



Identification of Physics Concepts in Reog Ponorogo's Dhadak Merak Dance as A Source of Learning Physics: An Analytical Study

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Abstract

Indonesia is famous for its diverse cultures, and unwittingly from each culture has a different appeal. In the culture itself, there is a science that is not widely known by people, besides local wisdom from several regions can be used as a source of learning science. So far, science learning, especially in physics, still refers only to a handbook of teachers and students, where it contains science products in the form of facts, concepts, principles, theories, and laws and their application in the context of daily life. However, many books often contain contexts of daily life related to western culture that is not well recognized by Indonesian children, especially those in certain areas who still rely on nature as a learning media. Based on these problems, the aim to observe the application of physics in Indonesia's national culture. The researcher intended to identify the concept of equilibrium and moments force in the technique of the Dhadak Merak dance movement in Reog Ponorogo. This type of research is an analytical study by using documentation studies and the research target is Dhadak Merak Dance. Data collected by the observation method and analysis method using literature study and training video. According to the results of the research, physics concept studies were obtained, especially in equilibrium materials and moments force in the Dhadak Merak Dance, and learning with an ethnoscience approach has the potential for innovation learning to be applied in physics learning because it can train students science literacy and train students to think creatively.

Keywords: Dhadak Merak Dance; Ethnoscience; Equilibrium; Physics Science Literacy

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INTRODUCTION

natural behaviour with various forms of symptoms. To understand it is necessary to learn physics by mastering basic concepts. Physics is not enough to just read, because physics is not just memorization. Hammer (1994) therefore, learning physics needs to be understood and practised to be able to solve problems.

Physics is the study of

Physics learning is one of the most influential subjects in the development of science and technology (Setiawan, 2012).

In general, the problem faced by physics learning is almost the same as mathematics, where some concepts and principles used for solving a problem. Therefore, most students lack interest in

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physics lessons and make the perception that physics lessons are difficult and boring lessons. Indirectly, negative perceptions that affect the poor or can be said to be poorly studied tend lowly. Also, several physical learning factors focus more on mathematical aspects that emphasize only a little on concepts and are not associated with the local culture of each region (Elvi & Billik, 2019).

It should be understood that physics learning is a process of understanding knowledge contextually. It requires a scientific approach to increase and develop student knowledge. Increasing knowledge concept in students can be seen through science process skills (Elvi et al., 2019).

In fact, at this time, learning physics is still not able to make the students active and involved in learning activities (Istyowati et al., 2017). Physics learning in schools mostly only refers to teacher and student handbooks, where the book already contains concepts, facts, theories, and formulas and their application in each chapter. However, the book tends to contents learning about the western culture that is often not recognized by Indonesian children, especially those in certain areas who still rely on nature for their learning media. That is one of the factors where most Indonesian children find it is hard to understand physics and make physics lessons less meaningful for their social and cultural life (Puspatantri, 2013).

Contextual learning includes learning concepts and the process of teacher teaching in the classroom by connecting the material with the environmental situation around students (Hasnawati, 2006). Also, it can encourage students to be able to connect their knowledge have to apply in student's daily lives.

Educational innovation is one of the changes, an idea, or a notion that is a brilliant idea that can apply in education to solve a problem in the environment around the community (Laos & Tefu,

2019). The narrow perspective will generate knowledge that shallow too, where the viewpoint and culture of the translation using only one side, in case only the original science alone. So, it cannot improve the mindset (Novitasari, Agustin, Sukesti, Nazri, & Handhika, 2017).

Science learning based on local wisdom or commonly called ethnosience is a learning activity that transforms original science and community beliefs that still contain myths or hereditary beliefs (Novitasari et al., 2017) and apply them in the concept of scientific science. One of the studies that have the realm of ethnosience and a branch of science that studies natural phenomena is physics.

Learning is the obligation of every human being who is undergoing education. Not only for humans who serve education, but learning has become a problem for every human being. Almost everything in this world can develop with study, suppose, knowledge, skills, habits, hobbies, and attitudes if not correct formed and developed will be useless. Hence, we all need to hone all of that by learning. Learning is done not only in school but can be carried out also outside the school, which is through the family environment, communities around the house, and socially in the community.

Science learning in schools still centres on the material in books. It is rarely for science learning to reveal the cultural realities of students. The content of the material taught is still not much that integrates with the local culture. Based on these conditions, it is necessary to develop learning methods, one of which is by using an ethnosience approach. The application of learning with an ethnosience approach requires a teacher's ability to combine indigenous knowledge with scientific knowledge (Sudarmin, Febu, Nuswowati & Sumarni, 2017).

