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Exploration of Physics Concepts in Local Wisdom of South Sumatera as an Effort to Develop Students' 21st-Century Skills

Ketang Wiyono[1,2,a)], Ismet[1,2], Nely Andriani[1], Alika Fitonia[2], Hartisya Nadia[2], Diana Meitasari[1], Nauratun Nazhifah[3]

[1]*Faculty of Teacher Training and Education, Universitas Sriwijaya, Jl. Raya Palembang-Prabumulih KM 32 Indralaya, Ogan Ilir, Sumatera Selatan, 30862, Indonesia*
[2]*Department of Magister Physics Education, Universitas Sriwijaya, Jl. Raya Palembang-Prabumulih KM 32 Indralaya, Ogan Ilir, Sumatera Selatan, 30862, Indonesia*
[3]*Public Senior High School Plus number 17 Palembang, Jl. Mayor Zurbi Bustan Pipa Jaya, Palembang, Sumatera Selatan, 30961, Indonesia*

✉: [a)]ketang_wiyono@fkip.unsri.ac.id

Abstract

This research aims to identify physics concepts in South Sumatera's local wisdom. South Sumatera is one of the provinces in Indonesia with a very high level of diversity. The heterogeneous geographical and socio-cultural conditions in South Sumatera provide a strong background for linking the local wisdom of the area with physics learning. The research was carried out using observations, interviews, and documentation. The process revealed a connection between various local wisdoms in South Sumatera and various concepts in physics. Some of the identified local wisdoms include typical South Sumatera food, the environment around the Musi River, and typical South Sumatera buildings. The barges adhere to Archimedes' Law principles. Temperature and phase changes are closely related to the pempek making process. Making smoked fish uses the concepts of temperature and heat. Making salted fish utilizes the concept of heat transfer by radiation and evaporation. The process of making Kemplang closely aligns with the concepts of heat transfer, evaporation, and expansion. This local wisdom, when used as an object in physics learning, is highly suitable and relevant to the Merdeka Curriculum. In this way, students will more easily understand the learning they are doing.

Keywords: local wisdom, physics, South Sumatera, 21st century skills

INTRODUCTION

Natural science or science is a science related to the universe and its environment and regularity that requires a process and product in its study (Wijayanto, Supriadi & Nuraini 2020; Puspitasari, Putri & Yohanes 2019). One of the branches of natural science studied at the high school level is physics. Physics is a branch of science that specifically studies matter and energy, along with all the interactions that occur in them (Khandagale & Chavan, 2017). Physics is also a universal science that underlies the development of modern technology and plays an important role in various disciplines (Syifa et al., 2021). As a subject, physics is an abstract science subject that relies heavily on practice, and the important role played by the use of teaching materials (Bada & Jita, 2021). Physics as a subject in schools is generally less popular or less popular with students (Haagen-Schützenhöfer & Kopper,

2019). According to Ornek et al. (2008), physics is considered difficult because it must be studied through experiments, formulas and calculations, graphs, and conceptual explanations at the same time. In addition, students also have difficulty representing physics material, for example from graphical representation to mathematical representation. Low student learning outcomes can also be caused by inappropriate teaching models or methods. As in research by (Laksana & Adawiyah, 2022) which shows that students' physics learning outcomes using the Inquiry learning model with a scientific approach are significantly better than when using conventional learning. Furthermore, (Putri, 2020) also shows that the use of the Guide Discovery Learning model can improve student learning outcomes better than the use of conventional learning models. Therefore, the right solution is needed to make physics lessons more enjoyable and easier to understand, for example by using certain media and/or learning models. One of the learning models that can be applied is contextual-based learning (CTL).

CTL is an approach that requires educators to present real-life situations in the classroom, to encourage students to connect the knowledge they have and apply it contextually (F. P. Lestari et al., 2021). Contextual learning can be integrated into teaching materials or learning media, as discussed in research Firdaus, Amin & Lovisia (2022) that makes Powtoon-based learning media with a contextual approach to impulse and momentum material, research Aryansi & Yolanda (2020) that develops contextual-based physics textbooks on magnetic field material, and research Rosdiana et al. (2020) that develops contextual-based animated video learning media on the concept of motion dynamics. The use of contextual-based learning models can increase learning motivation, learning understanding, and students' critical thinking skills (Saidi, 2022; Haryadi & Nurmala, 2021; Lestari et al., 2021; Ramdani et al., 2021). According to (I. P. Sari & Desnita, 2019), physics learning has several main characteristics, namely scientific, contextual and developing in tandem with technology. One of the difficulties students experience when studying physics is connecting the knowledge learned in class with what exists in real life. Therefore, physics learning needs to be equipped with activities that involve students in carrying out small observations or investigations so that the material studied can be related to events in everyday life. Contextual learning can be the right solution, namely by utilizing the surrounding environment as a means of learning, one of which is the local wisdom of an area.

