Learning efforts for students are still often carried out in the classroom, namely with explanations from the teacher and students only listen to what is conveyed by the teacher, but in realizing increased understanding and experience of students, it is necessary to carry out learning outside the classroom, so that students understand learning better. Physics is related to daily activities, by seeing it directly students can learn as well as get a new atmosphere. One thing that can be realized is by inviting students to visit several tourist attractions that have game rides for them to play while at the same time learning the relationship between the concept of physics and game rides (Yusuf et al., 2017; Nichols et al., 2016).

Indonesia has many tourist attractions and rides from many parts of Indonesia. Both traditional game rides and modern game rides. Along with technological developments, amusement parks in Indonesia are increasing and developing with their innovations. According to the results of research by Harefa (2019) that there are many physics concepts that can be

DOI : https://doi.org/10.46627/sipose.v3i1.253

connected in one form of equipment as a result of technology. Not only for children's play areas, game rides can also be used for learning, especially learning physics concepts. All game rides are related to physics concepts, for example swings, ferris wheels, slides, roller coasters, and many more (Semken et al., 2017; Miller 7 Twum, 2017). One of the places for the game is Surabaya Prestasi Park.

Prestasi Park is one of the many parks that have many rides on Street Ketabang Kali no. 6, Surabaya City, East Java. The Surabaya City Government built this Prestasi Park in 1992, then in 1995 Mrs. Marie Basofie Sudirman inaugurated this park. The location of this Prestasi Park is very strategic because it was built on Street Ketabang Kali, Genteng District, Surabaya, where the location is very strategic. Judging from its utilization, this Prestasi Park is used as a character as an active green open space. There are several tourist spots in the Prestasi Park, such as replicas of the achievements that have been achieved by the City of Surabaya, namely in 1992 as the "Wahana Tata Nugraha" and "Adipura Kota Raya". Prestasi Park is still operating today where it was built over 6,000 square meters, various public facilities such as a children's playground, games rides, open stage, and the B-16 Bomber aircraft monument are in Prestasi Park (Imansari & Khadiyanta, 2015).

Physics learning, especially students from Surabaya can use the Prestasi Park to make physics learning not monotonous where learning activities are only carried out in the classroom. Physics learning activities at the Prestasi Park allow students to see directly the concepts of physics that are applied to everyday life, namely in games, because contextual learning like that is still rarely done for learning physics. By implementing physics learning outside the classroom, students get a new atmosphere of learning outside the classroom, learning physics like that can also make students' understanding of physics concepts more embedded in their memory, various questions will arise from students about the vehicle for the game, how can the game rides be like that, what affects it, if the game rides don't work properly what happens, and there are many more student questions that can provoke them to better understand physics concepts. The process of understanding physics concepts is carried out with the aim of being able to solve problems so that the results of exploring physics concepts can be said to be meaningful. This can be realized if you are able to exceed the limits of your previous capabilities (Wulansari & Admoko, 2021). We as teachers must also be able to provide the facilities needed by students. So, on the basis of this statement and background, this research was conducted, with the aim of exploring the concept of physics in various games in Surabaya Prestasi Park.

RESEARCH METHOD

Qualitative descriptive is the type of research used in this research. Descriptive is a problem formulation that has the aim of exploring social situations which will be examined in depth, comprehensively, and broadly. According to Bogdan and Taylor, cited by Lexy J. Moleong, a qualitative approach is a procedure of a study in which descriptive data is produced in the form of spoken words from several people, or written words and observing behavior (Lexy, 2007).

The stages of this research are: (1) Exploring some of the rides, (2) Documenting the rides to be studied, (3) Collecting references to rides related to physics concepts, (4) Analyzing the concepts of physics contained in some rides studied, (5) Discuss the results of data analysis, (6) Formulate the conclusions of the study.

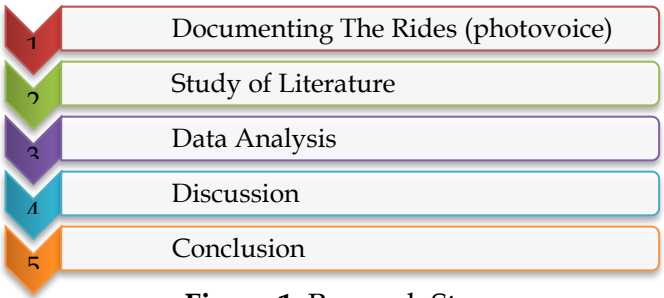

Figure 1. Research Stage

DOI : https://doi.org/10.46627/sipose.v3i1.253

This study uses direct observation, documentation, and analysis (literature study) as a form of data collection. Data analysis used observation pictures taken directly at the Surabaya Prestasi Park and then explored the physics concepts that exist in the game rides to be compared with the literature studies that have been obtained by the author. The following research stages on Figure 1.