Culture-based learning can create through learning environments and learning experiences. One of them is to

emphasize learning with culture. Besides culture, the learning process also emphasizes providing a direct experience for students to develop self-competence about the natural surroundings scientifically. This learning will be more meaningful in people's lives if the teacher can design or develop learning in a more effective and attractive atmosphere.

In general, local wisdom arises from being long internalization process already passed down from generation to generation and is the result of interactions between humans and their environment. The evolutionary process that lasts long enough grades has led to the formation of a value system that crystallizes in the form of customary laws, beliefs, and cultures (Makhmudah, Subikti, & Supeno, 2019).

One area that is Javanese culture is still lumpy. However, cultural excavation efforts in education are still very little studied. It may result in a lack of knowledge of students as the future generation will be their traditional cultures.

Javanese culture has not yet explored its original scientific potential, both in its content and pedagogical context (Sarwanto, 2014). Efforts to explore authentic Javanese science is urgent, avoid the loss of Javanese indigenous culture, and avoid cultural clashes and conflicts. One of the ethnosciences that have developed in the community is the Dhadak Merak dance in Reog Ponorogo. Reog art is a tradition that is still very much alive in society to strengthen the relationship between the people in Ponorogo (Hartono, 1980). Besides, the Reog Ponorogo show also used as a means of mobilizing many people.

According to KH. Mujab Tohir, the name Reog was original "Barongan". Which one of these art exists because of Ki Ageng Kutu Suryongalam from Bali. Therefore, Reog is almost the same as Barongan form art from Bali, while Reog itself is not actually from the original barong. Hence, it is called Barongan. Two

players in Reog lead Dhadak Merak or Barongan are usually in front of one and behind one. Then player of barong on Reog is a player with a lion's head decorated with peacock feathers and always followed by a dealer behind him who seems to be the lion's feet.

Barongan (Dhadak Merak) itself is the dominant dance equipment in Reog Ponorogo. Part of the barong itself, there is a tiger head made of wood, bamboo, rattan that close to the skin of a real kingpin tiger, then there is a lion barong where the player brings a mask in the shape of a lion's head with a crown of peacock feathers and shows his strength in lifting Dhadak Merak weighing less. over 50-60 kilograms using only the strangest of the teeth to lift the mask during the show. It is known that the abilities a player acquires when lifting a mask are through strenuous training are undeniably and believed to also be obtained by spiritual practice by fasting and meditating.

The player who raises the Dhadak Merak is not only a boy aged between 20 years and over, but women and children who are still in school can also play it. However, not many Dhadak Merak players know to carry the mask, their steps must be taken to ensure that they are not injured. Besides, there is still no development of science in the surrounding community regarding how Dhadak Merak can move as he wishes without fear of injury.

Based on the description above, the researcher realized the need to identify the Reog Ponorogo dance, especially in Dhadak Merak be a local culture of people in East Java into physics learning. Cause not many people to understand that local wisdom can be used as a learning resource and makes it easier for students to get to know the surrounding environment. And the appointed as a research topic that integrated with the concept of equilibrium and forces aims to develop a physics-based local culture in schools and develop in society.

METHOD

This type of research is an analytical study using a literature analysis (Lasswell, 1968). The research stages carried out were: collecting information about Ponorogo culture, selecting information relevant to learning physics, analyzing the physics quantities in the Merak Dhadak dance, then formulating the results of the study. The target for this research is the Dhadak Merak dance at Reog Ponorogo.

The data collection method in this research uses the observation method. This observation method uses to obtain information about the Reog dance and to analyze the movements contained in the Dhadak Merak dance. Besides, there are two methods of analysis data used, from studies literature and analysis of observations from exercise videos to find physics concepts. Data collection based on literature studies is by collecting previous journals, books and thesis results.

RESULT AND DISCUSSION

Indonesia is a country that has many cultures, such as Javanese culture that is famous for politeness, or in the Javanese language is polite, the Sundanese culture that is famous for its tenderness, and many other cultures scattered throughout Indonesia.

Then, what is meant by culture? The culture term comes from Sanskrit, which is *Buddhayah* is included in the plural form of the word *buddhi*. Where word *Buddhi* is have spoken in Indonesian, namely *Budi*, which means things related to the human sense. Meanwhile, the culture term is taken by English culture from the Latin culture from the root word *coloured* had means to cultivate or work (to civilize).

Art refers to behaviour, beliefs, and other outcomes from a group of people passed down from generation to generation. Another result of this is an interaction between humans and their surroundings over the years (Santrock, 2014).