In learning, the material presented should always be related to the surrounding environment such as culture, regional excellence, regional potential, and others that are around or can be said to be related to local wisdom (Sofyan et al., 2019). Constructivist philosophy states that knowledge is constructed by learners through their interactions with the environment, challenges, and learning materials (Mufit et al., 2023). The interaction of students with the surrounding environment can be done with the introduction of local wisdom in the area where they live. Local wisdom of an area can be introduced through physics because physics learns about the symptoms and subtleties of nature so that the nuances of local wisdom can enter the subject (Erlangga et al., 2022).

Physics learning that is integrated with local wisdom can improve creativity, critical thinking, and student learning outcomes (Isnaniah & Masniah, 2022). Increasing critical and creative skills are needed to support 21st-century learning (Setiyani et al., 2022). In addition, it is also able to improve the positive character of students such as honest character, discipline, perseverance, responsibility, and caring for the environment (Anikarnisia & Wilujeng, 2020). The goal of learning physics in the 21st century is to improve high-level reasoning abilities and deep conceptual understanding (Bao & Koenig, 2019). Currently, there are still many teachers who ignore the development of creativity and critical thinking of students in the learning process (Kettler et al., 2018). The results of previous studies indicate that the level of critical thinking of students integrated with local Eremerasa natural tourism potential is in the low category (Suryani et al., 2020). A contextual approach included in physics teaching materials will be very helpful in improving students' 21st century skills by integrating literacy, knowledge, skills and technology into it (Oktrisma & Ratnawulan, 2021).

Several physics concepts in local wisdom have been analyzed by researchers from several regions in several studies. Laos & Tefu (2019), Langtang & Mataubenu (2019), and Husin & Billik (2019) have identified physics concepts in several local wisdom of South Central Timor Regency, namely at the tourist attractions of Fort None Tetaf Village, sago processing (PUTAK), and the typical weaving of South Central Timor Regency. Exploration of physics concepts with traditional crank games (Rizki et al., 2022). test the graphical representation of straight-motion kinematic physics based on the local wisdom of Perahu Boti (Armanto et al., 2021). The creation of an electronic book of Newton's Law is

based on the local wisdom of the Manatahan and Nekeran games (Sukma et al., 2019). Development of a Madihin culture-based physics module to train baimbai paddling characters (Wati et al., 2020). From some of these studies, no one has analyzed the concept of physics in the local wisdom of South Sumatra.

South Sumatra is one of the provinces in Indonesia with a very high level of diversity (G. Lestari, 2016). Heterogeneous geographical and socio-cultural conditions in South Sumatra are a strong background to associate the local wisdom of the area with physics learning. As with the actual phenomenon, the icon of Palembang city in the environment of students is the Musi River. In Palembang city itself, the Musi River divides the city into two, namely Seberang Ilir in the north and Seberang Ulu in the South which are connected by the Ampera Bridge. The Musi River which forms the backbone of water transportation in Palembang is a river that has high potential and selling value for water tourism activities (Syabani & Abdillah, 2022). One of the traditional livelihoods of most residents in the city of Palembang adapted from geographical conditions is fishermen, using the Musi River as the main source of livelihood which has various types of fish in abundance. This abundant fish is then processed into typical Palembang foods including pempek, kemplang, smoked fish, and salted fish.

South Sumatra's local wisdom is not limited to the Musi River but there are many other local wisdom found in South Sumatra, one of which is a Gudang house located in the Ogan Ilir region. To preserve the cultural potential in South Sumatra, the effort made is to instill local cultural values in the community. If local wisdom-oriented learning is not implemented early, then the future of globalization and rapid technological developments can shift local wisdom in society. Based on the background described above, the purpose of this study is to identify the concept of physics in the local wisdom of South Sumatra, both buildings, the surrounding environment, and special foods in South Sumatra.

METHODS

This research is a qualitative descriptive study with an analytical approach (Amiruddin & Suliyanah, 2023; W. Sari et al., 2020). This technique will describe and interpret the meaning of the data obtained related to how the phenomenon occurs and what features (Amiruddin & Suliyanah, 2023; Nassaji, 2015). The data collection process was carried out in May-July 2023 using triangulation in the form of observation, interviews, and literature studies and supported by documentation (Saphira et al., 2022). Primary data of this study were collected through observation, interviews, and documentation, while secondary data were obtained through literature studies (Febrian & Jumadi, 2022).

