THE PRANATA MANGSA IN THE PERSPECTIVE OF AN ETHNOSCIENCE APPROACH AS NATURAL SCIENCE TEACHING MATERIALS IN ELEMENTARY SCHOOLS

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Abstract

Javanese people have a close attachment to nature and the environment. One of the local wisdom related to nature that is still used by the Javanese is the pranata mangsa. The pranata mangsa is an indigenous science which can be seen through the perspective of the ethnoscience approach. This research aims (1) to examine the pranata mangsa from the perspective of an ethnoscience approach and (2) to examine the use of the pranata mangsa as teaching materials for science in elementary schools. This research uses a qualitative approach that is library research. Data collection techniques using documentation. The analysis technique used is descriptive qualitative. The results of this research indicate that (1) the pranata mangsa in the perspective of ethnoscience approach is a Javanese calendar system that can combine events between sky and earth by revealing the behavior of flora and fauna in Java and soil characteristics that are affected by temperature changes and (2) the use of the pranata mangsa as a science teaching material in elementary schools can be a learning innovation based on local wisdom that can provide knowledge to students about the phenomena and symptoms of science in a contextual and modern manner related to environmental management, natural resource conservation, environmental pollution, and ecosystems.

Keywords: ***Ethnoscience, Local Wisdom, Natural Science Teaching Materials, Pranata Mangsa***

1. Introduction

Science is knowledge obtained through data collection by experimentation, observation, and deduction to produce a reliable explanation of a symptom (Widiyatmoko & Pamelasari, 2012). Science learning has been given since elementary school. Science learning is a process that helps students learn more meaningfully through process skills so that they can master scientific knowledge and natural laws and apply them in real life (Wicaksono, 2020). Natural science learning in elementary school aims to make students know and understand the events around them, especially events in everyday life. Science is a subject that is difficult for students to solve, therefore learning needs to make science concepts following its context in everyday life, so that the learning process is more meaningful and effective for students (Indriati & Riskiyah, 2018). Many events occur in everyday life. One of them is the local wisdom that has been integrated with the community. The science learning process itself can be through understanding the knowledge of a culture or it can be called an ethnoscience approach.

Ethnoscience is a community belief in certain areas whose truth can be studied scientifically (Fasasi, 2017; Mahendrani & Sudarmin, 2015). The ethnoscience

approach is the process of reconstructing the original science that develops in society into scientific science (Khoiri & Sunarno, 2018; Sudarmin et al., 2017). The ethnoscience approach can also be interpreted as a way to improve the quality of learning, besides that it can introduce the surrounding cultures or local wisdom.

Local wisdom is an activity carried out by the community to solve a problem. Local wisdom is very attached to the community and becomes a way of life or a way of life in the form of science. Local wisdom is the potential of an area and everything about human thought and work that contains wisdom and wisdom values and is passed on from generation to generation so that it becomes a symbol of the region (Shufa, 2018). Local wisdom has values that become traditions and beliefs in a particular society. The local wisdom of each region is different and becomes one of the original wealth of an area and a way of life. Besides, culture in certain communities is used as a tool to determine activity in life. One of the local wisdom in Java is the Javanese calendar *pranata mangsa* system used in daily life, especially in agriculture.

The *pranata mangsa* is a product of Javanese culture which is full of scientific content. The *pranata mangsa* is a traditional calendar of seasonal rules which is well known in Java. The *pranata mangsa* is local wisdom regarding the calculation of the seasons listed in the calendar based on natural events (Zaki et al., 2018). In his day the *pranata mangsa* system as a guide for farmers as a determinant in doing something. The *pranata mangsa* is based on the apparent circulation of the sun in the sky. The *pranata mangsa* have become a part of community life.

This *pranata mangsa* system is prepared based on observations of natural events that occur on earth and in the sky due to the apparent shift in the location of the sun which is the core of the science content in this system (Sarwanto et al., 2010). The use of *pranata mangsa* as a source of learning can open opportunities for regions and education managers to adapt, modify, and contextualize the curriculum according to conditions in the field (Anazifa, 2016). Ethnoscience that lives and develops in society is still in the form of concrete experiential knowledge as a result of the interaction between the natural environment and its culture (Suastra, 2005). Curriculum development needs to integrate ethnoscience so that the student learning process becomes more meaningful and contextual (Wahyu, 2017).

This research aims (1) to examine the *pranata mangsa* system from the perspective of an ethnoscience approach and (2) to examine the use of the *pranata mangsa* system as teaching materials for science in elementary schools. The implication of the application of ethnoscience by incorporating culture into science in learning in elementary schools is to be able to improve the quality of education and can introduce existing local cultures so that students can know the relationship between culture and phenomena that occur around scientifically.

