Ethnoscientific Reconstruction of Wonosobo District on the Concepts of Temperature and Heat

Ahmad Khoiri, Kurniawati Mutmainah, Marwiati, Achmad Affandi,
Nurma Khusna Khanifa, Dewi Candra Resmi and Indrawati Aris Tyiarini
Universitas Sains Alqur an, Central Java in Wonosobo, 56351, Indonesia

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Abstract: Students have not fully understood the reconstruction of society's original science as a source of science learning. The research aims to analyze the reconstruction of original science into scientific science based on the concepts of temperature and heat. Interdisciplinary basic research methods use a qualitative descriptive approach, data collection techniques use observation, local wisdom, Wonosobo Regency, Central Java Province, and documentation. Qualitative descriptive analysis techniques use local wisdom exploration patterns. The research results show that science reconstruction can provide opportunities for students to think through recognizing issues that are developing in society and turning them into scientific knowledge. Ethnoscientific reconstruction in Wonosobo Regency includes: 1) In the dreadlock hair ruwatan tradition there is a scientific concept regarding measuring body temperature; 2) Dieng plateau house roofs using zinc can explain thermal conductivity; 3) The dew phenomenon identifies changes in the form of objects; 4) The endemic Carica tree expresses the air pressure and temperature conditions of the highlands; 5) Pranotomongso agricultural system in explaining the concept of factors that influence environmental temperature; 6) Sikidang Crater shows heat transfer by convection. Science reconstruction training equips students' character to respond to the environment.

1 INTRODUCTION

Human Resource Development is the focus of the 21st-century learning process. Advances in science and technology and the presence of the Industrial Revolution 4.0 era have made the flow of information and globalization increasingly unstoppable. When the younger generation, especially junior high school students, are not capable enough to adapt and have strong character, they will easily be carried away by the negative currents of this era of disruption (Kahfi & Binamadani, 2023; Rusnaini, Raharjo, Suryaningsih, & Noventari, 2021) So, it is important to strengthen the character from the grassroots regarding values that reflect the manners and culture of the Indonesian nation, namely as reflected in Pancasila.

The importance of improving thinking skills and character through opportunities for students to discover concepts will be easier when the learning resources presented are directly close to their lives, namely through scientific reconstruction included in the ethnoscience approach (Khoiri, 2021) in addition to ethnoscience learning resources which must consider the challenges of the century. 21. Respect for regional culture and traditions is an important factor in why an ethnoscience approach is used (Arlianovita, Setiawan, & Sudibyo, 2015; Fitriani, 2016); Vitasurya, 2016) Learning activities through scientific reconstruction are assumed to be able to empower students' skills in scientific thinking activities that can realize national character.

Strengthening the results of research on scientific reconstruction can develop students' appreciation in the form of appreciation for the potential of their region and having science process skills, improve student learning achievement (Okwara & Upu, 2017) and develop scientific knowledge (Sudarmin & Sumarni, 2018); Widodo, 2012) through a strategy of developing science issues in society will be more effective in constructing science (Amelia, Jumini, & Khoiri, 2021;) and can foster an attitude of concern for the environment, maintaining community traditions and culture. This issue is very appropriate

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to apply to schools that have their local characteristics.

Based on interdisciplinary problems, it is important to study efforts to reconstruct science into scientific knowledge by exploring societal issues to equip students with thinking skills and character.

2 METHODS

This type of qualitative research with a descriptive pattern is used to describe and explore the local wisdom of Wonosobo Regency, Central Java Province, Indonesia. The data collection method uses local wisdom observations according to the theme of physics material, namely the concept of temperature and heat. Furthermore, the documentation method is used to provide strengthening data sources and evidence of scientific research activities. The data analysis technique uses inductive-deductive to provide a comprehensive general overview of issues developing in society, scientific knowledge, and learning resources.

3 RESULT AND DISCUSSION

Research (Rostikawati & Permanasari, 2016) on the reconstruction of science using a socioscientific issues approach in increasing scientific literacy has proven to be effective through science learning. Furthermore, research results from (Supriyadi, Haeruddin, & Nurjannah, 2016) show that there is a higher difference in the results of the ability to solve physics problems between ethnoscience-based causal reasoning models compared to modern science because the culture inherent in society provides more real physics learning resource references in understanding the problems being studied. Through science. Similarities examine ethnoscience approaches, while differences relate to problem-solving skills. The results of research (Fitria & Wisudawati, 2018) The Development of Ethnoscience-Based Chemical Enrichment Book as a Science Literacy Source of Students aims to determine the characteristics of teaching materials using an ethnoscience approach that was developed to increase students' scientific literacy by introducing Jogjakarta culture or customs such as Batik varieties. Jogja, Shadow Puppetry, and Mount Merapi are used as learning resources to transform original science into scientific studies by utilizing regional culture to improve cognitive, affective, and psychomotor abilities (Fitria & Wisudawati, 2018).