According to Koentjaraningrat (1984), there are three forms of culture, namely complex culture from several ideas, an activity of human behaviour in society, and culture as the work of humans in object form.

A culture is a form of local wisdom that use as an identity for an area. In general, "local wisdom" is something that is usually done and applied by local people (Kun, 2013). And almost every region has its cultural characteristics.

The development of local wisdom in the area has significant meaning for the cultural development of a nation. Mainly to maintain this culture still has significance for an area.

There is one way that we can be applied to cultivate cultural knowledge to connect with up-to-date scientific knowledge, which is by apply ethnosience knowledge. Because ethnos is a knowledge that comes from culture and acts as a basis for realistic known from someone who can be related to the scientific knowledge obtained (Novitasari et al., 2017).

Ethnosience knowledge is knowing where the known comes from the norms and beliefs of specific local communities that will influence the interpretation and understanding of nature (Fasasi, 2017).

Learning science with an ethnosience approach is culture-based learning through extracting genuine understanding from students of a particular regional culture with the next one made into scientific knowledge (Sudarmin et al., 2017).

The application of ethnosience learning has potential in developing learning methods that are difficult to exist, where so far, especially in physics learning, still uses teacher-centred learning. Therefore, if ethnosience learning can apply to learning, it will change the method from teacher-centred learning to student-centred learning. Thus, students have expected to increase their appreciation of the knowledge of culture

and be able to create learning contextual situations and full of meaning, so that the knowledge gained by students becomes long-term knowledge or understanding (Atmojo, 2012).

In addition to making knowledge ethnoscience learning students to remember into a long-term understanding and more meaningful, it can encourage learning by ethnoscience motivate students to learn about science by using the surrounding environment (Novia, Nurjannah, & Kamaluddin, 2015).

Culture-based learning an expectation that students will understand the concept of science, can apply it in daily life, preserve, respect, train character, increase motivation, and better learning results in school. Based on this, it is necessary to have teaching materials that use as intermediaries between the subject matter and the local wisdom of the local community (Jufri, 2019; Bakhtiar, 2016; Husin & Darsono, 2018).

This culture-based learning turns out can make students not only receive the information that is delivered. But, students also able to get meaning, understanding, and develop the knowledge they have acquired. In this learning process, it is not only transfer culture in realization yet, but students make meaning to break the boundaries of their imagination in achieving deep understanding, which turns out that students can be more creative in the subjects that have been studied.

Ethnoscience study of the Dhadak Merak dance

The results in Reog Ponorogo Dhadak Merak dance indicate a value of local wisdom and potential entrains that can be applied as a reference for learning science.

Traditional art culture is Reog art which is popular in East Java. Around 17 areas in East Java have Reog performing arts such as the cities of Surabaya, Mojokerto, Jombang, Kediri, Magetan, Nganjuk, Ngawi, Pacitan, Trenggalek, Sidoarjo, Tulungagung and Ponorogo

Regency which are the places where Reog's performing arts develop (Trisakti, 2012).

Even though Reog art exists in various regions in East Java, Reog art has become a typical icon of Ponorogo Regency. Reog Ponorogo is a traditional performing art that has a very diverse background in performances. This art has become part of society, which symbolizes life and representation of people's daily activities.

There is no standardization in the type of movement that causes diversity between regions. In response to this, to avoid significant differences, a regularity of motion and instruments in Reog's art has been carried out to stop misunderstanding and multiple interpretations. Besides, it is also possible to create uniformity in the preservation of Reog's art.

The results of the analysis of the concepts of physics in the Dhadak Merak dance

The results of the analysis researchers from study literature show in the technique of Dhadak Merak dance, during the show a player shouldering the head of a lion which decorate with peacock feathers or called Dhadak Merak with weighs about 50-60 kg and only uses teeth. It can be done because of long enough physical training and done by professional players.

The physics concept that existed when Dhadak Merak was in a standing position was Newton's First Law, namely:

$$\begin{aligned}\sum \vec{F} &= 0 \\ W_1 + W_2 - N &= 0\end{aligned}$$

When standing, position your legs open with a low. Then for both arms forming elbows with palms facing forward. When the sleeve from the elbows, there is a contraction of the bicep muscle that becomes a power arm that results from oxidation in the body through food consumed by Dhadak Merak players (Erman, 2016). The position of head

upright with the neck supporting the load, namely Dhadak Merak that bitten. In this situation, the pressure on the neck is overpowering then it can hold Dhadak Merak in a stable or balanced state (Wahyuni et al., 2019). Can see Figure 1 and Figure 2.