2. Literature Review

The Javanese people have one of the local wisdom which is very closely tied to nature and the environment which is still used, namely the *pranata mangsa* system. The *pranata mangsa* system is an indigenous science that can be studied from the perspective of an ethnoscience approach so that it can be used as science teaching material in elementary schools. Based on this linkage, this study will examine the *pranata mangsa* system in the perspective of the ethnoscience

approach as science teaching materials in elementary schools, with a theoretical review as follows:

2.1. *Pranata Mangsa* System

Javanese farmers have one of the local wisdom, which is a calendar system that regulates the working procedures of the farmers or season regulation which is called *pranata mangsa* (Hakim, 2014; Khotimah, 2019). Javanese farmers use *pranata mangsa*, which is based on the intuition of their ancestors and is used as a benchmark for farming. *Pranata mangsa* can guide farmers to follow natural signs according to existing season and can use the land as they wish, even if it is supported by infrastructures such as drains and irrigation. By calculating the *pranata mangsa*, natural balance can be maintained. The word *pranata mangsa* comes from the Javanese language which consists of two words, namely "*pranata*" and "*mangsa*". *Pranata* means provisions or rules and *mangsa* means season. The *pranata mangsa* is several years based on the course of the sun which shifts from the equator to north and south for six years and the circulation of the sun in a year affects the seasons on earth (Anazifa, 2016). The *pranata mangsa* is the result of Javanese culture which is full of scientific content (Iskandar, 2016; Sarwanto et al., 2010). The *pranata mangsa* system is a traditional calendar system that is used as a guideline for the Javanese community, especially farmers, to determine the planting season and harvest season based on the prevailing weather and climate.

2.2. Ethnoscience Approach

The word ethnoscience comes from the word *ethnos* (Greek) which means nation, and *scientia* (Latin) means knowledge, so ethnoscience is the unique knowledge possessed by a nation. Ethnoscience is an activity of transforming original science which consists of all knowledge about the facts of society that comes from hereditary beliefs and still contains myths (Novitasari et al., 2017). Ethnoscience deals with the knowledge that comes from a culture which can act as a basis for building a reality that promotes cultural relations with the latest scientific knowledge (Abonyi et al., 2014). The ethnoscience approach is a strategy for creating a learning environment and designing learning experiences that integrate culture as part of the learning process (Kurniawan et al., 2019; Sardjiyo & Pannen, 2005). Ethnoscience approach learning is based on the recognition of culture as a fundamental (fundamental and important) part of education as an expression and communication of ideas and the development of knowledge (Dewi et al., 2019; Ryan, 2016). Learning that uses the concept of culture as a learning resource can improve the ability of students to use scientific knowledge, this is following the opinions expressed (Nuroso et al., 2018; Sudarmin, 2014). Students can make observations or observations in connecting phenomena that occur with the culture of the community that occurs around them through the ethnoscience approach.

2.3. Science Learning in Elementary Schools

Science is a collection of theories regarding natural phenomena that are born and developed through scientific methods that require scientific attitudes such as curiosity, openness, honesty, such as in systematically arranged observations and experiments (Wicaksono & Sayekti, 2020). Sciences is a branch of science that discusses natural phenomena and materials which are the result of a collection of observations and experiments (Rustaman, 2011). Science learning is an introduction to, as well as observations, of the phenomena that occur around and that occur in nature. Science learning is the study of events that occur in nature (Samatowa, 2010). Science learning is expected to be an aid for students to learn about their surroundings and themselves (Laksana et al., 2016). From some of the

opinions above, it can be concluded that science learning is an introduction to how attitudes about phenomena that occur around you by conducting experiments are structured, tested, and can be assessed for truth.

3. Research Methods

This qualitative research is a literature study using books and other literature such as scientific journals and scientific articles as the main object. Library research is a study carried out to solve a problem that is based on a critical and in-depth study of relevant library materials (Danandjaja, 2014). Sources of data are divided into main and additional ones from scientific articles in journals, research reports, and reference books related to the *Pranata Mangsa* System, Local Wisdom, Ethnoscience Approach, and Science Learning in Elementary School. Data collection techniques use primary data documentation and additional scientific references. The validity of the data used triangulation of primary and secondary sources. This kind of qualitative data analysis is inductive, which is based on the analysis of the data obtained, then developing a particular relationship model or becoming a hypothesis. The analysis technique used is descriptive analysis. Descriptive analysis techniques provide a clear, objective, systematic, analytical, and critical description and explanation of the *pranata mangsa* system from an ethnoscience perspective, and the *pranata mangsa* system used in elemtary school science teaching materials.