Observations are made directly and indirectly. Direct observation is carried out by observing the process of the object of local wisdom and food processing typical of South Sumatra. In addition, indirect observation came from the observation of documentation given by respondents to researchers (Mekarisce, 2020). This observation activity helps researchers see the process of making or implementing directly, thus facilitating the process of analyzing local wisdom with physics concepts. Then the interviews were conducted directly and indirectly through WhatsApp using open-ended questions that supported the analysis of the research topic by prioritizing ethical attitudes towards respondents. Then the literature study in this study was carried out by looking for as many references as possible from various sources such as journal articles, books or reliable sources, and previous research (Saphira et al., 2022; W. Sari et al., 2020).

The data analysis technique used in this study is qualitative descriptive data analysis technique (Laos & Tefu, 2019; W. Sari et al., 2020). The qualitative data collected will be interpreted using the Miles and Huberman model which includes data collection, data reduction, data presentation, and conclusion drawing (Dull & Reinhardt, 2014; Laos & Tefu, 2019). In qualitative research, data collection is carried out naturally in the actual state or condition of nature (Sugiyono, 2012). The stages of implementation include (1) collecting detailed information on local wisdom in South Sumatra such as ships/ barges, traditional houses, traditional foods (Pempek, Smoked fish, Salted fish, and Kemplang) through interviews, direct and indirect observation, literacy studies, and documentation; (2) reducing data or summarizing and sorting out information relevant to the concept of Physics. This activity is carried out by choosing the main things, and focusing on things that are important and

relevant to the concepts of physics. So the reduced data will provide a clearer picture and make it easier for researchers to collect further data (Febrian & Jumadi, 2022).

The third stage is explore the concepts of Physics in the local wisdom of South Sumatra. The process of exploring the concepts of physics is carried out by studying literacy to explain the concepts of physics contained in the culture in South Sumatra. The analysis of physics concepts is carried out by balancing the reality and workings of the local wisdom of South Sumatra. Appropriate physics concepts are then explored based on the existing context. Concept analysis is carried out by formulating physical facts, physical concepts, physical principles, physical laws, and physical theories based on the local wisdom of South Sumatra (Ramadhan et al., 2019); (4) summarizing the concepts of Physics on the local wisdom of South Sumatra that has been found and then presented the data. In qualitative research, the data will be displayed in the form of descriptive or narrative text; (5) conclusions and suggestions based on the results obtained (Khoiriyah et al., 2021). The findings can be in the form of concrete evidence, causal relationships, or theories. This finding will be the conclusion of research that results in the identification of scientific concepts and principles in local wisdom in South Sumatra. FIGURE 1 below shows the stages of the research.

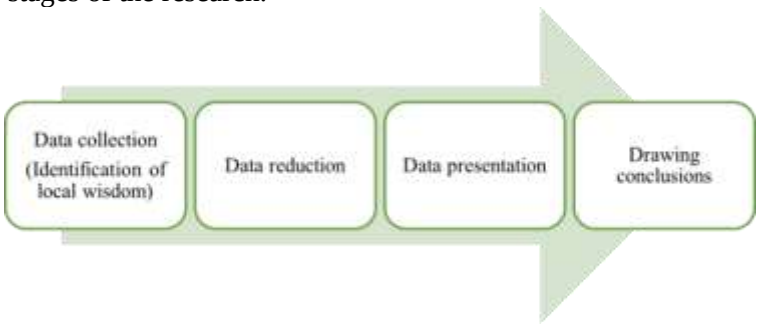


FIGURE 1. Research Stages

RESULTS AND DISCUSSION

Culture as a form of local wisdom is an identity for an area. In general, local wisdom can be interpreted as something that is done and followed by members of the community (Prasetyo, 2013). The development of relevant and contextual local wisdom has an important meaning for the development of a nation. Almost every region has a distinctive culture with its uniqueness. SouthSumaterais one of the provinces in Indonesia with a very high level of diversity (G. Lestari, 2016; Pitoyo & Triwahyudi, 2017). Heterogeneous geographical and socio-cultural conditions in SouthSumaterahave various potentials to be used as learning resources, especially in physics learning. TABLE 1 shows some physics concepts contained in the local wisdom of South Sumatra.

TABLE 1. Physics concepts in the local wisdom of South Sumatra

No.	Local Wisdom of South Sumatra	Physics concepts
2	Kapal/Tongkang	Archimedes' law
3	Limas House	Elasticity and equilibrium of rigid objects
4	Pempek	Temperature and heat
5	Salai fish	Temperature and heat
6	Salted fish	Heat transfer
7	Roasted Kemplang	Temperature and heat

The results of the analysis of physics concepts in the local wisdom of South Sumatra

Tongkang Barge

A barge is a type of vessel used for the transportation of goods and cargo in deep waters, rivers, and coastal waters. A distinctive feature of barges is their simple structure, often flat and flat, allowing them to carry large loads. These vessels usually have flat or nearly flat hulls, and often do not have

their engines. Typically, barges are towed by other propulsion vessels, such as tugboats, or propelled using paddles, bearing decks, or small motors. Barges are usually used to transport dry bulk or liquid bulk goods or more recently also used to transport containers (Rieke et al., 2019). The most transported dry bulk goods in the Musi River are coal.

