24 (2), 2023, 406-418

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Karapan Sapi Madura: An Analytical Study toward Potential Local Wisdom as Teaching Materials of Newtons's Laws of Motion

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Abstract: Developments in science and Indonesia continue to overgrow. One of them is proven by integrating knowledge through local wisdom in each of the studied knowledge. This study aims to explore and identify the potential of the local wisdom of *Karapan Sapi Madura* as teaching material on Newton's law material. This research uses qualitative descriptive type through Education analysis. Technique collection that data used is study literature, observation, and interviews. The results of this study present a linear study with knowledge of ethnoscience and ethnophysics on *Karapan Sapi Madura*. Besides that, study This study also found the potential for the local wisdom of the Madura Sapi Karapan to be used as teaching material on Newton's law material. In the future, local wisdom is expected of *Karapan Sapi Madura* that can be compiled in book form, e-books, or handouts that students and teachers can utilize to support learning physics by giving real examples and learning more meaning. In addition, it is also hoped that research related to wisdom locally is continuously developed and optimized for material learning, which is linear.

Keywords: Indonesia local wisdom, physics learning, ethnophysics.

Abstrak: *Perkembangan ilmu pengetahuan di Indonesia terus berkembang pesat. Salah satunya dibuktikan dengan adanya integrasi pengetahuan melalui kearifan lokal pada masing-masing ilmu yang dipelajari. Penelitian ini bertujuan untuk mengeksplorasi dan mengidentifikasi potensi kearifan Lokal Karapan Sapi Madura sebagai bahan ajar pada materi Hukum Newton. Penelitian ini menggunakan jenis deskriptif kualitatif melalui studi analitik. Teknik pengumpulan data yang digunakan adalah studi literatur, observasi, dan wawancara. Hasil penelitian ini menyajikan kajian yang linear dengan ilmu etnosains dan etnofisika pada Karapan Sapi Madura. Selain itu, penelitian ini juga menemukan potensi kearifan Lokal Karapan Sapi Madura dijadikan sebagai bahan ajar pada materi Hukum Newton. Kedepannya diharapkan kearifan lokal Karapan Sapi Madura ini dapat disusun dalam bentuk buku, ebook, ataupun handout yang dapat dimanfaatkan oleh peserta didik dan guru dalam menunjang pembelajaran fisika dengan memberikan contoh nyata sehingga pembelajaran lebih bermakna. Selain itu, juga diharapkan penelitian terkait kearifan lokal terus dikembangkan dan dioptimalkan untuk materi pembelajaran yang linear.*

Kata kunci: *kearifan lokal, pembelajaran fisika, etnofisika*

▪ INTRODUCTION

The existing cultural wealth makes Indonesia one of the countries with so much local wisdom. Local wisdom comes from two words; wisdom means wisdom, and local means local (Affandy, 2017; Njatrijani, 2018). According to Hasanah et al. (2016), local wisdom can be understood as a collection of valuable, wise, and wise ideas that are well-maintained and followed by the whole community. Along with the development of the education sector, the Ministry of Education and Culture regulates local content in the 2013 curriculum and the Kurikulum Merdeka (Machali, 2014; Rahmadayanti & Hartoyo, 2022; Suja'i, 2023). One of the most famous cultures in East Java, precisely in

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DOI: http://dx.doi.org/10.23960/jpmipa/v24i2.pp406-418
Received: 14 April 2023
Accepted: 10 June 2023
Published: 19 June 2023

Madura, is the *Karapan Sapi*. According to Fauzuna (2020), *Karapan Sapi* is a bull racing competition and is a hallmark of the Madurese people. This distinctive Madurese culture is held every year in August or September and will be contested again for the final at the end of September or October. The hope is that the various cultures in Indonesia can be integrated into learning so that learning is more meaningful while preserving local wisdom through the education sector.