3.1 Ethnoscience Approach and Reconstruction of Science

Ethnoscience or Ethnoscience comes from two words, namely "ethnos" meaning nation and the word "Sciententia" meaning knowledge (Kertiasih, 2018). The ethnoscience approach is a strategy for creating a learning environment and designing learning experiences that integrate culture as part of the learning process.

The role of ethnoscience in reconstructing as contextual learning provides students with an understanding of science and can be implemented in real life. Integration of students with the environment can be realized when learning is oriented towards the surrounding environment which is studied meaningfully. So that students can make reciprocal relationships with the surrounding environment (Lia, 2016) students are able to recognize and understand the local potential of their region, so regional environmental sustainability becomes an important factor in learning with ethnoscience. HOTs are very difficult to identify in a short time because they are not immediate, but they can be identified through a series of activities that define the HOTs themselves. The activity in question is a habitual activity of thinking, saying, and acting with all behavior that can change for the better through learning activities on the Student Activity Sheet. All learning activities are carried out to train students' habits of exploring higher-level thinking skills.

Characteristics of the ethnoscience approach in constructing as a form of strategy and design of learning experiences by creating an integrated environment of culture and tradition in the learning process (Parmin & Fibriana, 2019; Parmin, Nuangchalerm, & El Islami, 2019). The results of human creativity and initiative developed as original knowledge (independent science) and can be transformed into formal science. The term ethnoscience can be studied in traditional ecological, original science (Indigenous Science), local culture, and local wisdom (Agussuryani, Sumarni, Subali, & Saptono, 2020).

Learning from the culture and traditions surrounding students' lives is much more meaningful and easier for students to analyze than studying abstractly. Ethnoscience is presented in community activities which are important to study to maintain culture in the era of modernization. Students become more aware of the culture and traditions of the community, and students feel part of community life, so students will care more about their own culture. This is confirmed by research (Parmin & Fibriana,

2019) showing that ethnoscience maintains students' awareness of their culture and potential and fosters learning independence.

The highest category of reconstruction efforts is in the Potential Scientist Student (PS) category where students can easily learn science because it is directly related to students' lives. In the lowest category, Inside Outsider (IOS), students feel discrimination or alienation from the culture studied in scientific science. The categorization is considered difficult to develop because students cannot get out of their zone. Meaningfulness and cultural isolation are determining factors in exploring environmental learning resources using an ethnoscience approach. Knowledge will be transformed by describing based on experience, verification, and data reduction to complete concepts into scientific knowledge. The boundaries of students' thinking as a reconstruction effort are categorized into five groups.

3.2 Relevance Reconstruction of Original Science to Physics Concepts

Based on scientific reconstruction research on local wisdom in Wonosobo Regency, Central Java Province, Indonesia which can be studied through the concepts of temperature and heat.

3.2.1 Dreadlock Ruwat Tradition

Social issues that are developing in the Dieng Plateau, Wonosobo Regency, Central Java Province, which not only contain beauty but also the mystery of the dreadlocked boy who appears every now and then, the Dreadlocked Boy is said to be the incarnation of Kyai Kolodete and Nini Roro Ronce. Dreadlocks appear as a sign that the child is suffering from a fever so the child's dreadlocks can be cut, a Ruwatan must be done, and the hair-cutting ritual must be followed. Cutting children's dreadlocks is done using water taken from Sendang Sedayu located in the corner of the Dharmasala complex. After Dharmasala, the children carried by their parents entered Arjuna Temple. The temple complex has prepared a place for the dreadlock hair-cutting procession. The procession was led by the Dieng traditional elder, Mbah Sumanto, before having their hair cut, the children had asked for something that had to be realized at the time of shaving their hair, and the public was informed about each child's request.

The procession begins with the singing of the Dandanggula macapat song, the child's dreadlocks are cut. Initially, the person who started shaving hair was a traditional elder, namely Mbah Sumanto. The hair that has been cut is put into a barrel. The hair that has been cut is then thrown into the river that flows to the Indian Ocean. Usually, the place used for banning is Telaga Warna. The dreadlocks "Larung" procession is the final part of dreadlocks-cutting ritual which is presented in Figure 1.

Based on Figure 1 Dreadlocks grow in children aged one to five years. When dreadlocks first appear, there are signs that the child's body temperature is high, some are even accompanied by convulsions. It is said that children can recover from heat after dreadlock growth is complete. An explanation of ethnoscience and its integration with physics concepts is presented in Table 1.