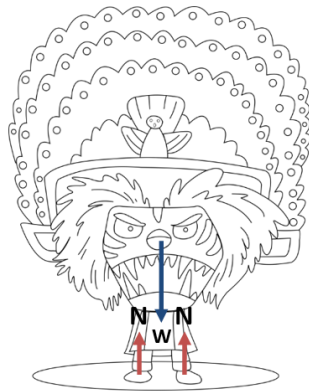


Figure 1 Position of The Standing Dhadak Merak Player

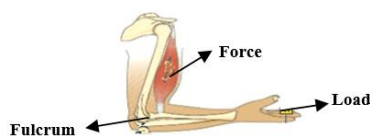


Figure 2 Schematic of Dhadak Merak's Player Arm

Besides, there is a working concept where an activity carried out by humans uses a certain amount of energy. This concept exists when the Dhadak Merak dancer tries to move right or left.

$$W = \vec{F} \cdot s$$

In addition to force, power, or power is describe the size of an effort also includes. With a comparison between work (W) and time (t), the working coefficient of a movement performed by the Dhadak Merak dancer will obtain, that is:

$$P = \frac{W}{t},$$

Work and power of the efforts made dancers perform efficient action and can calculate through a mechanical advantage

from a comparison of the force produced between the force exerted by the player.

$$K = \frac{\vec{F}_o}{\vec{F}_i}$$

It can observe that there is a simple airplane concept here, with the main aim of getting the value of the mechanical advantage so that the Dhadak Merak position can remain balanced.

Because to support the Dhadak Merak, there is the concept of lifting heavy loads, it takes the right position with the effort required is also quite large. It is also influenced by the muscle force that results in reduced energy because it takes a lot of effort to consider when the Dhadak Merak is standing to remains balanced. This energy to obtained from food through the body's metabolic processes.

When nodding the head forward while still biting the Dhadak Merak, the head and neck work as levers with the pile point on the top of the neck. Neck muscles play a role in providing a powerful force to pull the head into its original position. Can see in Figure 3.

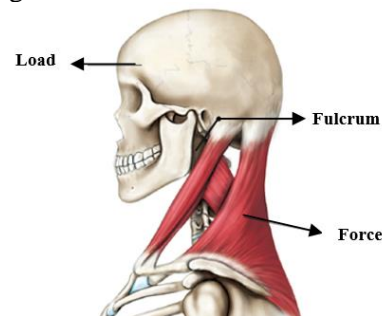


Figure 3 The Scheme When Dhadak Merak Players Move The Dhadak Merak Mask Forward or Backward

Sometimes Dhadak Merak players also perform attraction movements with their tiptoes feet. The toes of these feet are the fulcrums. Besides, it turns out that tiptoe can train body balance. So for more details, please see Figure 4.

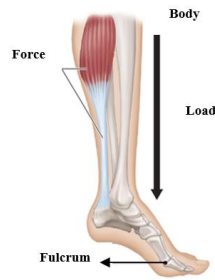


Figure 4 Schematic of Dhadak Merak's Feet When Tiptoeing

So that when performing the Dhadak Merak player attraction it remains balanced, the position of the legs must adjust accordingly in Figure 5.

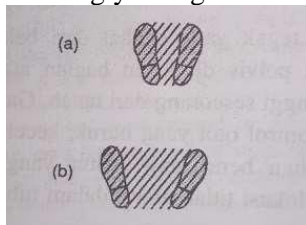


Figure 5 The Position of The Legs While Standing to Produce A Stable Area

The position of the feet as support and this position of the body in the perfect placement of emphasis should be the focus of the Dhadak Merak dance player. Then when the Dhadak Merak is carrying and moving is the concept of Newton's Law II, namely:

$$\Sigma \vec{F} = m \cdot \vec{a}$$

Wherefrom Newton II's Law can derive to be:

$$\begin{aligned} \vec{F} &= m(\alpha \cdot R) \\ \vec{F} \cdot r &= m\alpha r^2 \\ \vec{\tau} &= I \cdot \alpha \end{aligned}$$

And for more details, please see Figure 6 and the Dhadak Merak motion diagram.