Research related to the local wisdom of *Karapan Sapi Madura* has been widely discussed, but integration in the world of education is still lacking limited. Research conducted by Suprapto et al. (2022) discusses the relationship between *Karapan Sapi Madura*, ethnoscience, and ethnophysics using model equation modeling. The research resulted in variable latent against Madura Bull Race. Then research is done by Tartila (2020) developing the historical comic *Karapan Sapi Madura* used as a deep media effort to conserve culture. In addition, research was conducted by Mappiare-AT et al. (2021) presents results related to how the values contained in the Madura Cow Race can be developed to shape student character. From this it can be seen that the *Karapan Sapi Madura* has the potential to be used as a reference in several sectors.

Based on previous research, it appears that the local wisdom potential of *Karapan Sapi Madura* is enormous. Previous studies still present the relationship between *Karapan Sapi* on knowledge, the preserving medium culture, and as efforts to build student character. In this case, the potential for local wisdom of *Karapan Sapi Madura* can also be found in integrated learning physics, specifically on Newton's Laws. This can be supported by the successful application of local wisdom in sector education that is used as a source or media learning

Cultural diversity from various regions began to be utilized in the education sector. This is evidenced by the many studies conducted on local wisdom with different objectives. The existing potentials make researchers continue to seek and develop research through ethnoscience studies, ethnophysics, ethnomathematics, and ethnochemistry (Abonyi et al., 2014; Ajayi et al., 2017; Fitriyah, 2022; Fadilah et al., 2021; Lestari & Apsari, 2022; Zidni & Eilks, 2018). In addition, in the world of education, local wisdom is used as a source and learning media such as worksheets, e-books, e-modules, handouts, and many more. This indirectly states that local wisdom has extraordinary potential to be used as a source of learning in academic units.

One of the subjects that require real examples is physics. According to Jh (2018); Hartuti (2015); Sabiroya et al. (2018), Physics is known for its material that is difficult to learn in junior high school, high school, and college education units. Physics is so abstract without exists real examples given in learning. Therefore, one that is closest to everyday life is local wisdom. Local wisdom can be an alternative to providing contextual examples during learning so students can understand the material better (Saputro et al., 2021; Suyitno, 2012). However, an in-depth study is needed before using local wisdom as a source or learning material because it must have linearity between the material and local wisdom.

Based on the description above, researchers are interested in conducting further analytical studies related to the local wisdom of *Karapan Sapi Madura* as learning material. This study has a specific objective of exploring and identifying the physics concepts of Newton's law on the local wisdom of *Karapan Sapi Madura* found on

Madura Island. On the other hand, it can also preserve local wisdom through the education sector and provide examples real for participants to educate

▪ METHOD

The research used is descriptive qualitative through analytic studies. Descriptive qualitative is a technique that can guide in exploring a situation in detail carefully and deeply (Angito, 2018; Nugrahani & Hum, 2014; Pahlaviannur et al., 2022; Rukin, 2019). Data collection techniques used in this study were literature studies, observations, and interviews. Literature study activities are carried out at the outset to collect information related to the concept of Newton's laws from studies of journal articles, books, or reliable literary sources. Observations were made to observe the appropriate *Karapan Sapi Madura* activities and have the potential to be integrated into Newton's Laws. Observations were made directly or indirectly. Direct observation is carried out during trials by cattle owners in the field. While indirectly, it is done through observing relevant youtube videos.

After that, unstructured interviews were carried out directly with random questions from the researcher but they were still under research. Interviews were conducted directly with owners and joki. The interview aims to further ensure the information obtained is more valid and in accordance with the research being conducted. After all the data has been collected, reduction, summarizing, and analyzing activities will be carried out according to the needs of the analysis needed. In addition, the results will be presented and used as teaching materials and a source of efficiency for students, teachers, and even the government through physics learning based on the local wisdom *Karapan Sapi Madura*. The research steps are presented in Figure 1.