3.2.2 Dieng Plateau Traditional House

Social issues regarding traditional Dieng Plateau houses located in Kejajar and Patak Banteng Villages, Dieng, Wonosobo are presented in Figure 2.

Figure 2 shows that traditional houses in the Dieng High Mountains appear lower than houses in general, with a height of no more than 2.5 meters, which has a purposeless meaning. Houses with low roofs and roofing materials using zinc, although a small number of houses use tile roofs. The aim of low-roof houses in scientific studies is to retain heat for longer, considering the extreme cold environmental conditions, so that with low-roof houses it will last longer to store heat in the rooms of the house. Zinc roofing material shows that the thermal conductivity of the material is very different for each substance, zinc can absorb heat more quickly

Figure 1: Dreadlock Ruwat Tradition (Source: Dieng Culture Festival).

Table 1: Identification of the original science of the dreadlocks ruwatan tradition and its relationship to physics concepts.

Issues	The original science of society	Physics Content
dreadlocks ruwatan tradition	The dreadlocked boy is said to be the incarnation of Kyai Kolodete and Nini Roro Ronce	Temperature measuring instrument, thermometer
	Starting with a fever or high fever	
	For a boy's dreadlocks to be cut, he must perform Ruwatan and follow the hair-cutting ritual	The concept of temperature of objects in liquids
	Cutting children's dreadlocks is done using water taken from Sendang Sedayu. It is in the corner of the Dharmasala complex	
	The procession was led by Dieng traditional elders. Before having their hair cut, the children had asked for something that had to be realized when shaving their hair	Heat transfer by convection
	The procession begins with the singing of the Dandanggula macapat song, the child's dreadlocks are cut	
	The hair that has been cut is put into a barrel. The hair that has been cut will then be thrown into the river that flows into the Indian Ocean. Usually, the place used for banning is Telaga Warna	

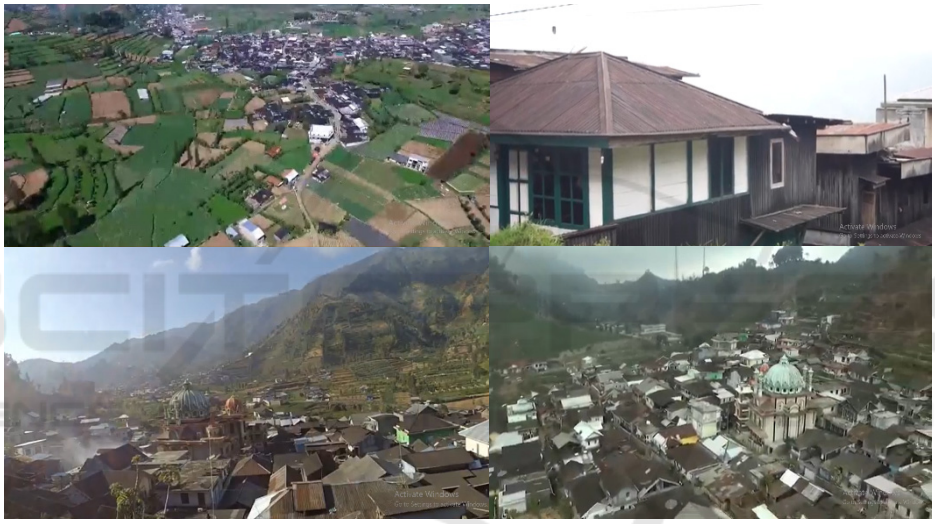

Figure 2: Dieng traditional house (personal documentation)

Table 2: Identification of the original science of traditional Dieng Plateau traditional houses and their relationship to physics concepts.

Issues	The original science of society	Physics Content
Dieng Plateau Traditional House	Most houses on the Dieng plateau use tin roofs	Heat transfer
	The height of the house is no more than 2.5 meters, which means it is lower than a normal house	The volume of a room that is affected by heat
	The walls of the house use wood instead of walls	The conductivity of an object's material

than roof tiles or other materials. The process of heat absorption occurs when heat is transferred from outside to inside the room by radiation. The relationship between ethnoscience and physics concepts in traditional Dieng Plateau traditional houses is presented in Table 2.

3.2.3 Upas Dew Phenomenon

Another social issue that is developing in the Wonosobo community, specifically in the Tambi Plantation area, Kejajar, Wonosobo is presented in Figure 3.

