Application of Concept Physics in the Aceh Culture

Yaumil Silvini¹, Derlina², Eva Marlina Ginting³
¹Physics Education Study Program, State University of Medan
²,³Lecturer in Physics Education, State University of Medan

Email: yaumlislvini92@gmail.com

Abstract. Physics is the science that studies an object, and interactions between objects, also studies natural phenomena that include matter, space, and interactions between humans. Human interaction is related to culture and customs that are inherent in people's lives. Every region in Indonesia has different customs and customs in the community. Aceh is one area that has diverse customs in the way of making food, playing games and using its musical instruments. The culture of people's original knowledge relating to scientific physics knowledge is called ethnoscience. The study examines, analyzes the application of the concepts of temperature and heat and impulse momentum in Aceh culture. The method used is a literature study with study materials including (1) the cultural art game of Aceh kekuriken, (2) The typical food of Aceh tribe Pisang sale.

1. Introduction
Physics is a very basic science from various other sciences. The purpose of studying physics is to be able to know the basic parts of an object and its interactions, and be able to explain natural phenomena that occur. According to Gerthsen physics as a theory that describes a variety of natural phenomena so as simple as possible, as well as trying to find the relationship between reality. The basic problem to solve the problem is by observing the symptoms. Natural phenomena that often occur in social life make people able to solve them by observing them, or translating natural phenomena according to the beliefs that have developed in their environment. Physics also influences scientific development in life. Generally people translate the phenomena they experience in accordance with the growing trust in the environment. The original science of society is reflected in local wisdom as an understanding of nature and culture that develops among the people.

Indonesian English Dictionary John M. Echols and Hassan Syadily, who interpret local means local, while wisdom (wisdom) is the same as wisdom. In general, local wisdom (local wisdom) can be understood as local ideas (local) that are wise, full of wisdom, good value, embedded and followed by members of the community. Among other things Haryati Soebadio said that local wisdom is also a cultural identity, national cultural identity / personality which causes the nation to be able to absorb and process foreign cultures according to their own character and abilities (Sartini in Ayatrohaedi, 1986). In general, local wisdom arises through a long process of internalization and goes on for generations as a result of humans and their environment. The process of value evolution that lasted long enough led to the formation of a value system in the form of customary law, belief in local culture (Wikantiyoso & Tutuko, 2009).

Narrow perspective will produce narrow knowledge as well. That is, the way of viewing and translating the culture of people who only use one side, in this case only original science, it will not
improve mindset. As is known that actually there was already a science in the past. However, science at that time was an invention based on trial and error which was an accidental finding, which then benefited many individuals and groups alike (Novitasari et al, 2017).

Ethnoscience is knowledge that is indigenous to certain languages and cultures. Its function is to estimate or reflect the customary 'thoughts' about how their physical world should be classified. The study of constructivism opens the way for humans to see science not only as a body of systematic knowledge, methods, processes, products or ways of inquiry, but also as a way of thinking.

Ethnoscience is related to local perceptions, practices, skills and ideas and the cosmology that underlies them in the context of the socio-economic development process. Therefore the term ethnoscience becomes a particular cultural articulation, describing the often unique system of indigenous knowledge (IK) and Indigenous Technology (IT) characteristics of local populations or groups in the third world as well as similar groups in western countries (Warren et al, 1995). In conclusion, Abonyi (2014) notes that the fundamental focus of ethnoscience is the indigenous 'point of view', their relationship to life, to realize their vision of the world. Given the fact that science is a tool through which humans learn about their environment, resources and problems and how to control and use both of them productively.

Ethnoscience covers a number of scientific disciplines namely ethnobiology, ethnochemistry, ethnophysics, ethnomathematics, ethnomedics, and various indigenous agricultural practices and food processing technologies. The fundamental principle in the aspect of indigenous knowledge systems is that the basic concepts and practices are outlined in an environment and cultural dependency that is strengthened by knowledge, myths, and the supernatural (Abonyi, 2014). It can be concluded that ethnoscience studies traditional knowledge and culture that are related to science that has been researched by scientists but is still regarded as knowledge from accidental discoveries by the community.