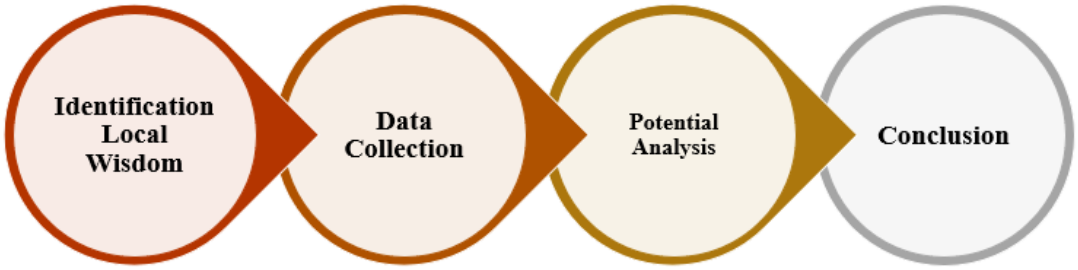

Figure 1. Research stages

▪ RESULT AND DISSCUSSION

Local Wisdom *Karapan Sapi Madura*

In the 14th century, King Sapudi ordered Panembahan Blingi. He did much to inculcate ways to breed bulls, which his son, Adi Poday, continued. The son wandered for a long time in mainland Madura and took advantage of his agricultural experience on Sapudi Island so that agriculture was increasingly advanced. Because agriculture is progressing rapidly in cultivating land, farmers are often competing to finish their job. The busyness of competing to finish the job eventually gave rise to a kind of sport or fast racing competition called *Karapan Sapi* (www.pulaumadura.com/).

Karapan Sapi is one type of art, sport, or traditional game that the people of Madura Island routinely carry out. There are two versions regarding the origin of the

word Kerapan or Karapan, reported by the Ministry of Education and Culture website. First, the term Karapan comes from the word "kerap" or "kirap," which means departing and being released together or in droves (Pambudi, 2015). The second version, namely Karapan comes from Arabic “Kirabah” which means friendship (Salihah, 2019). In the race, a pair of bulls pulled kaleles of bamboo, and the joki stands to control the pair of bulls. Pairs of bulls are driven to compete quickly against other pairs of bulls. The track distance of a race is usually approx 100 meters, and the race lasts about ten seconds to one minute.

Not only a competition, but *Karapan Sapi* is also a place for people's parties and prestigious events for the Madurese people (Kosim, 2007; Mutmainnah & Azar, 2022). Even the social status of the owner of the *Karapan Sapi* is raised if the bull becomes a champion. These animals are often used as investment materials by being trained and cared for before competing. That way, *Karapan Sapi* will become healthy and robust and win in participating in competitions. The monthly maintenance fee for a *Karapan Sapi* is quite large, namely IDR 4,000,000.00 per pair for food and other maintenance. *Karapan Sapi* is often given various herbs and dozens of free-range chicken eggs daily, especially before being contested in the race arena. The *Karapan Sapi* consists of several types, from small sub-district level races to residency level races which are attended by the champions of each region and becomes the highlight of the event.

Quoted from the Directorate General of Culture (1991) states that the *Karapan Sapi* competition also involves many parties in the community, (1) owners of racing bulls, (2) tukang tongko (joki) in charge of controlling the racing bulls above kaleles, (3) tukang tambeng who holds the bull's bridle before it is released, (4) tukang gettak who bully bulls so that when given a signal they can run fast, (5) tukang tonja who pulls and guides bulls, and (6) tukang gubra cheering to encourage the racing bulls.

Before the *Karapan Sapi* begins, pairs of bulls are paraded around the racetrack accompanied by Madurese gamelan. In addition to relaxing the muscles of the bulls, this process is also an arena to show off the beauty of the clothes and ornaments of the competing bulls. After the parade is over, then the clothes and all the decorations are opened. After that, the first race begins to determine the standings of the participants. In this round, the participants will set a strategy so that their bulls will enter the 'upper' group so that in the next round preliminary, they can compete with the 'lower' race bulls. The stages of the preliminary round are the first, second, third, and fourth elimination rounds or final rounds. In this preliminary round, the game uses a knockout system. So, racing bulls that have lost cannot participate in the next round of competition, while the winning bulls will face the winner of another competition. Thus, until one, *Karapan Sapi* remains the winner. If you pay close attention, *Karapan Sapi* is not just a competition but also contains noble values in social life, namely hard work, cooperation, sportsmanship, competition, and order.

