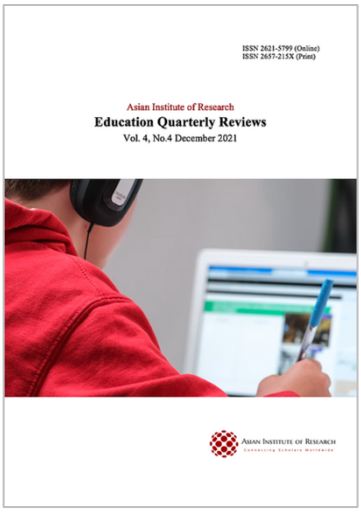

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Identifying Physics Concepts in *Moke* Making Process: An Ethnoscience Approach

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Abstract
The purpose of this research was to identify physics concepts embedded in *moke* making process. The research was conducted in Munerana village, Flores Island, East Nusa Tenggara province, Indonesia. The research data were mainly obtained through in-depth interviews and direct observations at the location of *moke* making process. The results showed that there are physics concepts embedded in *moke* making process that can be further explored.

Keywords: *Moke*, Ethnoscience, Physics Concepts

1. Introduction

Moke is a traditionally homemade alcoholic beverage produced mainly in Flores Island and its neighboring islands such as Solor, Lembata, and Adonara. All of these islands are located in East Nusa Tenggara province, Indonesia. This traditional drink is made from the fermentation and distillation of *nira,* a liquid substance taken from the fruits of palm trees (*Borassus flabellifer* and *Arenga pinnata*). The fermentation of *nira* occurs due to the activity of certain organisms found in *nira* (Irmayuni, Nurmila, & Sukainah, 2021) and the availability of *nira* sugar content which is the main ingredient for the fermentation process (Amema, Tuju, & Rawung, 2017). *Moke* is produced by distilling this fermented *nira*.

According to Adoe, Riwu, & Magang (2018), people in East Nusa Tenggara have been making use of palm tree fruits to produce local alcoholic beverages, namely *tuak, moke,* and *sopi* for such a long time. Saka & Nainggolan (2019) mentioned that *moke* is an inherited traditional drink and in the context of East Nusa Tenggara culture, offering *moke* to other people is a symbol of hospitality, friendliness, and unity. The existence of *moke* is also acknowledged in the regional government policy of East Nusa Tenggara Province (Law No. 5/2017) which categorizes *moke* as a cultural based traditional drink in East Nusa Tenggara.

Like in many other villages in Flores Island, in Munerana village, *moke* is produced by using easily accessible traditional tools. The villagers also use traditional techniques passed down from generation to generation. In this village, *moke* has become an integral part of villagers' lives and has even become part of their culture. When people are celebrating traditional ceremonies or any such parties as engagement and wedding parties, *moke* is a

must-served beverage. In addition, producing *moke* is the main source of livelihood in the village. Economically speaking, like other families in moke making villages in Flores Island, most families in this village heavily rely on *moke* production to fulfill their daily needs (Dentis, 2017).

As an integral part of their culture, almost all people in Munerana village are accustomed to *moke* making process, including the school aged children. These children are growing up under the palm trees. They observe on daily basis how their parents or other family members are producing *moke.* Some of them even help their parents to produce *moke* after their school time.

According to Normina (2018) and Matondang, Lubis, & Suharyanto (2018), culture and education are closely interrelated and can influence each other. Culture can influence education and vice versa. A local culture might have any local wisdom and knowledge which can be explored to contribute to our existing knowledge as well as to science being taught at schools or universities. For instance, the traditional ways of counting and native mathematical concepts embedded in traditional ceremonies, dances and traditional games used by the Palue community in East Nusa Tenggara could be explored and integrated into the mathematical learning process for elementary school children (Bunga, Zaenuri, & Isnaeni, 2018). Another example is the use of betel leaf in Nyirih tradition (this tradition exists in most religions in Indonesia, including in East Nusa Tenggara) as learning materials for physics, biology and chemistry subjects (Rizaldi, Andayani, Doyan, & Makhrus, 2021) or how scientific concepts embedded in the production of rebon shrimp paste could be used to improve students' characters and awareness of their local wisdom (Hadi, Sari, Sugiarto, Mawadda, & Arifin, 2019). These aforementioned researches are examples of efforts conducted to transform native or indigenous science into scientific science which is commonly known as ethnoscience (Sudarmin, Febu, Nuswowati, & Sumarni, 2017). According to Sumarni, Sudarmin, Wiyanto, & Supartono (2016), in the context of Indonesia, implementing learning with ethnoscience based approach is very essential as Indonesia comprises thousands tribes and cultures which could provide us with various native cultures and traditions to be explored. Besides that, implementing learning with ethnoscience based approach can help us preserve Indonesian local cultures and traditions.