RESULTS AND DISCUSSION

Based on the results of observations by the author, the results and discussion of each photo will be presented as follows:

Preliminary Study: Observation of rides in Surabaya Prestasi Park

In the Prestasi Park that we observed, there were lots of rides that we encountered, and of the many rides, we only decided to observe and analyze 3 rides for children's play in the Prestasi Park. The following are the results of direct shooting on several children's games in Surabaya Prestasi Park:

Figure 1. Swing game at the Surabaya Prestasi Park

(Source: personal documentation)

Figure 2. Slide game in Surabaya Prestasi Park

(Source: Personal documentation)

Figure 3. Seesaw game in Surabaya Prestasi Park

DOI : https://doi.org/10.46627/sipose.v3i1.253

(Source: personal documentation)

Table 1. The relationship between several rides in Surabaya Prestasi Park with the concept of physics

Rides	Physics Concept	Description
Swing game (Figure 1)	Simple harmonic motion	The swing is a simple pendulum that exhibits oscillatory motion
	Potential energy	A form of energy contained in an object caused by its position or position
	Kinetic energy	An energy found in every object that is in motion or is in motion
	Mechanical energy	A combination of kinetic energy and potential energy by adding up
Slide (Figure 2)	Friction	Friction usually appears when 2 surfaces touch each other directly, and the frictional force is in the same direction as the surface of the plane being touched, but opposite to the direction of the object's motion
	Potential energy	When you are at the top of the slide, the potential energy is greater than at the bottom of the slide
	Kinetic energy	When sliding down, the speed of the object will appear. In addition, the potential energy at the top of the slide will be converted into kinetic energy
Seesaw (Figure 3)	Levers	The seesaw is the first type of lever because the fulcrum is located between the load point and the force point

Discussion

In Figure 1, namely children's swings, it was found that the motion of the swings contained the concept of physics, namely simple harmonic motion. Swings make it possible to be pushed higher and higher; then slowly change the moment of inertia to keep the swing motion going.

Simple Harmonic Motion

The swing is a simple pendulum that exhibits oscillatory motion. Simple harmonic motion is an alternating motion experienced by objects by passing a certain balance point with the vibrational frequency of the object always being constant every second (Abdullah., 2016). The pendulum will stop swinging if it is not moved continuously, this is due to the influence of friction (air friction). Where the air friction force makes the pendulum stop oscillating, even though the air friction force is small. The swing of the pendulum can move back and forth because there is a restoring force. Where the restoring force is a force that always opposes the direction of the deviation (position) and has the same magnitude as the displacement.

Figure 4. Illustration of Harmonic Vibrations on a Mathematical Pendulum Swing

DOI : https://doi.org/10.46627/sipose.v3i1.253

Source: (Nurlaila, Riskawati: 2017)

$$F = mg \sin \theta \quad (1)$$

The period is the time span during which 1 vibration occurs. The resulting period value will be proportional to the comparison between time and vibration

$$T = \frac{1}{f} \ atau \ T = \frac{t}{n} \quad (2)$$

The frequency contained in the pendulum swing is the number of vibrations in one second. The resulting frequency value will be proportional to the ratio between the number of vibrations (n) in the duration of the vibration

$$f = \frac{1}{T} \ atau \ T = \frac{n}{t} \quad (3)$$

Deviation from simple harmonic motion can be considered as uniform circular motion in the diameter of a circle, where there is an angular velocity and radius, then the formula for deviation from simple harmonic motion is

$$y = A \sin \omega t \quad (4)$$

Energy in Simple Harmonic Motion

The energy contained in simple harmonic motion is the same as the energy that exists in general, kinetic energy, potential energy, and mechanical energy (Abdullah, 2016). In accordance with the law of conservation of energy says that "In harmonic vibrations there is an exchange of potential energy into kinetic energy or vice versa, but mechanical energy, namely the total potential energy and kinetic energy remain". While the meaning of potential energy itself is an energy contained in an object due to its position or position which shows that work can occur. Mathematically, the potential energy equation can be formulated as follows:

$$E_P = m \ g \ h \quad (5)$$

Meanwhile, the kinetic energy of simple harmonic motion is a form of energy contained in an object that is in a state of motion or is in motion. Mathematically, the kinetic energy equation can be formulated as follows:

$$E_K = \frac{1}{2} mv^2 \quad (6)$$

And for the mechanical energy itself in simple harmonic motion is a combination of kinetic energy and potential energy by adding up. Mathematically, the mechanical energy equation can be formulated as follows:

$$E_M = E_p + E_K \quad (7)$$

In Figure 2, which is a children's slide, there are many physics concepts that occur in motion and the inclined plane, namely the motion of friction, the concept of energy, and the concept of an inclined plane. The slide we are analyzing takes the form of an initial vertical drop and then a gradual curvature to the horizontal.