Indonesia is a country rich in culture. Every region in Indonesia has different customs and customs in the culture of the community. Munzir S et. Al (2011) Aceh is one of the regions that has a culture and customs attached to the lives of its people. The existence of norms, customs and beliefs in a community in Aceh are all related to balance. In order to create a harmonious relationship between the people of Aceh, both in the management of nature and in social relations. These customs can be noted through the culture (inheritance) left by the Acehnese people (Ernita, et al, 2012). Seeing this connection, culture is a control mechanism for community behavior in Aceh. The existence of natural challenges and community response, resulting in this life developed into knowledge in a dynamic society. Every time various thoughts or knowledge arise to respond to these natural challenges, then the dynamics of the Acehnese people are born giving cultural opportunities to develop (Saminan, 2015); Munzir S, 2011).

One culture (inheritance) of the people of Aceh that is still used today is the making of Aceh's special food, games played by Acehnese children, and traditional Acehnese musical instruments. Aceh's special food is a culture that is still preserved by the Acehnese people, especially to hold weddings, thanksgiving and parties. Such is the case with traditional Acehnese musical instruments which are often played when performing party events, as well as prayer events. Whereas in the traditional Acehnese game the native Acehnese still play it. Fire. This culture which is used in Acehnese society is identical with science knowledge known as ethnoscience. But all of Aceh's cultural heritage from food, games to musical instruments related to the concept of physical science is very important to study. This study aims to describe the concepts of physics in culture, namely: (1) Analyzing the concepts of temperature and heat physics in the use of Aceh culture; (2) Analyzing the concepts of momentum and impulse physics in the use of Acehnese culture.

2. Methods

This study uses a literature review method. The study material examined is the culture of Aceh in Indonesia, where researchers take samples of two types of culture including (1) typical Acehnese
cultural games played by children called kekuriken games, (2) typical food of Acehnese culture which is often made from banana ingredients called pisang sale.

3. Results and Discussion

The results of the study of two types of culture include (1) typical Acehnese cultural games played by children called kekuriken games, (2) typical Acehnese culture foods that are often made from banana ingredients called pisang sale. Shows the value of local wisdom and ethnics potential that can be applied as a reference for learning physics.

The results of the reconstruction of the original science of society into scientific science in the process of kekuriken, and the typical food of Aceh pisang sale are used as a reference in the development of the concept of learning integrated physics of ethnoscience. The results of the reconstruction are presented in table 1. The importance of rebuilding (reconstructing) scientific knowledge based on original science from the local culture of a community because the original knowledge of the community has not been scientifically conceptualized and formalized textually and contextually (Sudarmin, 2014).

3.1. Kekuriken games

Gayo comes from the ancient Acehnese language which was adopted from the Sanskrit language which means mountain and lues means broad in the local language. Most of this game is done in a group way. Community life in the past that could be considered unfamiliar with the outside world had directed and led them to high social activities and togetherness. Moreover, Indonesian culture in general upholds the values of togetherness. This then encourages the creation of traditional types of games. One of the traditional games from Gayo Lues is Kekuriken. Kekuriken is the language of the Gayo region where the origin is said to be kurik, meaning chicken. Kekuriken means fighting like chicken. This game uses balls made of clay. The ball was named "kurik" because it would be pitted with other kurik in the arena of matches that were made in such a way that the ball was rolled then naturally it would meet with other balls, so that it clashed violently. A broken ball or a losing kurik has to bear the risk, that is, the owner must carry out the sanctions agreed upon previously. Narrow rice fields that are worked on continuously cause the soil to become barren and eventually become clay. This clay ball is rather strong so it is fun when pitted.