In the case of a barge, it can float in water due to buoyancy and weight, as shown in FIGURE 2. Where the barge is floating if the density of the object is smaller than the density of water. Meanwhile, objects will sink if the density of the object is greater than the density of water. Barges float on water because of Archimedes' principle. This means that the weight of the water replaced by the barge is equal to the weight of the barge itself. According to the principle of Archimedes, for the ship to float, the interior of the hull of the ship is made hollow. This cavity contains air that has a density smaller than water. With this cavity, the average density of the marine hull can be made smaller than the density of water (ρ hull < ρ water) (Giancoli, 2005). With a density of the ship's body that is smaller than the density of the water, the weight of the ship (W) will be smaller than the upward force (F_a) of the water so that the ship can remain floating on the surface of the water.

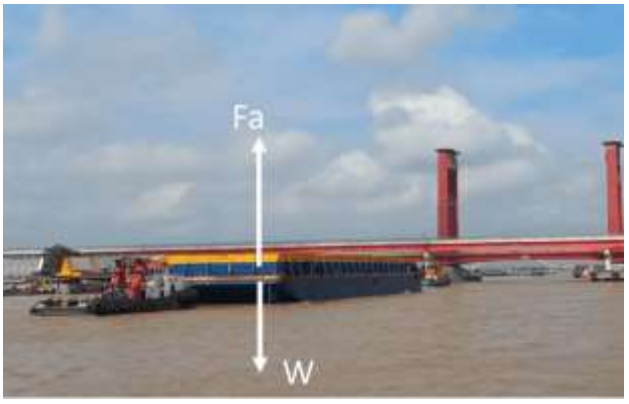


FIGURE 2. Buoyancy and weight on barges

South Sumatera Traditional House

Indonesia is known as a country that has cultural diversity and richness, one of the various tribes and languages is the diversity of traditional houses (Pasaribu et al., 2023). Traditional houses are houses that are typical of buildings, characterizing and symbolizing the culture of an area and the local community (Abdulghani & Sati, 2020). In various regions in Indonesia until now there are still many traditional houses as a form of cultural preservation that has begun to shift with modernization (Pitoyo & Triwahyudi, 2017). Customary houses in Indonesia have the shape and architecture of each region according to the local customary culture. Traditional houses are generally decorated with beautiful carvings. Many traditional houses currently still stand firmly and are deliberately maintained and preserved as symbols of Indonesian culture (Fitriaty et al., 2011). Traditional houses in Indonesia are mostly used as a shelter from wild animals and natural phenomena.

Indonesia, especially on the island of Sumatra, is located at the confluence of tectonic plates such as the Indo-Australian plate, the Eurasian plate, and other small plates. So there are often natural phenomena or disasters such as earthquakes accompanied by tsunamis (W. Sari et al., 2020). Therefore, the architecture of the archipelago's traditional houses is built using organic building materials such as wood and selected bamboo. Moreover, the development is oriented toward earthquake-resistant construction (W. Sari et al., 2020). Bamboo has good tensile strength and bearing capacity (Cui et al., 2020). While wood has good load-bearing strength, this is related to the elasticity of the material (Gomon et al., 2022). As a load-bearing, wood has a rupture modulus that determines the strength and elasticity associated with the rigidity of the wood (Gomon et al., 2022). Several types of traditional houses in Indonesia, such as the Nias traditional house, use wood as the main material to contain earthquakes (Siahaan, 2021). Also, the construction of Gadang houses is earthquake-resistant (Fitriaty et al., 2011; Malik, 2022; Zulfadrim et al., 2018). The purpose of earthquake-resistant building construction is to minimize damage to buildings caused by earthquakes (Kaushal, 2014).

(a) (b) (c)

FIGURE 3. (a) Pagar Alam Basemah House; (b) Limas House, South Sumatra; (c) Gudang House, Ogan Ilir

FIGURE 3 shows several types of traditional houses found in South Sumatra, namely Rumah Limas, a typical natural fence basemah house, and a typical ogan ilir "Rumah Gudang". Basemah Pagaralam traditional house is one of the traditional houses designed with the concept of earthquake resistance. Meanwhile, the gudang house is a traditional house with the concept of loading and unloading. All traditional houses are made of wood and apply physics concepts. Physically, the elasticity of a material determines the strength of a material as the foundation of a building. Elasticity (E) is the ability of an object to return to its original shape after being given a force or load (Giancoli, 2005). Wood and other materials have an elasticity value that can be seen in TABLE 1. If the wood is given a load, the wood will deform and still be able to return to its original state indicated by a linear line. However, wood also has an elasticity limit. If the wood receives a load that exceeds its elasticity limit, it will be permanently deformed or broken (Simanjuntak, 2021). In addition, Sun et al., (2020) mention that wood has a type period and compressive power that is very suitable for use as a building material. The EQUATION (1) show an elasticity equation.