Context Ethnoscience and Ethnophysics

From the side terminology, ethnoscience derived from the word ethnos greek word meaning nation, and the word science latin word which means knowledge. According to Sudharmin et al. (2017), ethnoscience knowledge is the knowledge possessed by a particular community, ethnic group, or group. Ethnoscience is the knowledge that is owned by a cultural community. This science then studies or

examines knowledge systems and certain types of cultural cognition, emphasizing indigenous and distinctive knowledge of a cultural community.

According to Harefa (2017), Irawan and Muhartati (2019), Satria and Egok (2020), ethnoscience is a branch of cultural studies that seeks to understand how natives understand their nature. Indigenous people usually have an ideology and philosophy of life that influences them to survive. On this basis, ethnoscience is a form of new ethnography. Various terms such as cognitive anthropology, ethnographic semantics, and descriptive semantics arise because each expert gives a different emphasis. However, the essence is to seek a scientific level of cultural studies (Spradley, 2001).

According to Siyati (2022), Kerabhan Sape or *Karapan Sapi* is a term in the Madurese language used to name a bull racing competition. *Karapan Sapi* is also defined as a race between a pair of bulls and another bull, which both panggonong and kaleles link. *Karapan Sapi* is usually held in several locations, both at the sub-district level, then continue at the district level, and finally at the Madura level. In this way, it can be seen that *Karapan Sapi* is included in the study of ethnoscience because it contains knowledge that is closely related to a group or culture. The close link in question is the local wisdom of *Karapan Sapi*, owned by the people of Madura Island.

Ethnic consists of several scientific disciplines, such as ethnobiology, ethnochemistry, ethnomathematics, and ethnophysics (Azizah & Premono, 2021). One aspect that has a great opportunity in the future to be studied as teaching materials referring to ethnoscience is culture local wisdom. This is because culture reflects people's lives toward knowledge through trial and error (Novitasariet al., 2017). In this way, it is hoped that science learning will use an ethnoscience approach, namely linking learning with cultures local wisdom through exploring students' perspectives which are then integrated or translated into scientific knowledge (Setiawan et al., 2017).

Relationship Between Newton's Law Material and Local Wisdom of *Karapan Sapi Madura*

Newton's I Law

As is known, Newton proposed the laws of motion. Newton assumed that objects that tend to be at rest will remain at rest, and objects in motion will tend to keep moving with the same speed and direction. In addition, Newton's I Law is often called the Law of Inertia because it always wants to maintain its original state. After being analyzed, there is a concept of Newton's First Law that applies to *Karapan Sapi* activities, namely when the bull is resting (Figure 2) and the bull is walking towards the trajectory (Figure 3).

Figure 2. *Karapan sapi* at res

Figure 2. *Karapan sapi* at res

Figure 2 shows the position of the *Karapan Sapi* when it is still. Under these conditions, the force acting on the bull is zero, so the bull tries to maintain its position in a state of rest or ∑F = 0. In Figure 3, the bull's position is walking, which is guided by the owner. When the bull is running, the bull will continue to run at a constant speed or zero acceleration (v = constant or a = 0). This applies if there is no external force after the bull is running. Likewise, when the joki position is above the noise among the *Karapan Sapi* of the starter up to your finish. The joki tries to stay in his position even though much pushing occurs due to the movement of the *Karapan Sapi*.

The study of Newton's I Law is in accordance with what was presented by Halliday et al. (2013) in his book "An object at rest tends to stay at rest, and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force". On the other hand, an explanation regarding Newton's First Law is necessary noticed with carefully at the *Karapan Sapi* when used as a learning resource or teaching material. This matter worries will bring up misconceptions when not studied in depth. In line with that be delivered by Kauffman (2019) that the concept be delivered through an example should really be considered because it can have misconception when delivery.

Newton's II Law

As stated by Newton, an object's acceleration is directly proportional to the net force acting on it and inversely proportional to its mass. The direction of acceleration is the same as the direction of the net force acting on it, which is written in the form of the equation:

$$\sum F = m.a$$

Information:
∑F : force (N)
m : mass (kg)
a : acceleration of the object (m/s2)

Newton's Second Law relates the acceleration of an object to its cause (the applied force). If viewed from the *Karapan Sapi*, Newton's II Law occurs when the joki hits the back of the bull using a bill. The following illustration can be seen in Figure 4.