4. Result and Discussion

4.1. The *Pranata Mangsa* System in Ethnoscience Approach Perspective

The *pranata mangsa* has been known by agricultural communities on the island of Java in the past (Hakim, 2014). Agricultural communities know the planting time and rest time of agricultural land so that agricultural land and the surrounding ecosystem have time to restore its condition. The traditional communities at that time had fully understood the basic idea that the land needed a rest period after carrying out its food production function so that the community believed that the *pranata mangsa* system was more able to guarantee the sustainability of the land.

Standardization in the use of *pranata mangsa* was only carried out during the reign of Sri Susuhan Paku Buwana VII in Surakarta on June 22, 1856 (Sindhunata, 2011; Witasari, 2016). The purpose of standardizing *pranata mangsa* is to strengthen the *pranata mangsa* system so that it is easy for farmers to use in Java. The *pranata mangsa* system standardized by Sri Susuhan Paku Buwana VII was divided into 12 season. The *pranata mangsa* calendar consists of 12 season with an age of 23-43 days for each season. The *pranata mangsa* system is divided into four major seasons, namely: *katigo* (dry season), *labuh* (frequent rainy season), *rendheng* (rainy season), and *mareng* (transition season to dry season). The *pranata mangsa* divides a year into 12 season, namely *kasa*, *karo*, *katelu*, *kapat*, *kalima*, *kanem*, *kapitu*, *kawolu*, *kasanga*, *kasapuluh*, *destha*, and *saddha* (Sindhunata, 2011; Witasari, 2016).

The relationship between climate and living things, especially plants and animals, is closely related to the *pranata mangsa* (Khotimah, 2019; Sindhunata, 2011; Witasari, 2016). *Mangsa Kasa*, *sesotya murca ing embanan* (a diamond falling from its container) describes the leaves beginning to fall. Natural phenomena that accompany fall leaves, soil begins to dry up, and springs begin to shrink.

Mangsa Karo, *bantala rengka* (the earth breaks), this season, the palawija plants begin to grow, the randu trees and mango leaves begin to bloom, the soil is cracked a lot. *Mangsa Katigo*, *suta manut ing bapa* (child according to his father) means that this season the lung-lungan plant begins to spread, here lung-lungan is likened to a child (suta) and lanjaran means father. *Mangsa Kapat, waspo kumembeng jroning kalbu* tears well up in the heart), meaning that the sources begin to dry up, tears are like water, the heart is like the heart is like a spring. Natural phenomena that accompany the heat, this season begins to harvest crops, bamboo, uwi, gadung, kunci, and others begin to grow. *Mangsa Kalimo, pancuran mas sumawur ing jagad* (golden shower wateres the earth), gold shower is likened to rain, sumawur means scattered, in universe means on earth. It was getting cold, the tamarind tree began to bloom, snakes and flies began to appear, the mango harvest. *Mangsa Kanem, rasa mulyo kasucen*, it means the season of lots of fruit. Natural conditions such as rambutan, durian, and mangosteen fruit are beginning to ripen. It's time to cultivate the fields, spread the rice seeds in the fields (Sindhunata, 2011; Witasari, 2016).

Mangsa Kapitu, *wisa kentir ing maruto* (the poison is washed away with the wind), which means the season for many diseases. The season is raining a lot, rivers start to overflow, it floods, farmers start planting rice in the fields. *Mangsa Kawolu*, *anjrah jroning kayun* (out of heart), meaning the cat mating season, because his heart is happy and excited. The weather is getting hot, the rice plants in the fields are turning green, the caterpillars are getting bigger. *Mangsa Kasongo, wedharing wacana mulyo* (the appearance of noble sounds), meaning that the crickets and gangsir began to sound (*ngentir*) and the garengpung began to sound (*ngereng*). *Mangsa Kasepuluh, gedhong minep jroning kalbu* (the building is trapped in the heart), meaning that this season is the time for pregnant animals. The rice began to turn yellow, the rice harvested, the little birds began to make nests, brood, and hatch. *Mangsa Destha*, *sesotya sinarawedi* (a diamond that shines gloriously), meaning that at this time the birds began to feed their young. The farmers began to harvest the main season, harvest rice and pala pendhem crops such as cassava, tubers. *Mangsa Saddha, tirto sah saking sasono* (the water disappears from its place), meaning that this season people rarely sweat because the air is cold and dry (Sindhunata, 2011; Witasari, 2016).