$$E = \frac{\sigma}{\varepsilon} = \frac{F/A}{\Delta L/l_0} \quad (1)$$

TABLE 2. Modulus of elasticity of materials

No.	Material	E (kg/cm^2)
1	Concrete	210,000
2	Iron	2,100,000
3	Wood	125,000 (cl.1)
		100,000 (cl.2)

TABLE 3. Wood tension value

Material	Flexural Pressure	Pull Pressure	Stress Stress
Wood: Class I	150	130	130
Class II	100	85	85
Class III Glass Ionomer	75	60	60

TABLE 3 shows that wood has a high-stress value. The bending stress, tensile stress, compressive stress, and shear stress values on the wood can anticipate deformation due to earthquakes. The construction of earthquake-resistant buildings with wood materials must pay attention to 3 main things, choosing wood types with a high level of strength and durability, planning the dimensions of logs, and

planning wood joints taking into account the forces that occur during earthquakes (Kopač & Šali, 2003). In the construction of traditional houses, wood mass is one of the important points that must be considered. The composition of the wood mass used in the upper, middle, and lower parts of the traditional house construction is certainly different. At the top and middle of the construction, the wood mass used tends to be lighter (Rinaldi et al., 2015). While the foundation or bottom construction gets a greater inertial force. The difference from the mass of wood in the arrangement of traditional houses aims to maintain a balance in distributing forces or loads in the event of an earthquake.

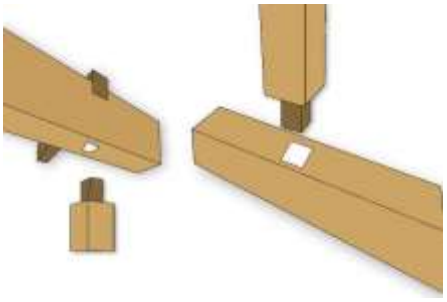


FIGURE 4 Knockdown system for making traditional Gudang houses in Ogan Ilir

In addition, wood splicing also has a contribution to reducing earthquake strength. This connection is carried out with a knockdown system or connection without the use of nails or pegs. This system is considered to have better resistance to earthquakes. The majority of traditional houses in South Sumatera use this system, one of which is a Gudang house in the Ogan Ilir area. Knock-down houses apply several physics concepts in their manufacture, especially on the concept of equilibrium of rigid objects. In making a knock-down house frame, the applicable physics concept is the weight point, where the weight point will play an important role in determining the stability and equilibrium of the entire structure of the house. Wooden poles and beams will be positioned and designed so that the weight point remains in the desired position so that the house can be in optimal equilibrium. Knock-down house roof design can affect the natural lighting inside the house and the distribution of solar heat. In addition, there is also the concept of structural mechanics. This concept involves analyzing how the structural elements in the roof, such as beams, columns, and frames, interact with the loads and forces acting on the roof. Structural mechanics help ensure the roof can withstand working loads and distribute them safely. The roof must be in static balance so as not to collapse or undergo excessive deformation. This means that the total force and moment on the roof must offset each other. The concept of physics is also found in the installation of knock-down windows and doors. The installation of windows and doors utilizes the concept of torque. When opening or closing windows and doors, torque is applied to hinges or door handles and windows.

Pempek

Pempek is one of the typical culinary of South Sumatera, especially the city of Palembang. Pempek is made from pureed fish meat mixed with flour, as well as other spices. The main ingredients in making pempek are Belida fish, Cork fish, Tenggiri fish, and other fish obtained from the geographical waters of SouthSumatera (Amal et al., 2023). Pempek is served with a cuko broth made from a mixture of vinegar, brown sugar, salt, garlic, and chili that gives it a distinctive spicy and sour taste. Some of the popular pempek variants among the public are Pempek lenjer, Pempek submarine, Pempek crackers, Pempek leather, Pempek egg, Pempek dos, Pempek pastel and Pempek adaan (Ningrum & Arrianie, 2019). The process of making pempek utilizes many physical principles, starting from the process of making dough, to the frying process.