Individual game. Two children sit at the base of a playground that has been made together, holding each other's kurik. Simultaneously with the cue the two children jerked his kurik with the intention to roll quickly toward the opponent's kurik. In the middle of the arena, kurik collided with a strong impact. For the first or second time, there may not be any broken kurik, but after a number of times, one of them has broken. The owner of a broken curricule was declared defeated. This owner must accept the penalty agreed upon earlier, for example holding the winner from one place to another, for example who plays A and B, the winner is A, then B must carry A from line 1 to line 2 as far as 25 meters, etc. Sanctions used for losers depend on mutual agreement before playing.

In terms of momentum, (Mughny & Rahmawati, 2016) it is said that the ball being thrown changes in momentum due to the force exerted within a specified time interval. This style, which only works in a very short time interval, is called an impulsive force. Therefore, the multiplication between the force and the time interval that force acts on an object is called an impulse. Mathematically, written as:

\[ I = F \cdot \Delta t \]  

The collision event is an event that is the main characteristic of the particle properties of an object. Collisions can be explained using the concept of momentum. In mechanics, the amount of momentum is one of the most fundamental quantities of motion. Momentum is a vector quantity with the same momentum as the object's velocity. Basic physical libraries such as Halliday et al (1997) provide a lot of discussion about momentum. The momentum of a particle is defined as the product of mass and velocity.
\[ \vec{p} = m \vec{v} \]  

(2)

The equation shows that momentum is directly proportional to mass and velocity. The greater the mass, the greater the momentum. The greater the speed, the greater the momentum. A mass object \( m \) that moves with initial velocity \( \vec{v}_i \) toward the second object whose mass \( m_2 \) and moves at initial velocity \( \vec{v}_2 \). If both collide, then the two objects after collision will move with speed \( \vec{v}_{1f} \) and \( \vec{v}_{2f} \). The symbol \( \vec{v}_{1f} \) and \( \vec{v}_{2f} \) is the final velocity of objects after the collision. Sustainability of momentum in the system is illustrated in the following equation:

\[
m_1 \vec{v}_i + m_2 \vec{v}_2 = m_1 \vec{v}_{1f} + m_2 \vec{v}_{2f} \\
m_1 (\vec{v}_i - \vec{v}_{1f}) = m_2 (\vec{v}_{2f} - \vec{v}_2).
\]

(3)

Halliday et al. (1997) state that equation (3) provides a relationship between the two velocities \( \vec{v}_{1f} \) and \( \vec{v}_{2f} \), which can be determined through energy review. If there is no change in the potential energy in the internal system, the final kinetic energy after the collision is the same as the initial energy. One application of the law of conservation of momentum is the collision of two things. From the above equation, we can know the general equation of the coefficient of restitution in the collision event of two objects:

\[ e = -\frac{\Delta \vec{v}_f}{\Delta \vec{v}_i}. \]

(4)

Collisions are divided into 3 types based on the restitution coefficient, namely:

a. Perfect resilient collision

In this type of impact applies the law of preservation of momentum and the law of preservation of kinetic energy. In perfectly resilient collisions, the value of the restitution coefficient \( e = 1 \).

b. Inelastic collision / not resilient at all

In this event just after the collision the two objects come together and move together at the same speed. The magnitude of the coefficient of restitution \( e = 0 \).

c. Partially collision collision

Partially resilient collisions are collisions between two extreme situations where collisions are perfectly resilient and collisions are not resilient at all. The value of \( e \) is between 0 and 1. (Resmiyanto.R, 2017).

Kekuriken game activities carried out by the community in the Gayo tribal village in the Aceh area have implemented original science, but have not been elaborated and conceptualized in scientific science. Scientific science is summarized in the concept of physics, namely the concept of motion and collision. The motion experienced by a clay ball when played is straight-changing irregular motion, that is, the motion of objects in a straight-line path with constant acceleration. So, the main characteristic is that over time the speed of things changes, the faster / slower. In this case the clay-made ball experiences an irregularly changing straight motion slowed. When the kurik ball is thrown by hand it means that there is a force that works in a short time so that the kurik ball experiences speed, this momentary force is called the impulsive force, this force initiates an acceleration and causes the kurik ball to move fast. In addition, when the kurik ball is played and then collides with another kurik ball, then the concept of physics is a collision. Collisions are of three types, namely perfectly resilient collisions, partially resilient collisions, and collisions are not resilient at all.
In game *kekuriken* when colliding, including the type of partially resilient collision, where the kinetic energy is reduced during the collision. Therefore, the law of conservation of mechanical energy does not apply. The relative speed is also reduced by a certain factor called the restitution coefficient.