Figure 5. Illustration of a child playing on an inclined plane
Source: (Iconis Bestiary, August 2018)

Friction

Friction is generally divided into 2, namely static friction and kinetic friction, where static friction is a frictional force acting on a stationary object, and kinetic friction is a frictional force acting on a moving object. Friction usually occurs when two surfaces touch each other directly, and the

DOI : https://doi.org/10.46627/sipose.v3i1.253

frictional force is in the direction of the surface being touched, but opposite to the direction of the object's motion. There are 2 kinds of surfaces in contact with objects, smooth/slick surfaces and rough surfaces. The influence of this type of object is called the object friction coefficient (Tiara, 2019). For smooth surfaces the frictional forces are neglected and for rough surfaces the frictional forces are sufficient to influence the motion of an object. Mathematically the formulation of the friction force is as follows:

$$f_s = \mu_s N \quad (8)$$

$$f_k = \mu_k N \quad (9)$$

Potential Energy

Potential energy is a form of energy contained in objects caused by their position or position (Abdullah, 2016). In the slide game there is also the concept of energy in a conservative system. When you are at the top of the slide, the potential energy is greater than at the bottom of the slide. According to Maison et al (2020) that the potential energy will be greater the higher the position of the object. The formulation of gravitational potential energy is:

$$E_P = mgh \quad (10)$$

Kinetic Energy

Energy will always exist in a moving object (Abdullah, 2016). When sliding down, the speed of the object will appear. In addition, the potential energy at the top of the slide will be converted into kinetic energy. Kinetic energy is the energy contained in an object due to its motion. The concepts described above are in accordance with what was studied by Kalhor et al (2020), that it takes a certain particle effort and speed to increase a kinetic energy. Systematically, kinetic energy is formulated as follows:

$$E_k = \frac{1}{2} mv^2 \quad (11)$$

The law of the conservation of energy says that energy cannot be destroyed nor can it be created, but can only change it into another form. Therefore, when sliding, there is a gradual change in potential energy to kinetic energy. In figure 3 the game of seesaw can be associated with the concept of a lever. In addition, a person with a small mass can lift a person with a larger mass by adjusting the distance from the fulcrum.

Figure 6. Illustration of two children playing on a seesaw
Source: (Suhartanti et al., 2008)

Levers

The seesaw game is included in the first type, this is because the position of the fulcrum is between the powerpoint and the load point. The fulcrum is the point where the seesaw rests. The load point is the point where the load is. The power point is the point where the force is applied. Levers can make it easier to lift heavy loads and increase the force so that the force released will be smaller than the force generated. This lever can also be explained in terms of material balance principles and rotational dynamics (Destini & Nasution, 2020). The equation that applies to the lever is:

$$W_x L_B = F_x L_K \quad (12)$$

$$KM = \frac{W}{F} = \frac{L_K}{L_B} \quad (13)$$

Information:

DOI : https://doi.org/10.46627/sipose.v3i1.253

W = Weight of load (N)
F = Force (N)
L_B = Load arm (m)
L_K = Power arm (m)
KM = Mechanical Advantage

CONCLUSION

Based on the research that has been carried out, it can be concluded that the concept of physics can be found in the games at the Surabaya Prestasi Park. The rides include swings, slides, and seesaws. In the swing game, several physics concepts are identified in the swing motion, namely simple harmonic motion and the energy contained therein. In the slide game, several physics concepts are identified in motion and the inclined plane, namely the motion of friction, the concept of energy, and the concept of an inclined plane. In the seesaw game, we can associate it with the concept of a lever. In addition to playing, children have indirectly learned physics concepts thereby increasing their knowledge and insight.

ACKNOWLEDGEMENTS

Our thanks go to God Almighty, because of His blessings and grace the data collection can run smoothly, so that the writing of this article can be completed properly and on time. We also thank the lecturer for the Physics Edutainment course, Dr. Binar Kurnia Prahani, M.Pd. and Mr Drs. Dwikoranto, M.Pd. for the guidance and direction that has been given to us while working on the article, as well as all parties involved in completing the article that we cannot write one by one.

