Berkala Ilmiah Pendidikan Fisika
ISSN : 2337-604X (print)
ISSN : 2549-2764 (online)

Vol 10 No 2 2022
https://ppjp.ulm.ac.id/journal/index.php/bipf
page 153-162

Wetland Ethnoscience Learning Resources: An Overview of Physical Science Concepts

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DOI:10.20527/bipf.v10i2.12698

Received: 5 February 2022 **Accepted: 30 June 2022** **Published: 30 September 2022**

Abstract

The potential of wetland ethnoscience in the South Kalimantan region needs to be explored more deeply so that it can be used as a learning resource that produces meaningful learning. This qualitative research has applied the Spradley method to explore the facts and experiences of wetland-based indigenous science in Amuntai Hulu Sungai Utara Regency to transform it into ethnoscience which is used as a natural science learning resource, especially for the concept of physical science. Ethnoscience learning resources for the Mamar Alabio village community in raising Alabio ducks have original knowledge in the form of hatching techniques and indigenous knowledge of the Banyu Hirang village community in the use of sunlight to dry water hyacinth and purun plants, as well as the use of a raw material pounder which were very potential as science learning resources related to with physics concepts according to the junior high school curriculum 2013. These ethnoscience learning resources can be integrated into science learning designs to produce meaningful learning and train students' competencies.

Keywords: Ethnoscience; Learning Resources; Physical Science Concepts; Wetlands

How to cite: Sholahuddin, A., Sya'ban, M. F., Fitriana, R., Shalihah, A., & Misbah, M. (2022). Wetland ethnoscience learning resources: An overview of physical science concepts. *Berkala Ilmiah Pendidikan Fisika*, 10(2), 153-162.

INTRODUCTION

Indigenous science in traditional societies has been built in the form of symbolic messages, customs, and socio-cultures and passed down from generation to generation. This kind of traditional knowledge is a holistic understanding of traditional communities in daily practice based on their life experiences and interactions over centuries (Sumarni, 2016).

Indigenous knowledge contains knowledge, experience, concepts and principles that have been tested for a long time, passed down from generation to generation but have not been scientifically tested (Singh & Saha, 2017; Darmadi, 2018). However, most of the traditional knowledge has been forgotten and lost due to a lack of understanding about conservation and the importance of its preservation (Dentzau, 2019).

Exploration of local culture is important to understand local wisdom and integrate and elaborate it with learning and science in schools or classroom so that there is a balance between modern science and traditional science for building meaningful learning and connecting the gap of science education pathways (McKinley & Stewart, 2012; Handayani et al., 2018). Sudarmin (2014) argues that local wisdom in the scientific context is limited to something that has been applied as a tradition in society that can be scientifically proven so that it can be used as a source of learning.

The integration of learning resources based on indigenous knowledge or indigenous knowledge can increase the attractiveness and meaning of learning (Hewitt et al., 2013). Meaningful learning occurs when students are actively involved in connecting knowledge and ideas in their cognitive structures with new information being learned, thereby encouraging students to engage in deep learning (Hofstein & Lunetta, 2004; Sholahuddin, 2015). In addition, the integration of indigenous knowledge in various forms of ethnoscience into the learning process will bridge students' preconceptions with scientific concepts. This can avoid misconceptions (Østergaard, 2017); (Rahmawati & Ridwan, 2017; Saparini et al., 2021; Sudarmin, 2014).

Ethnoscience integration has been proven to be able to improve various types of learning outcomes such as knowledge, actual problem solving, critical thinking skills, and scientific work (Agustin et al., 2018; Ariningtyas et al., 2017; Emdin, 2011; Jamalludin & Nuraini, 2021; Parmin et al., 2016; Zimmerman & Weible, 2017), scientific literacy (Sholahuddin et al., 2021) and develop critical self-awareness in the formation of cultural identity and character (Rahmawati & Ridwan, 2017).

The diversity of the physical and social environment, including wetlands, has several potentials that can be explored and developed as a very useful science learning resource. The physical environment in the form of a diversity of flora, fauna and the application of simple technology in the community has not been used optimally in the learning process (Handayani et al., 2018; Sya'ban et al., 2017). Whereas society has a variety of traditions, habits, and values of life that have been used for generations, even in the past, and have been proven to be able to preserve the environment. Some customs and values exist and survive sustainably in society (Zidny et al., 2021).