### 3.2 Typical Food of Aceh Pisang Sale

*Pisang sale* are processed foods from bananas which are combed thin and then dried in the sun. The purpose of drying is to reduce the water content of bananas so that bananas for sale are more durable. Sale bananas can be eaten or fried directly with flour first. *Pisang sale* is a banana product made with drying and fumigation. *Pisang sale* is known to have a distinctive taste and aroma. The characteristics that determine the quality of a *Pisang sale* are its color, taste, odor, suppleness, and the resistance of its drift. These properties are greatly influenced by the processing, packing, and storage of the product. So that the sale of bananas is needed in a stable and maximum temperature can produce good products.

Heat is a form of energy that moves from high temperature objects to low temperature objects. The object receives heat, the temperature of the object rises or its form changes. Objects that release heat, the temperature will go down or change shape. The amount of heat absorbed or released by an object is directly proportional to: (a) the mass of the object; (b) heat of a type of object; (c) changes in temperature.

The heat moves from an object with a high sound to an object with a low temperature. There are 3 ways of heat transfer, namely conduction, convection, and radiation.

1. **Heat transfer by conduction**: heat transfer without particle transfer. Each substance can conduct heat by conduction, both substances that are classified as conductors or insulators. In the manufacture of banana sale fogging space uses a base of conductor material that provides heat energy from the medium to the material. So that energy is lost from the wall or the base of the smoking room. The loss of energy through the wall of the smoking room is calculated by the equation (Napitupulu, F., and Pratama, Y: 2011);

   \[ Q/t = \frac{u.A.\Delta T}{x} \]  

   Where \( Q/t \) is the energy lost from the wall of the fumigation chamber (kJ), \( A \) is the wall area (m\(^2\)), \( u \) is the overall heat transfer coefficient of the wall (W/m\(^2\)K), \( \Delta T \) is the air dryer temperature (\( ^\circ \)C), and \( x \) is the wall thickness or base (mm).

2. **Convection heat transfer**: the process of heat transfer carried out by fluid movement due to density transfer. In making banana sale, banana evaporation occurs by removing water vapor from bananas due to the heat absorbed by bananas through smoking and drying using sunlight. Energy to raise the temperature of the material is calculated based on the equation (Muhammad: 2011);

   \[ Q/t = h.A.\Delta T \]  

   Where \( Q/t \) is the energy to evaporate water (kJ), \( h \) is the increase in the type of dried material (kJ/m\(^2\).\( ^\circ \)C), \( A \) the surface area of the evaporated banana sale (m\(^2\)), \( \Delta T \) is the increase in the period of sale banana (\( ^\circ \)C).

3. **Heat transfer by radiation**: heat energy transfer in the form of electromagnetic waves. Like the heat transfer from the sun's rays to the earth. In the sale of bananas, bananas are dried using sunlight as a heating agent for bananas. The resulting solar energy is calculated using the equation (Novitasari, et al.:2014);

   \[ Q = I.\pi.A.\Delta T \]  

Where \( I \) is the solar intensity (W/m\(^2\)).
Where \( Q \) is the sun’s energy absorbed by Pisang sale (kJ), \( I \) is solar radiation (W/m\(^2\)), \( \tau \) is transmissivity of polycarbonate (77%), \( A \) is the area in which dried Pisang sale (m\(^2\)), \( \Delta T \) is the drying time (seconds).