REFERENCES

Abdullah, M. (2016). *Fundamental Physics 1*. Bandung: Bandung Institute of Technology.

Corbett, M. (2020). Place-based education: A critical appraisal from a rural perspective. *Rural teacher education: Connecting land and people*, 279-298. https://doi.org/10.1007/978-981-15-2560-5_14

Destini, R., & Nasution, L. A. (2020). Use of Lever Props for Student Enthusiasm in the Classroom Learning Process. *Proceedings of the National Seminar on Research Results*, *3*(1), 569-572.

Harefa, A. R. (2019). The role of physics in everyday life. *News Journal*, *13*(2), 1–10.

Imansari, N., & Kadiyanta, P. (2015). Provision of urban forests and city parks as public green open spaces according to people's preferences in the downtown area of Tangerang–in Bahasa. *Ruang*, *1*(2), 101-10.

Kalhor, B., Mehrparvar, F., & Kalhor, B. (2020). Does using multi-dimensional energy-momentum equation change the kinetic energy formula?. *Available at SSRN 3637222*.

Lexy, J. M. (2007). Metodologi penelitian kualitatif edisi revisi. *Bandung: PT Remaja Rosdakarya*.

Maison, Lestari, N & Widaningtyas, A. (2020). Identification of Students' Misconceptions on Business and Energy Materials. *IPA Education Research Journal, 6*(1), 32-39.

Miller, D., & Twum, S. (2017). The Experiences of Selected Teachers in Implementing Place-Based Education. *in education*, *23*(1), 92-108. https://doi.org/10.37119/ojs2017.v23i1.282

Nichols, J. B., Howson, P. H., Mulrey, B. C., Ackerman, A., & Gately, S. E. (2016). The promise of place: Using place-based education principles to enhance learning. *The International Journal of Pedagogy and Curriculum*, *23*(2), 27. https://doi.org/0.18848/2327-7963/CGP/v23i02/27-41

Semken, S., Ward, E. G., Moosavi, S., & Chinn, P. W. (2017). Place-based education in geoscience: Theory, research, practice, and assessment. *Journal of geoscience education*, *65*(4), 542-562. https://doi.org/10.5408/17-276.1

Suprapto, N., Sunarti, T., Adam, A. S., & Mubarok, H. (2021). Learning from Technopark: Exploring of Physics Concept Through Advanced Technology. *International Joint Conference on Science and Engineering 2021 (IJCSE 2021)*, 642-648.

https://doi.org/10.2991/aer.k.211215.107

Tiara, K.A. (2019). *Interactive Physics Mobile Learning Media (IPMLM) A Thematic Study of Newton's Laws of Motion*. Yogyakarta: Yogyakarta State University.

Windariyah, S. (2018). Pengembangan Perangkat Pembelajaran Terpadu Model Networked Terintegrasi Place-Based Education Di Sekolah Dasar. *Jurnal Review Pendidikan Dasar: Jurnal Kajian Pendidikan Dan Hasil Penelitian*, *4*(1), 618-625. https://doi.org/10.26740/jrpd.v4n1.p618-625

Wulansari, N. I., & Admoko, S. (2021). Identification of Physics Concepts in Reog Ponorogo's Dhadak Merak Dance as A Source of Learning Physics: An Analytical Study. *Berkala Ilmiah Pendidikan Fisika*, *9*(1), 105-113. https://doi.org/10.20527/bipf.v9i1.9862

Author (s):

Dimas Ari Pratama
Department of Physics, Faculty of Mathematics and Natural Science,
Universitas Negeri Surabaya,
St. Ketintang, Surabaya 60231, Indonesia
Email: dimas.20070@mhs.unesa.ac.id

Alvin Khoirun Niza
Department of Physics, Faculty of Mathematics and Natural Science,
Universitas Negeri Surabaya,
St. Ketintang, Surabaya 60231, Indonesia
Email: alvin.20054@mhs.unesa.ac.id

Dwikoranto
Department of Physics, Faculty of Mathematics and Natural Science,
Universitas Negeri Surabaya,
St. Ketintang, Surabaya 60231, Indonesia
Email: dwikoranto@unesa.ac.id

Binar Kurnia Prahani
Department of Physics, Faculty of Mathematics and Natural Science,
Universitas Negeri Surabaya,
St. Ketintang, Surabaya 60231, Indonesia
Email: binarprahani@unesa.ac.id