Various studies have been carried out to integrate ethnoscience into learning, especially based on local wisdom, but most of them are cases of ethnoscience implementation in certain regions or communities, including those related to wetland-based ethnoscience. Damayanti et al., (2017), reported that the integration of local batik culture in Bakaran Village, Juwana District, Pati Regency into science learning had a significant effect on mastery of concepts and students' creative thinking skills. Through batik activities, students can study science learning materials such as chemistry in life, the role of heat in everyday life, and the role of humans in environmental management. Perwitasari et al., (2016) have integrated the ethnoscience of smoking fish in Demak Regency in learning the concept of energy and its changes and has been proven to be able to improve students' scientific literacy. Other studies have investigated the integration of ethnoscience in the form of science learning modules to improve mastery of the concepts of temperature and heat as well as the concept of motion (Fitriah, 2021; Navisah et al., 2021) to foster entrepreneurial interest (Khoerunnisa et al., 2016), and science process skills (Pangestu et al., 2020). The integration of environmental education with local Balinese values can increase students' environmental awareness (Surata et al., 2018). The research of Sya'ban et al., (2017) is also still being carried out for prominent ethnoscience cases and has not been standardized and does not involve experts. Thus, the ethnoscience facts disclosed have not provided a strong justification for the accuracy of ethnoscience in the framework of science learning resources.

This study has examined qualitatively several potential resources for learning ethnoscience based on wetlands that can be developed as a source of learning physics in junior high schools through qualitative studies that are reviewed based on the Junior High School curriculum 2013.

METHOD

The research design used a qualitative approach with the ethnographic method of the Spradley model as shown in Figure 1 (Creswell, 2012). This study explored the meanings of actions from events that happen to someone who wants to be understood or also understand the characteristics of social situations more comprehensively through participatory observation.

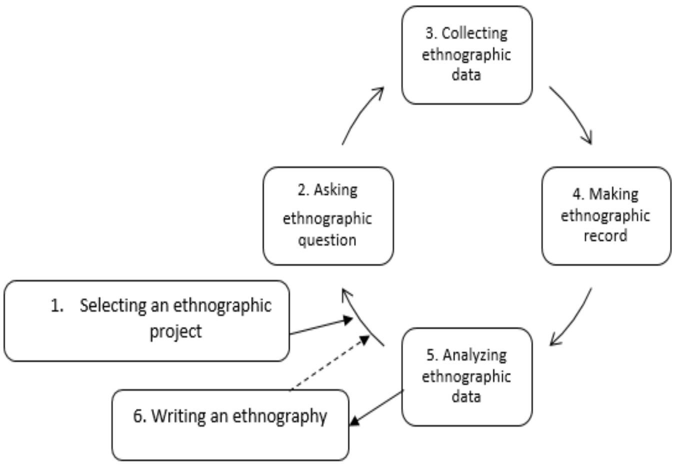

Figure 1 Spradley's Ethnographic Method

The research was carried out for 1 month in Amuntai, Hulu Sungai Utara Regency related to the ethnoscience potential of wetlands. The initial analysis was carried out based on a literature review and community experience related to ethnoscience which was then carried out in-depth into the field.

Sources of data in the form of facts and experiences of community ethnoscience were grouped into three categories (1) ethnomedicine (2) ethnotechnology such as transportation, sasirangan, food, agriculture, and (3) ethnoenvironment such as swamp forest, mangrove forest, flora, and fauna. In addition, it also involves the subject as a competent resource person, either ethnoscience actors, community leaders, or experts.

Data collection was carried out through participatory observation, in-depth interviews, and document/library studies. Many tools are used to support data collection such as a recording device or camera, and notes where the researcher plays the main role as the research instrument.

The credibility of the data was achieved by extending the time of stay at the research location, observing diligently, testing triangulated, and conducting peer-to-peer discussions. The validity of the data is proven by triangulation of data collection techniques, triangulation of data sources, and triangulation of theories.

Based on the Spradley method, the steps of this research include (1) FGD to analyze and determine the attributes, objects, sources, experts, types of facts, and experiences of wetland-based ethnoscience and ethnoscience criteria. (2) Collecting data through documentation, observation, and interviews with relevant sources at the location and object of research. (3) FGD to reconstruct scientific science from the indigenous science community to group and validate to achieve research objectives. (4) Mapping wetland-based ethnoscience into the Junior High School Curriculum 2013.