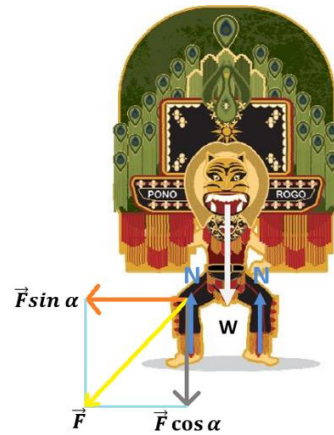


Figure 6 Dhadak Merak's Moving Position

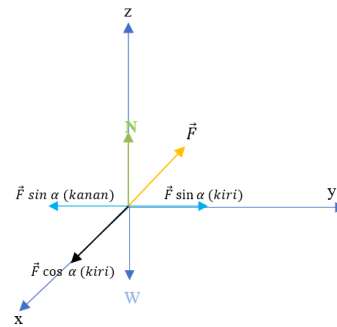


Figure 7 Dhadak Merak Motion Diagram

Because the movement of the Merak Dhadak also rotates not only by holding heavy loads, it is a concept of torque, namely:

$$\vec{\tau} = \vec{F} \cdot r \sin \phi$$

Where $r \sin \phi$ or usually d is the moment arm. The value of the forces and torque that works based on the motion diagram are:

$$\begin{aligned} \Sigma \vec{F} &= 0, & \Sigma \vec{\tau} &= 0 \\ \Sigma \vec{F}_x &= 0, & \Sigma \vec{\tau}_x &= 0 \\ \Sigma \vec{F}_y &= 0, & \Sigma \vec{\tau}_y &= 0 \\ \Sigma \vec{F}_z &= 0, & \Sigma \vec{\tau}_z &= 0 \end{aligned}$$

The player focuses on the centre of mass of the body in the middle with both legs as support for the weight. The chest is tilted forward, the shoulder blades are pulled back to create an upright and optimistic impression. This attitude can be called the resistance force of the force.

While moving, the Dhadak Merak player must also have a strong stance, this is one of the tricks to gather strength in the thighs so that the legs become stronger. It is said to be balanced if the peacock impromptu is in a stable state, namely:

$$\Sigma \vec{F} = 0, \text{ dan } \Sigma \vec{\tau} = 0$$

Besides, there is also the concept of Newton III's Law, namely:

$$\vec{F}_{aksi} = -\vec{F}_{reaksi}$$

This concept applies when the position of the Dhadak Merak dance player is standing and maintaining the position of the mask to remain balanced. The force that embraces the concept of Newton III's Law is in the Dhadak Merak mask that presses the head of the Dhadak Merak dance player. Action Force (\vec{F}_{action}) was given by a mask that presses the head and points downward or towards the centre of the earth, while for the Reaction Force ($-\vec{F}_{reaction}$) found on the human head or the head of the Dhadak Merak player.

Where it explains that Newton III's Law can work if it has the same force in the opposite direction and acts on a different object therefore, the concept of Newton's Law III works on the mask against the head of the Dhadak Merak dance player. For more details, can see Figure 8.

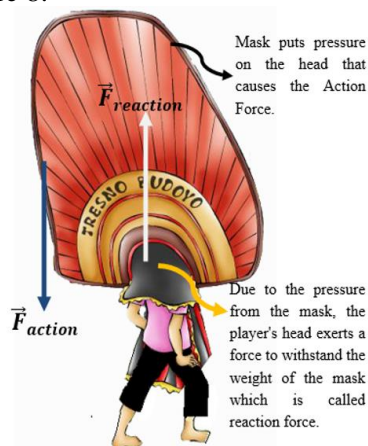


Figure 8 Illustration of Newton III Law on the Peacock Dhadak Mask against the Player's Head

In addition to physical exercise and strong stances, it is believed that there is one other factor that allows players to perform rotating movements or attractions using only the strength of their teeth to withstand Dhadak Merak, namely the power of spiritual practice by fasting and meditating.

CONCLUSION

Based on the results and discussion above, it can be concluded that every movement made by the Dhadak Merak dancer can be studied with physics. In the Dhadak Merak dance technique, there is a concept of physics that includes: gravity which is controlled by the muscles, and the equilibrium of the Dhadak Merak player's stance to keep the centre of gravity in position. Newton I Law to study the balanced position and strength of the player which can be analyzed from the simple plane concept that is in the player's body and the concept of effort and energy, then Newton II's Law when the player is doing an attraction which causes a moment of force and to maintain balance from the position of the mask. From Newton II's Law, the derivative of the equation is obtained to determine the concept of equilibrium and the moment of force from the movement of the player while using the Dhadak Merak mask. And Newton's Law III explains that there is an active force from the mask that presses the player's head with the same force as the reaction force, and there is a reaction force from the player's head to the mask to maintain balance.

If the movements made by the player are faster, the player's energy will be drained a lot because the effort is quite the biggest. Where this concept can develop in society without realizing that this is called the original science of society. Through physics learning with ethnoscience can help people to improve genuine scientific knowledge from people become real science.

For further research, it can be done by examining other concepts, and it is

advisable to search for more references to help analyze the existing concept studies in the Merak Dhadak Dance.

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