The process of making Pisang sale begins at the stage of stripping bananas, then fumigation using coconut shells as fuel, and finally banana drying, so that the water content in bananas is reduced. The process of drying and smoking is related to the concept of physics, namely the concept of temperature and heat. The smoking process aims to make bananas long-lasting and durable, and the colors in bananas brighter. Fumigation using fuming cabinets. Bananas are arranged on shelves made of iron. In Research (Harianto, & Aziz: 2018) the drying process in principle involves the process of heat transfer being transferred from the heating medium to the material. Furthermore, after the evaporation of water occurs, the water vapor formed must be transferred through the structure of the material to the surrounding medium. It is clear that the explanation says there is a banana evaporation cycle (convection transfer) and heat transfer from the material (by conduction), then drying depends on solar radiation (by radiation).

In this process bananas absorb heat through iron, iron is heated by coconut shells, the heat produced by coconut shell is very large per gram of 8025.26 cal. This is also to save energy. The process of heat absorbed by bananas through iron is heat transfer by conduction. Furthermore, the drying process aims to eliminate the water content of bananas, the process of absorption of heat from sunlight includes heat transfer by convection, the flow of water in the banana rotates up, resulting in evaporation of the banana, and the banana slowly dries.

The relationship between the kekuriken game and the physics learning of impulse momentum is in the collision that occurs between the two balls made of clay. And the typical Pisang sale aceh foods made by fumigation which requires sunlight as heat to absorb water in the sale bananas that make the sale bananas evaporate and remove liquid so as to make the banana sugar out, reduce the size of the banana, and the color of the banana . There is heat transfer by convection in the sale banana. The following are explanations and examples of ethnophysical profiles and values of local wisdom in Acehnese culture.

### Table 1. Ethno Physics Profile of Aceh Culture

| No | Cultural Science | Original Science Society | Scientific science of Physics |
|----|-----------------|---------------------------|------------------------------|
| 1  | Kekuriken games | This game is a ball made of clay. played by children in the middle of the field by being thrown from a different side crushed between two balls. | When the kurik ball is thrown, there is a concept of motion in the ball, straight motion changes irregularly, its main characteristic is that from time to time the speed of objects changes, the faster / slower. Then the ball is thrown using a hand with a certain speed in a short time there is an impulsive force of the concept of momentum on the ball. Then, when the kurik ball is played and then hit each other with another kurik ball, there is a physics concept that is a collision, because both balls are hard and not broken, the ball is said to be nearing perfectly resilient, or called partially resilient, where kinetic energy is reduced during collision . Therefore, the law of conservation of mechanical energy does not apply. The relative speed is also |
reduced by a certain factor called the restitution coefficient

### 2. Pisang sale

Foods made from bananas are made by smoking and drying so that the banana turns brown and tastes sweet.

The process of making *Pisang sale* during the fumigation stage, bananas absorb heat through the iron fumigation chamber, this process is called heat absorption by conduction. Furthermore, in the process of smoking and drying aims to eliminate the water content of bananas, bananas absorb heat through iron smoke and sunlight, the flow of water in bananas spinning up, resulting in evaporation of bananas, and bananas slowly drying up this process is called heat transfer by convection. then the sun's rays on the *Pisang sale* are included in the process of radiation transfer.

### 4. Conclusions

Based on the results and discussion above, it can be concluded that the typical Aceh *Pisang sale* food, and the traditional game of Aceh *Kekuriken*, are Aceh's cultural heritage. In Aceh culture, it is reflected as a belief and knowledge that is prejudiced and trial and error as a form of genuine science from the community. Physics as part of scientific knowledge plays an important role in translating the original science of society into scientific knowledge so as not to cause multiple interpretations. Besides that, there is a connection between the culture that has been carried out in relation to the physics concepts learned so far. So this research can be literacy as a reference in learning physics.

### References

[1] John, M. Echols and Syadily, H. 2005. *Kamus Inggris Indonesia*. Jakarta : PT. Gramedia Pustaka Utama.

[2] Ayatrohaedi. 1986. *Kepribadian Budaya Bangsa (Local Genius)*. Jakarta: Pustaka Jaya.