Regarding the *moke* making process, it is apparent that the process involves traditional techniques, tools, and steps that can be explored for educational purposes. This research aimed to identify physics concepts embedded in the *moke* making process by adopting an ethnoscience approach. The research was guided by this research question: what embedded physics concepts can be explored from the *moke* making process? The research was worth conducting for the following reasons: firstly, the topic discussed is well known and directly experienced by school-aged children in Munerana village and also by most school-aged children in East Nusa Tenggara. This research can help to create a better learning process. Not only do students learn theories, but they can also relate theories they are learning with their direct observations and daily experiences. Secondly, the research will contribute to adding on the bank of Indonesian native or indigenous sciences which have been transformed into scientific sciences. This will eventually contribute to helping Indonesian students understand scientific concepts in the learning process.

2. Method

The research was conducted in Menerana village, Flores Island, East Nusa Tenggara province. This research used an ethnoscience approach and was a descriptive qualitative research. As a qualitative research, the researcher examines the condition of the object or phenomenon that occurs naturally and focuses in depth on the object or phenomenon being studied (Hardani, 2020). The researchers are the main instrument that can collect and interpret information needed for the research. The data of this research were obtained mainly through the in depth interviews with one respondent: a local villager who has been producing *moke* for more than thirty years, and direct observations at the location of *moke* making process. The researchers then analyzed and triangulated all sorts of data obtained during the data collection process and described in detail physics concepts embedded in *moke* making process.

3. Results and Discussion

3.1. The meaning of Moke for People in Munerana Village

In Munerana village, *moke* plays an important role culturally and economically. Culturally, *moke* is an integral part of the villagers' culture. People in this village treat *moke* as a sacred drink; they cannot proceed to conduct any traditional ceremonies without making sure that they have provided *moke*. Besides that, when people are celebrating parties such as engagement and wedding parties, *moke* is a must served drink. Viewed from the economic perspective, producing *moke* is the source of livelihood for most villagers. Economically, most people in the village earn money from *moke* production and marketing. In terms of the tools used to produce *moke*, the villagers make use of easily accessible traditional tools, mainly consisting of earthen pots, an array of bamboos, and used jerry cans. They also use certain firewood to generate heat for the heating and distillation process.

3.2. Moke Making Process and the Embedded Physics Concepts

There are three steps of *moke* making process, namely *nira* taking process, *nira* heating process and the distillation process.

3.2.1. *Nira* taking process

Nira taking process comprises three steps:

a. Clamping the ripen palm fruits

The clamping process is carried out in order to open the pores of the ripen palm fruits. It is believed that ripen palm fruits would produce *nira* better than the young ones. These ripen palm fruits are clamped using a traditional tool, called *pikut. Pikut* is made using a pair of wood tied at one end (see figure 1). Based on the way it works, *pikut* can be categorized as a simple machine, namely ***lever***. As *pikut* belongs to a lever, the tool can generate several physics concepts which can be explored such as ***classes of lever, lever arm, load force, effort force, mechanical advantage of the simple machine and torque***.

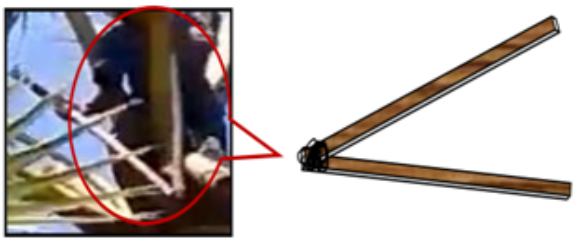

Figure 1: *Pikut*

b. Slicing the palm fruits

The clamped palm fruits are then sliced to make ways for *nira* to flow out of the palm fruits. They are sliced using a special knife (see figure 2), from which concepts related to ***pressure, force and area*** could be explored.

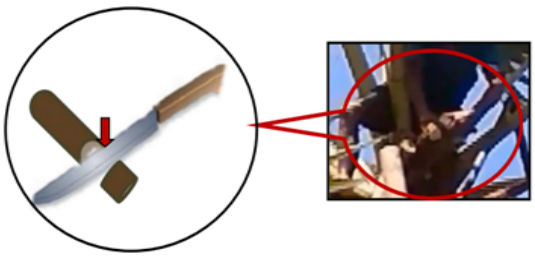

Figure 2: Special Knife used to slice the palm fruits

c. Nira tapping process

The flowing *nira* is tapped in a bamboo, traditionally called *teren* or a used jerry can (see figure 3). The flowing *nira* is an example of ***a fluid (unsteady fluid)***. Another physics concept that can be explored is about ***the fluid flow rate***.