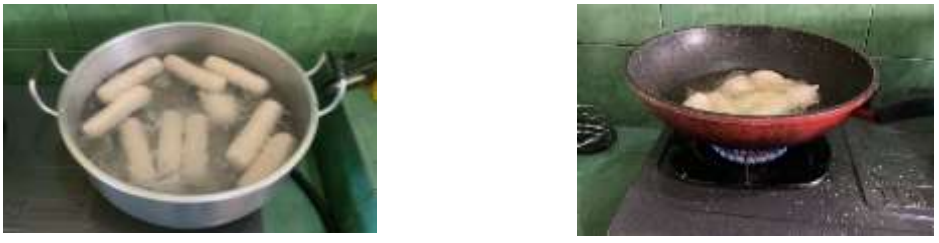
In the process of making dough, the temperature of raw materials such as sago flour, water, and mackerel affects the chemical and physical reactions in the dough. Cold water or even ice water is often used to set the temperature of the dough to keep it low. This helps produce a chewy, elastic dough, which is essential for a good texture. In addition, when the dough is mixed by hand, the dough will be pressed to get enough density to make the dough chewy and not hard. In addition, when the dough

formation becomes round, the pressure applied greatly affects the shape and density of the dough. This process can be seen in FIGURE 5.

FIGURE 5. Pempek kneading process.

When frying pempek, the oil temperature plays an important role. The oil should be heated to the right temperature before cooking the pancake. The right temperature will ensure the pancakes fry well and get a crunchy texture. The use of temperatures that are too low can make the pack absorb too much oil, while temperatures that are too high can make it burn too quickly. During frying, the oil will change phase from liquid to steam when exposed to high heat. This steam will help cook the pancake and give it a crunchy texture on the surface. This process also allows the pempek to undergo a phase change from liquid to solid, forming a crystalline outer shell and a golden surface. After the pen is fried, it should be removed from the hot oil and placed on a tissue paper or sieve to remove excess oil. This involves transferring heat from the still-hot pempek into the air and tissue paper so that the pempek can coagulate.

In addition, the process of frying pempek also applies the concept of heat transfer physics because when cooking, the bottom oil or water gets heat from the heater, the oil or water particles expand so that they become lighter and move up and are replaced by cold particles from the top. In this way, the heat from the bottom oil or water moves with the flow of water towards the top. In this process, there was a convection event (Elisa et al., 2022; Giancoli, 2005). The process of cooking pempek can be seen in FIGURE 6.



(a) (b)

FIGURE 6. (a) Pempek Making Materials, (b) Pempek Frying Process

Salai fish

Smoked fish is one of the processed fish that goes through a preservation process by smoking (Alfitri et al., 2023). Before smoking, the fish is usually cleaned first and then smeared with herbs and spices. The fumigation process is carried out by hanging the fish over a fire or charcoal that is lit until cooked. The smoke produced from this process gives the fish a distinctive taste and smell of smoke.

(a) (b)

FIGURE 7. a) Smoked Fish during the Smoking Process; b) Smoked Fish after the Smoking Process

The main concept in making smoked fish is fish smoking. The fumigation process involves transferring heat from the heat source (fire) to the fish to be fumigated. The temperature of the fire plays an important role in generating the hot smoke necessary to fumigate the fish. The higher the temperature of the fire, the more smoke is produced, which will give the fish a stronger sense of smoke. The smoke produced during the fumigation process contains microscopic particles that carry the taste and smell of smoke. Smoke temperature, or smoke temperature, will affect the degree to which smoke particles adhere to the surface of the fish. The higher the smoke temperature, the more smoke particles will stick to the fish, giving it a stronger smoke taste. The fumigation temperature of the fish must be kept stable and controlled. This helps in producing smoked fish that has the right texture, not too dry or too oily.

The fumigation process also involves heating and cooling. Fish are first heated by hot smoke during the fumigation process. Then, the fish will get time to cool down, which will affect how the taste of the smoke seeps into the fish's meat. The cooling temperature must be set so that the fish has an even and balanced smoke taste. In the initial heating stage, the fish undergoes a phase change as the meat heats up and the water inside evaporates. This is the stage where the fish will dry out and produce the typical texture of smoked fish. This phase change is closely related to temperature regulation during the fumigation process.

The fumigation temperature of the fish must be kept stable and controlled. This helps in producing smoked fish that has the right texture, not too dry or too oily. After the smoking process, smoked fish must be stored at an appropriate temperature to maintain food safety and quality. Sudden temperature changes or temperature fluctuations can affect the shelf life and quality of smoked fish.

Salted fish

Salted fish are fish that have been processed with salt or salted to last longer without the need to be stored in cold temperatures. Salt helps prevent it from rotting and allows it to be stored for a long time (Hafidhin et al., 2020). In contrast to smoked preserved smoked fish, salted fish is preserved by drying. One of the areas that routinely process salted fish in SouthSumaterais Burai Village, Ogan Ilir.