Pranata mangsa is one of the local wisdom of the Javanese community related to agricultural land management. The application of the *pranata mangsa* shows that the Javanese will never be separated from their natural environment. Since ancient times, the Javanese have considered nature as a subject which means that it is influenced by nature. They believe that changes in weather and seasons determine what to do, especially in agriculture (Dumadi, 2011).

The *pranata mangsa* system is one of the original sciences originating from the Javanese society. The *pranata mangsa* system becomes a reflection material for humans to study and anticipate changes that occur in nature. The Javanese farmers' understanding of nature and behavior that occurs in nature is formulated into a *pranata mangsa* system that is very beneficial for their agricultural system. *Pranata mangsa* also help farmers in designing their economic life by seeing the results of the crops they plant in each season. In other words, the *pranata mangsa* is an ethnoscience that developed in Javanese society. Ethnoscience studies a lot of classifications to find out the structures used to regulate the environment and what an ethnic group considers important. Ethnoscience in society is still in the form of concrete experiences as a result of the interaction between humans and the

environment. Therefore, it is necessary to translate ethnoscience into high science language (Sarwanto et al., 2010). Ethnoscience development and empowerment can be preceded by human and environmental interactions that form ethnic knowledge. Ethnic knowledge is then researched, analyzed, and described from an ethnoscience perspective. Then carried out the modernization and rationalization of ethnic knowledge in the perspective of ethnoscience and modern science and technology so that the development and empowerment of ethnic knowledge occurs. The *pranata mangsa* system in the perspective of ethnoscience approach is a Javanese calendar system that can combine events between sky and earth by revealing the behavior of plants and animals in Java as well as soil characteristics that are affected by changes in temperature.

4.2. The *Pranata Mangsa* System as Science Teaching Materials in Elementary Schools

The application of *pranata mangsa* in agriculture needs to be done keeping in mind that *pranata mangsa* are local wisdom capable of overcoming agricultural problems, especially the effectiveness of agricultural land use and high demand for food. *Pranata mangsa* must be placed in the right position so that this local wisdom can still be utilized according to the portion. Some efforts that can be made are integrating the indigenous science system of *pranata mangsa* in science learning in elementary schools and guiding farmers to plant rice by following the planting season calendar.

Indigenous science, in the form of a *pranata mangsa* system, can be used as teaching material for students on the ecosystem and environmental materials that include environmental conservation and management. Students receive conservation education from an early age by teaching the *pranata mangsa* system. The *pranata mangsa* system has elements of environmental management to maintain environmental functions to remain sustainable. The application of the *pranata mangsa* system allows farmers to automatically plant crops according to the nature and characteristics of the plants in each season. Besides, by implementing an *pranata mangsa* system, farmers also carry out intercropping which can inhibit soil fragility. Land management carried out following agricultural timelines can also increase sustainable production yields in plants, improve land ecological conditions, and be in harmony with nature so that the sustainable functions of nature are maintained.

Science learning by utilizing indigenous science is very possible to be applied so that it will run contextually according to the conditions at hand. Besides, by raising indigenous science, there will be opportunities for regions and education managers to adapt, modify and contextualize the curriculum following the real conditions in the field, both demographic, geographic, sociological, psychological, and cultural for students. This also opens up opportunities for innovation based on local wisdom, so that students can learn according to their traditions based on local wisdom that is owned by the region so that they cannot be separated from the culture that applies in the social system of students (Sarwanto et al., 2014)

Pranata mangsa can be one of the science teaching materials in elementary schools to preserve local wisdom and as an effort to conserve natural resources in the agricultural sector. *Pranata mangsa* can also be used as a reference for various natural phenomena that are thought to arise in response to weather conditions or climate change. By studying *pranata mangsa*, it is hoped that the community will be able to read natural phenomena well because the community must be able to adapt

to changes in weather or climate. In this regard, the *pranata mangsa* are still reliable in observing various natural phenomena at present in the agricultural sector.

5. Conclusions and suggestions

Based on the research results that have been discussed previously, it can be concluded that (1) the *pranata mangsa* is an ethnoscience developed in Javanese society. The *pranata mangsa* system in the perspective of an ethnoscience approach is a Javanese calendar system that can combine events between heaven and earth by revealing the behavior of plants and animals in Java as well as soil characteristics that are affected by changes in temperature. (2) the use of the *pranata mangsa* system as a science teaching material in elementary schools can be a learning innovation based on local wisdom that can provide knowledge to students about the phenomena and symptoms of science in a contextual and modern manner related to environmental management, conservation of natural resources, environmental pollution, and ecosystem. The suggestion from this research is that science learning based on local wisdom can be developed not only in *pranata mangsa* but can be done in other indigenous science.

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