[3] Wikantiyoso, R., & Tutuko, P. 2009. *Kearifan Lokal dalam Perencanaan dan Perancangan Kota; untuk Mewujudkan Arsitektur Kota yang Berkelanjutan (1 ed.)*. Malang: Group Konservasi Arsitektur dan Kota.

[4] Novitasari, L., Agustina, P., Sukesti, R., Nazi, M., & Handika, J. 2017. *Fisika, Etnosains, dan Kearifan Lokal dalam Pembelajaran Sains*. Journal Unimipa. ISSN: 2527-6670. Hal (81-88).

[5] Warren, A., & Wellek, R. 1995. *Teori Kesusastraan Adat*. Jakarta: PT. Gramedia.

[6] Aboyi, OS., Achimugu, L., Adibe, Mi. 2014. *Innovations in Science and Technology Education: A Case for Ethnoscientific Education in Elementary Schools*. International Journal of Scientific & engineering Research. Vol.05, Issue 1.

[7] Munzir, S., Salmawaty, & Harun, M. 2011. *Acehnese Manuscript of Fara‘idh a Preliminary Study*. 3 rd Biannual. International Conference on Aceh and Indian Ocean Studies (ICAIOS). Banda Aceh.

[8] Ernita, Salmawaty, A., & Said, M. 2013. *Penentuan Bagian Tiga Ahli Waris Berdasarkan Manuskrip Tabel Faraidh Menggunakan Metode Kombinatorik, Etnomatematik dan Etnosains*. Seminar Serantau Etnomatematik Malaysia II. Universitas Syiah Kuala: Syiah Kuala University Press. ISBN: 978-602-1270-23-3.

[9] Saminan. 2015. *Internalisasi Budaya Sekolah Islami di Aceh*. Jurnal Ilmiah Peuradeun. Vol. 03 (1) 147-168.
[10] Saminan, Johar, R., & Mustafa. 2017. *Konsep Pengukuran Berbasis Etnosains dan Etnomatematik dalam Masyarakat Aceh*. Journal Science Education Conference 2017. Hal (1-7).

[11] Sudarin, Febu, R., Nuswowati, M., & Sumarni, W. 2017. *Development of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student’s Entrepreneurship*. Journal of Physics. Conference Series: 824 (1).

[12] Mughny, A., & Rahmawati, E. 2016. *Rancangan Bangun Kit Percobaan Konservasi Momentum Berbasis Mikrokontroler*. Jurnal Inovasi Fisika Indonesia (IFI): Vol 05, No. 03. Hal (9-14).

[13] Halliday, D., Resnick, R., & Walker, J. 1997. *Fundamentals of Physics (5 th ed. Extended)*. New York : Wiley.

[14] Resmiyanto, R. 2017. *Eksperimen Konseptual Tumbukan Benda 1 Dimensi dengan Al Godoo*. Inegrated Lab Journal. ISSN 2339-0905: Vol. 05. No. 02. Hal (95-100).

[15] Napitupulu, F., & Pratama, Y. 2011. *Perancangan dan Pengujian Alat Pengering Jagung dengan Tipe Kabinet Dryer untuk Kapasitas 9 kg Per Siklus*. Jurnal Dinamis. Vol 2. No.8. Januari 2011.

[16] Muhammad, A. 2011. *Uji Kinerja Alat Pengering Hybrid Tipe Rak pada Proses Pengeringan Jagung Bertongkol*. Skripsi: UNILIA. Lampung.

[17] Novitasari, I., Warji, Dian, & Novita, D. 2014. *Uji Kinerja Alat Pengeringan Chip Pisang Kepok*. Jurnal Teknik Pertanian Lampung. Vol.03. No.1. Hal (59-68).

[18] Harianto, J., Aziz, A. 2018. *Analisis Pompa Kalor Siklus Udara Tertutup untuk Pengeringan Pisang*. Journal FTEKNIK. Vol 05. Edisi 2 juli 2018. Hal (1-5).