The process of making salted fish applies the physical concept of evaporation and heat transfer (conduction, convection, and radiation). Both of these processes occur when salted fish are dried. The heat transfer that occurs in the drying process of salted fish is radiant. The heat transfer is a heat transfer that does not require a medium (intermediary) and is without particle transfer(Jufrida, Kurniawan, et al., 2023). This radiation is usually in the form of Electromagnetic Waves (gem) coming from the Sun(Sriwahyuni et al., 2019). Energy from the Sun will be transferred to the Earth until it reaches the objects on Earth. The intensity of the energy waves emitted will be greater if the solar temperature is high (Giancoli, 2005; Walker et al., 2011). The amount of solar energy power transmitted can be expressed by the EQUATION (2).

$$P_{rad} = \sigma \varepsilon A T^4 \quad (2)$$

FIGURE 8 shows the radiation process in salted fish so that salted fish feel the heat from sunlight. In the process, there is also evaporation of water content contained in salted fish. Before drying, the salted fish has the same water vapor pressure as the air vapor pressure. When salted fish are dried, the water content in the fish will decrease due to the evaporation process. The hot steam flowing through the surface of the salted fish will create more water vapor pressure contained in the coffee beans. When

the hot steam flows to the surface of the salted fish, there will be a mass transfer from the inside of the salted fish to the surface of the salted fish in the form of water vapor. Then proceed with the evaporation process from the surface of the salted fish to the surface of the air (Jufrida, Kurniawan, et al., 2023). This evaporation will continue until the water content in the fish becomes very little and the fish becomes completely dry.

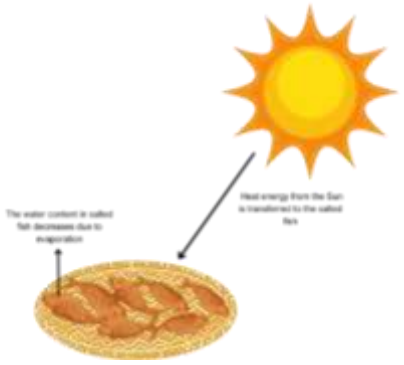


FIGURE 8. the process of radiant heat transfer in the drying of salted fish.

(a) (b)

FIGURE 9. (a) Salted Fish Before Drying, (b) Salted Fish After Drying

Roasted Kemplang

Baked Kemplang is one of the crackers processed into typical snacks of the people of South Sumatra. Kemplang is made by mixing flour dough and finely ground fish. One of the kemplang-producing centers in SouthSumaterais Ogan Ilir Regency (Sari et al., 2020). Observations were made in Burai Village, which is one of the villages in Ogan Ilir Regency. Kemplang typical of ogan ilir of southern Sumatera or better known by the community as kemplang tunu is a fish-based food (Kelvin et al., 2023). The fish commonly used are river fish or sea fish. The term "tunu" in Kemplang means Kemplang Bakar. This local wisdom through the process of steaming, drying, and roasting can be seen in FIGURE 10.

During the process of making kemplang, there are several physical concepts related to Temperature and Heat, especially expansion and heat transfer. The ingredients needed in making kemplang are approximately the same as pempek, which is a mixture of milled fish, flour, and other complementary ingredients. After the dough is mixed well, the dough is formed into a flat circle and then cooked by steaming as in FIGURE 10 (a). In this steaming process, there is a process of heat transfer by convection. The steaming process is carried out by placing raw kemplang in preheated water. After the water at the bottom of the steam pot receives heat, the water will expand so that the density is smaller than the density of the water at the top. The difference in density causes small-density water particles to move upward. The place left by water particles with smaller mass types will be filled by water particles with larger mass types. The event takes place continuously so that the water particles in the pot rotate up and down. The turnover of water particles is what constitutes a convection event.

After steaming, the kemplang is then ready to be dried to reduce its water content. In this drying process, there is a process of evaporation and radiative heat transfer. The heat produced by the Sun will be received by the kemplang and cause the water content in the kemplang to decrease (evaporate) so

that the kemplang becomes dry as shown in FIGURE 10 (b). After the kemplang is completely dry, the final stage of making kemplang is roasting. When roasting kemplang, Burai villagers use an iron blade made forked to help clamp the kemplang when placed on the coals. Iron was chosen for its heat-resistant properties. When the tip of this iron is brought closer to the embers, over time the other end that we hold and is not exposed to the embers will feel hot too. This event is one of the phenomena of heat transfer by conduction (delivery). To anticipate this, the clamp part that touches the hand is equipped with an insulator such as wood to prevent direct heat from hitting the hand.

FIGURE 10. a) Kemplang steaming process; b) Kemplang drying/drying process; c) Kemplang roasting process; (d) Packaged baked Kemplang.