RESULT AND DISCUSSION

Before integrating ethnoscience or local wisdom into the physics learning, it is necessary to examine the potential of ethnoscience learning resources in wetlands that can be used as learning resources. Through a qualitative study in the Amuntai area, Hulu Sungai Utara Regency, several potential sources of ethnoscience learning have been identified. This study focuses on two kinds of wetland learning resources, namely the local wisdom of the Mamar Alabio village community in maintaining Alabio ducks with indigenous knowledge in the form of hatching techniques for Alabio duck eggs (Table 1), and the indigenous knowledge of the Banyu Hirang village community in utilizing sunlight to dry water hyacinth. (Eichornia crassipes) and purun (Eleocharis dulcis) to be processed into woven crafts in the form of mats, chairs, bags, and other souvenirs (Figure 1; Table 2).

Figure 1 Crafts from Water Hyacinth and Purun

Table 1 Ethnoscience of Alabio Duck Farming

Indigenous Knowledge	Scientific Knowledge
The use of a hatching system by arranging eggs in special places according to the age of ripening eggs and regulating a sufficient temperature by using a cover from a plastic sack with a certain thickness.	Hatching duck eggs requires sanitation in the hatchery, disinfectant, water, fumigation of eggs, and hatchery using potassium permanganate and 40% formalin. The hatching temperature and humidity ranged from 37 to 38 ^{o}C for 28 days, while screening, cooling, and inspection were carried out. Turning eggs is done 3 times a day starting on the 3rd to 25th day. Cooling is done on days 26-28 every morning, afternoon, and evening. Then the examination is done to see the growth of the embryo. (Darmawati et al., 2016).

Table 2 Utilization of Swamp Plants

Indigenous Knowledge	Scientific Knowledge
Purun is a type of wild grass swamp plant.	Purun (Eleocharis dulcis) is one of the wild plants that are widely found in tidal swampland with acidic waters. This grass-like plant has a short rhizome with elongated stolons with flattened round tips, brownish to black in color. Stems erect, unbranched, gray to glossy green, 50-200 cm long, and 2-8 mm thick.
Purun can be used as craft materials such as woven mats, hats, and the like.	The stems of the purun plant are used by the community as craft material for woven mats, hats, and the like. Another benefit of purun is as an organic fertilizer and biofilter because it can improve water quality and can absorb toxic elements such as iron, sulfur, lead, mercury, and cadmium. The level of damage to rice plants due to stem borer in areas with high purun populations is only 0.0-0.1%, and this will increase in areas with lower purun populations. Purun rats are also a haven for natural enemy insects (Asikin & Thamrin, 2012).
Water hyacinth is a wild plant found in swampy wetlands around residents' housing.	Water hyacinth (Eichornia crassipes) is an aquatic plant that lives afloat, has high cellulose, 64.5% per dry weight, with very rapid growth reaching 3% per day so it is considered a weed (Aini & Kuswytasari, 2013).
Water hyacinth is used as a raw material for woven crafts and bags.	Water hyacinth is used as a raw material for various woven crafts, bags, mats, hotel sandals, furniture, and others.
Water hyacinth and purun are selected and sorted based on size and then dried under direct sunlight for a certain time until the appropriate level of dryness (not too wet and not too dry).	Indonesia is one of the tropical regions which is exposed to sunlight throughout the year. There are many uses of solar energy in the community, such as for drying grain, drying fish, and drying raw materials or handicrafts. The utilization of solar energy both traditional and using solar cells can be carried out sustainably by the people of Indonesia.

Based on the study of physics concepts in the Junior High School Science Curriculum of grades VII, VIII, and IX, the ethnoscience facts above can be mapped as shown in Table 3.

Table 3 Map of Basic Competencies in The Field of Science in Junior High School

Class	Basic Competencies
VII	3.3 Understand the concept of mixtures and single substances (elements and compounds), physical and chemical properties, physical and chemical changes in everyday life. 3.4 Understand the concepts of temperature, expansion, heat, heat transfer, and their application in everyday life, including the mechanism for maintaining a stable body temperature in humans and animals. 3.5 Understand the concept of energy, various energy sources, and changes in the form of energy in daily life including photosynthesis.