Figure 4. *Joki* activity

Figure 4 shows the position of the joki when hitting the bull's back using a bill. rekkang is a tool used to give a blow to the bull's back. This aims to give the bull a faster running speed. Newton's II Law, giving a push force (punch) to the bull's back gives a shock effect, and a thrust arises, affecting the bull's running speed. At first, the bill was made of wood and nails, but now it has become an ordinary whip.

The study of Newton's II Law is in accordance with what was presented by Halliday et al. (2013) in his book ”The acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass”. That way, the delivery of contextual examples based on local wisdom *Karapan Sapi Madura* must be correctly noticed when. That way, the knowledge and concepts to be conveyed are in accordance with the concepts of experts.

Gravity and Normal Force

The normal force is a contact force perpendicular to the contact surface between two objects in contact. At the same time, gravity is the gravitational force acting on an object. Gravity acts on the center of mass while the normal force acts along the planes that are in contact. The following illustration is presented in Figure 5.

Figure 5. Gravity and normal force

The gravity acting on the two bulls is the *kaleles's* gravity, the first bull's weight, and the second bull's weight. The normal force is the opposite of the direction of gravity. Based on the gravity equation, that is

$$\mathbf{W} = m.\ \mathbf{g}$$
$$\mathbf{W} = \mathbf{N}$$

Information:
W = weight force (N)
m = mass (kg)
g = acceleration due to gravity (m/s^2)

That way, the weight can be known as *kaleles* is $\mathbf{W}_{\text{Kaleles}} = m_{\text{Kaleles}}$. **g**, the weight of the bull 1 is $\mathbf{W}_{\text{bull 1}} = m_{\text{bull 1}}$. **g**, and the gravitational force of the bull 2 is $\mathbf{W}_{\text{bull 2}} = m_{\text{bull 2}}$. **g**. That way, then, $\mathbf{W}_{\text{total}} = \mathbf{W}_{\text{Kaleles}} + \mathbf{W}_{\text{bull 1+}}\ \mathbf{W}_{\text{bull 2.}}$ The mass and the gravitational pull of the earth influence the prevailing gravity.

Static Friction and Kinetic Friction

Static friction

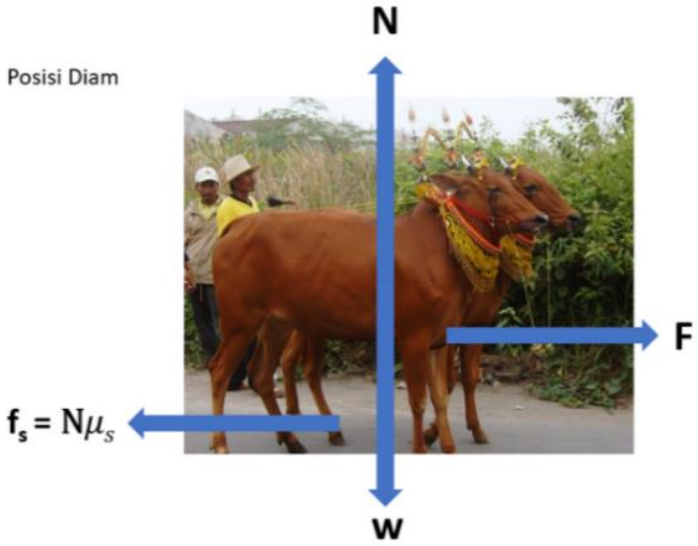

Figure 6. Illustration of static friction on karapan sapi

The static frictional force is the force acting on the object at rest (stopping). A pair of bulls stylized **F**, but the bull remained silent. This is meaningful $\mathbf{F} = \mathbf{f_s}$ to obey Newton's first law ($\sum \mathbf{F} = 0$). Static friction has a maximum value of $\mathbf{f_{s\ max}}$ when the suitable object moves. Maximum static friction $\mathbf{f_{s\ max}}$ This is influenced by the normal force and roughness of the contact area, which is determined based on the value of the static friction coefficient (m_s). This force is proportional to the normal force and the coefficient of static friction. Mathematically the static frictional force can be formulated as,

$$\mathbf{F} = \mathbf{f}_{s\ max} = \mathbf{N}\mu_s$$

Based on the equation for the maximum static frictional force, the value of the static force fully fulfills the following requirements:

$$\mathbf{F} \leq \mathbf{f_s} \rightarrow \text{Things are still}$$
$$\mathbf{F} \geq \mathbf{f_s} \rightarrow \text{Things move}$$