In addition to the process of grilling kemplang which involves the concept of physics, hold the grill kemplang (stick) there is also the concept of physics. Heat is defined as energy transferred from one object to another due to temperature differences (Walker et al., 2011). When a substance is given thermal energy, the temperature of the substance will rise. The amount of Q heat energy required to increase the temperature of a substance is proportional to the change in the temperature and mass of the substance (EQUATION 3) (Giancoli, 2005; Walker et al., 2010).

$$Q = m \cdot c \cdot \Delta T \tag{3}$$

With Q is total heat received or released (J), m is the mass of the sample (kg), c is spesific heat $(J/(\text{kg }^\circ\text{C}))$ and ΔT is the temperature change (°C).

FIGURE 11. Kemplang Roasting Process

In the process of roasting kemplang, charcoal is used as a baking agent that is put into the furnace. Kemplang will get heat energy that is distributed evenly from charcoal, making Kemplang experience expansion (W. Sari et al., 2020). The size of the kemplang increased due to the increase in temperature caused by the embers. This increase in size is in the form of an increase in length (diameter of the kemplang), area of the kemplang, and volume of the kemplang. The difference between kemplang before and after baking can be seen in FIGURE 10. A solid object if given heat will occur inventor.

Heat is energy that moves from one system to another as a result of temperature differences (Walker et al., 2011). The temperature of the system I (kemplang) is much lower than the temperature of system II (furnace) which causes heat transfer.

FIGURE 12. Size of Kemplang Before and After Baking

The results of the exploration of physics concepts in local wisdom in South Sumatera can be used as a medium in the learning process of physics in the classroom. The application of the results of the identification of local wisdom with physics concepts in the learning process is through the implementation of the Merdeka curriculum (Govender & Mudzamiri 2021). This curriculum emphasizes the integration of culture or local wisdom in the learning process in the classroom (Maryam et al., 2022). The Merdeka curriculum is designed to produce meaningful, deep, and fun learning for learners (Nurhayati et al., 2022). The curriculum also focuses on essential materials, developing students' skills, character, and competencies, and developing multicultural awareness and appreciation for cultural diversity in Indonesia (Barlian et al., 2022; Jufrida, Furqon, et al., 2023). Local wisdom brings students to understand physics concepts contextually, realistically, and very close to the daily lives of students (Setiyani et al., 2022; Suci et al., 2022). The application of local wisdom makes students interested and increases curiosity in studying science in a different way than usual (Jufrida et al., 2019).

Learning in schools that integrate local knowledge into modern knowledge can have a positive impact on students because it can connect physical concepts with everyday life (Maulida & Sunarti, 2022). This process hopes that students can more easily understand the material learned (Setiyani et al., 2022). Physics learning based on local wisdom can encourage students to build critical and creative thinking skills so that it has the potential to be used as a source of physics learning (Jufrida et al., 2019; Khoiri & Haryanto, 2018; Mukaromah et al., 2022). In addition, the application of local wisdom in the learning process can increase knowledge about regional history or culture (Khoiriyah et al., 2021). Physics learning can also be conveyed to students well so that students' understanding of physics becomes better (Suci et al., 2022). Several previous studies have shown that the application of learning materials based on the local wisdom of coffee on temperature and heat materials that the module is effective both in terms of learning outcomes and student learning activities (Safitri et al., 2018). Then Atabikrifki et al., (2019) in their research on the development of local wisdom-based physics students' books, it is feasible to use and easily understood by students. The implementation of local wisdom in the physics learning process can be done by developing student worksheets as has been done by Utami et al., (2020) in his research which produces worksheets that can increase students' interest in learning. In addition to the form of learning materials, the context of local wisdom can also be included in the assessment of the learning process. The research conducted (Nazhifah et al., 2022) successfully developed a computer-based test integrated with the local wisdom of Bengkulu that can be used to measure students' science literacy. So that the results of the exploration of physics concepts in the local wisdom of South Sumatera can be used as reference material in the physics learning process in Indonesia, especially in South Sumatra.

CONCLUSION

South Sumatera has local wisdom that is characteristic of the region in the form of food, customs, dances, songs, and regional ceremonies. Some of the local wisdom contains physics concepts in it. The construction of customary houses in South Sumatera uses the principles of Archimedes' Law. The

process of making pempek is closely related to the concept of temperature and phase change. Making smoked fish using the concept of temperature and heat. The preparation of salted fish utilizes the concept of radiant heat transfer and evaporation. The process of making roasted kemplang is closely related to the concepts of heat transfer, evaporation, and expansion. This local wisdom is very suitable if it is used as a physics learning object. The application of learning like this can be used as an effort to develop the 21st-century skills of students and supports the learning process in the Merdeka Curriculum. Thus, students will more easily understand the learning they do.

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