VIII	3.3 Describe the relationship between the properties of materials and their use in everyday life, as well as the effect of the use of certain materials on human health
	3.5 Describe the use of simple machines in everyday life and their relationship to muscle work in the human skeletal structure.
IX	3.10 Distinguish between environmentally destructive and environmentally friendly technological processes and products.

(Kemdikbud, 2013)

Traditional hatching of eggs by utilizing natural heat in a room with a metal roof. This phenomenon is a form of utilizing renewable energy sources in the form of cheap and simple solar heat. This phenomenon can be used as a discussion material for students in the class based on the theory of energy sources and heat transfer (KD 3.4 and 3.5 in class VII) both by conduction and radiation. Traditionally, alabio duck breeders also regulate the heat requirement of hatching by adjusting the thickness of the egg cover made of plastic sacks. Based on the concept of physics, this activity is the application of material properties, namely conductors and insulators (KD 3.3 in class VIII), where plastic is a heat insulator that can retain heat so that it does not easily move to the surrounding environment. The utilization of solar energy sources is a simple technological process that is environmentally friendly because it does not produce pollutants and is a renewable energy (KD 3.10 class IX).

Figure 2 Utilization of Solar Energy for Hatching Alabio Duck Eggs (Personal Document)

The ethnoscience potential of water hyacinth and purun is related to the use of solar energy for drying, it is closely related to learning various basic science skills, especially about heat and energy such as hatching alabio duck eggs. Class VIII KD 3.5 learning about simple machines (Figure 2). In addition, water hyacinth and purun in the context of KD 3.10 class IX regarding environmentally friendly technological products can be used as phytoremediation materials to absorb harmful heavy metals from waters (Novita et al., 2020; Yunus & Prihatini, 2018).

Figure 3 Traditional Purun Pounder Made of Ironwood https://banjarmasin.tribunnews.com/2020/01/18/

Ethnoscience derived from indigenous knowledge formed through the adaptation of human and environmental interactions will become a legacy of local wisdom from generation to generation. Even some experts view that original knowledge has an equal position with modern knowledge in finding and claiming a truth (Dentzau, 2019).Thus it is very important to be integrated into science learning tools. In this way, students not only memorize lessons but are also directly involved in meaningful learning through interaction with their environment. Systematic and planned integration of ethnoscience in learning can also avoid students' misconceptions (Østergaard, 2017; Rahmawati & Ridwan, 2017) due to cultural influences or unscientific daily habits.

Teachers play an important role as a bridge between indigenous knowledge that develops in society and scientific knowledge through curriculum analysis and appropriate learning designs (Nurhayati et al., 2021; Supriyadi & Nurvitasari, 2019). Some researchers have even tried to develop learning strategies or models that are specifically based on this ethnoscience integration (Damayanti et al., 2017). Some learning tools that have been partially reported in various studies include teaching materials, student worksheets, test instruments, and learning media. It is highly recommended that it is necessary to explore and transform the various wealth of indigenous knowledge in the community, especially the wetland environment to enrich science learning resources. Furthermore, ethnoscience that already has scientific evidence and explanations can be used in comprehensive learning designs that are supported by appropriate learning tools.

CONCLUSION

The diverse potential of wetland ethnoscience in South Kalimantan is very potential to be used as a source of learning science, especially physics, to produce meaningful learning and train students' competencies. Ethnoscience learning resources in Amuntai, Hulu Sungai Utara Regency which consist of local wisdom of the Mamar Alabio village community in hatching Alabio duck eggs and indigenous knowledge of the Banyu Hirang village community in utilizing sunlight to dry water hyacinth and purun plants, and the use of a raw material pounder can be used as a source of learning science related to physics concepts according to the Junior High school Curriculum 2013. Thus, the ethnoscience learning resources can be integrated into the science learning design to improve the quality of learning. It is necessary to further explore the various treasures of indigenous knowledge of wetlands to be scientifically proven and explained so that they are useful in learning.

ACKNOWLEDGEMENT

Thank you to the Rector of Lambung Mangkurat University who has funded research through DIPA ULM for Fiscal Year 2021 with Decree Number 023.17.2.677518/2021.

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