Information:
$\mathbf{f_s}$ = static frictional force (N)
μs = static friction coefficient
N = normal force (N)

Kinetic friction force

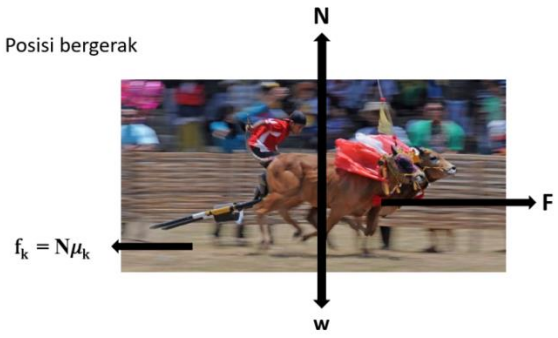

Figure 7. The kinetic frictional force on karapan sapi

Kinetic friction is the frictional force that acts when an object is moving. The magnitude of the kinetic friction $\mathbf{f_k}$ is proportional to the normal force and the coefficient of kinetic friction m_k. In this case, the coefficient of kinetic friction is smaller than that of static friction $\mathbf{f_k} < \mathbf{f_s}$. From this relationship, the kinetic frictional force can be formulated as follows.

$$\mathbf{f_k} = \mathbf{N}\mu_k$$

Information:
$\mathbf{f_k}$ = maximum kinetic friction (N)
μk = coefficient of kinetic friction
N= normal force (N)

Newton's III Law

Newton's third law states that when an object exerts a force on another object, the second object exerts a force on the first object. The two forces have the same magnitude but are opposite in direction. Newton's Third Law is often called the Law of Action and Reaction and can be written like this:

$$\sum \mathbf{F_{action}} = -\sum \mathbf{F_{reaction}}$$

Newton's third law can occur if it fulfills the following conditions:

1. Action-reaction forces act on two different objects.
2. The magnitude of the action-reaction force is the same, but the direction is opposite.
3. Action-reaction forces occur in pairs (there is no action without reaction)

In *Karapan Sapi*, Newton's III Law applies, namely when the joki gives a reaction (punches) to the bull and when the bull runs fast. The following illustration is shown in Figure 8.

Figure 8. Illustration of action-reaction on karapan sapi

Based on Figure 8, the action-reaction force occurs when the bull's foot hits the ground. Beef leg delivers $\mathbf{F}_{action}$ to the ground surface, and the ground surface gives $\mathbf{F}_{reaction}$ on a bull's leg, which is the same size as $\mathbf{F}_{action}$. The magnitude of the two forces is the same but in opposite directions $\mathbf{F}_{action} = \mathbf{F}_{reaction}$. This force applies to all four bull legs that step on the ground alternately. The action force of the bull race depends on the pushing force of the bull's leg to the ground so that the ground will cause a reaction force due to the push of the bull's leg, and the magnitude cannot be predicted. The study of Newton's III Law is in accordance with what was presented by Halliday et al. (2013) in his book *"For every action, there is an equal and opposite reaction".*

▪ CONCLUSION

Based on the results of the study, which has been carried out on the local wisdom of *Karapan Sapi Madura*, it can be concluded that *Karapan Sapi* has the potential to be made as a learning material in learning Newton's Law motion. The results of this study are expected to provide information and solutions to teachers and students to implement learning physics based on real examples to make learning more meaningful. In the future, further development will be carried out so that it can be studied and better structured and interactive to support learning physics, specifically Newton's laws.

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