Figure 3: *Nira* tapping process

3.2.2. *Nira* Heating Process

Firstly, the fermented *Nira* is poured into an earthen pot. The earthen pot is closely connected with the firewood generated furnace or fire stove (see figure 4). Next, the fermented *nira* is heated until it reaches the boiling point and then vaporizes. During the heating process, people must stay away from the fire stove to get rid of the heat. There are several physics concepts that can be explored from this process, namely ***heat, heat transfer (conduction, convection and radiation), change of temperature, changes of state and how energy is involved in the state changes.***

Figure 4: The heating process

3.2.3. The Distillation Process

The distillation process is carried out by using array of bamboos (see figure 5). The array consists of two bamboos with different lengths. The longer bamboo is traditionally called *wewur* while the shorter one is called *mangun*.

Figure 5: Array of bamboos used for the distillation process

In the distillation process, the fermented *nira* which is continuously heated will reach the boiling point and eventually, it will vaporize. The vapor of the *nira* will flow through the *mangun* to reach the *wewur* pipe. In the *wewur* pipe, the vapor will contact with cooler surfaces and will travel longer distance to reach the other end of the pipe. And these will allow the vapor to condensate to a liquid which is called *moke* (see figure 6).

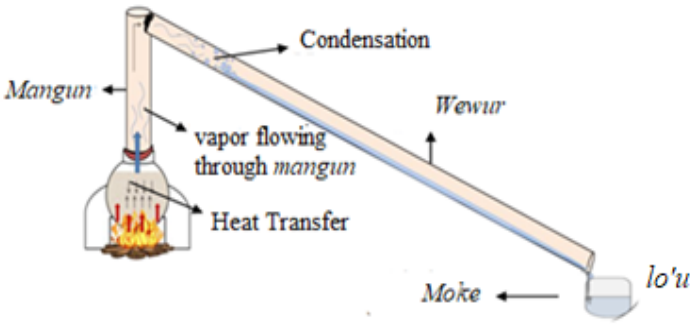

Figure 6: The distillation process

This alcoholic liquid is tapped in a container, locally called *lo'u* (*lo'u* observed in this research is a five liter used jerry can). The amount of *moke* in a *lo'u* is measured by using a traditional measuring instrument which is locally called *peli ukur;* a ruler-like instrument as depicted in picture 7. When immersed in the *lo'u* (five-liter jerry can), one scale of the *peli ukur* has been converted to be equal to 0.62 liters.

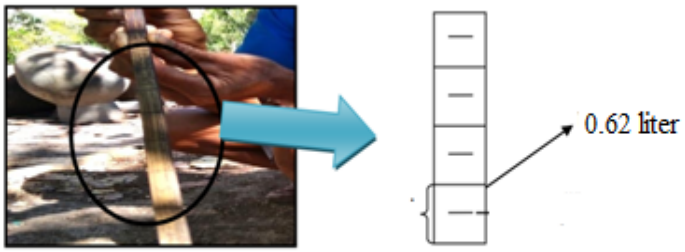

Figure 7: *Peli Ukur*

It is very clear that during the distillation process, **concepts related to changes of states, particularly from liquid to gas (vaporization) and from gas to liquid (condensation) can be clearly explored. In addition, concepts related to measurements such as measuring instrument and unit conversions can also be explored.**

4. Conclusion

In Munerana village, *moke* is culturally and economically important. In addition, the *moke* making process which comprises *nira* taking process, *nira* heating process and the distillation process contains several embedded physics concepts which can be further explored. In *nira* taking process, one can explore concepts related to simple machines such as classes of lever, load force, effort force, and mechanical advantage of a simple machine. Besides that, concepts related to torque, fluid, and pressure can also be explored. In *nira* heating process and in the distillation process, one can explore concepts related to heat, heat transfer, temperature change, changes of states as well as how energy is involved in temperature and states changes. In addition, concepts related to measurements such as measuring instruments and unit conversions can also be explored. It is clearly seen that *moke* making process contains important physics concepts which can be explored and transformed into our existing knowledge or sciences, particularly with sciences being taught at schools.

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