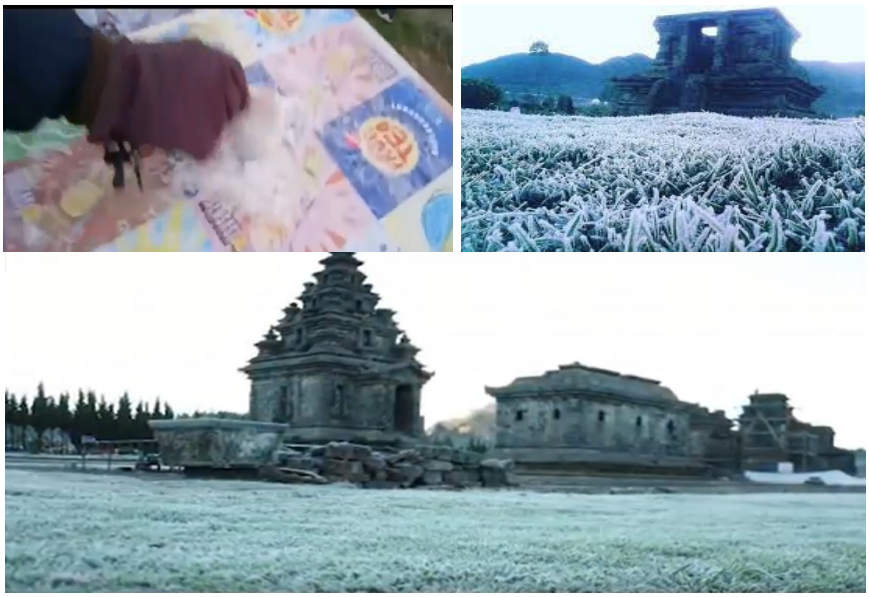

Figure 3: Upas Dew Phenomenon (personal documentation).

Table 3: Identify the original science of the Dew Upas phenomenon and its relationship to physics concepts.

Issues	The original science of society	Physics Content
Upas Dew Phenomenon	Dew is a condensation event that changes the form of an object	Changes in the form of objects due to heat
	The extreme conditions of Dew Upas are part of a weather anomaly	Freezing point of a liquid
	The Upas Dew event is a change in state from gas to solid and liquid	Conversion of object temperature

Figure 3 shows the meteorological conditions and the ongoing dry season. The phenomenon of cold temperatures at night and Dew Upas on the Dieng Plateau, Wonosobo is caused by meteorological conditions and the changing of the dry season which cannot be predicted with certainty. The peak dry conditions that occur will cause several areas of the Dieng Plateau to have the opportunity to experience air conditions that are less than the freezing point (0^0C) because air molecules in mountainous areas are more tenuous than in lowland areas.

Some places located in the mountains at a certain altitude (1500-3000 meters above sea level) will have the opportunity to experience surface air conditions that are less than the freezing point of 0°C. Upas dew which begins with the condensation process changes form to become a solid and then melts if the weather conditions in the area increase in temperature, this is because the air molecules in mountainous areas are more tenuous than in the lowlands so they cool very quickly, especially when the weather is sunny. Not covered by clouds or rain.

Water vapor in the air at night will experience condensation which will condense, sticking to the ground, leaves, or grass. "Water vapor in the air will condensate at night and then condense to fall on the ground, leaves or grass." The dew that sticks to the shoots will immediately freeze because the air temperature is very cold. These conditions are relatively fluctuating as presented in Table 3.

The effects of Upas Dew are especially troubling for farmers in Dieng, such as potato farmers, who are worried that they will experience crop failure because it damages the leaves and stems of plants. Based on social issues, Dew Upas can be integrated into discovery-oriented learning, giving rise to many alternative answers and ways of solving problems, environmental problems are very complex, allowing students to find creative solutions. Local potential which is part of the ethnoscience approach to learning is used as a concrete learning resource to analyze the environment, making students more active and appreciative of the potential of their region. Local wisdom is part of ethnoscience which is the result of cultural heritage from ancestors and can increase

Figure 4: Endemic Carica Tree (personal documentation).

students' understanding of concepts assisted by an ethnoscience approach which has been proven to be able to develop indigenous knowledge in a community that is studied through formal science as a learning study.

3.2.4 Endemic Carica Tree

The endemic Carica tree (Carica pubescens) is a social issue in the Dieng Plateau, usually along the road to Dieng there are Carica trees. Dieng is a highland area located on the island of Java with a land height of up to 2400 meters above sea level. The fruit that can only grow in low-temperature areas is carica fruit (Carica pubescens). Carica plants are endemic plants because they can only grow at a height above sea level. Study of the Carica plant which only lives on the Dieng plateau, a unique event that can be studied is presented in Figure 4.

Figure 4 shows the learning resources studied to explore students' creative thinking skills through an analysis of the surrounding environment in the Dieng plateau with several questions arising about "Why only in the Dieng plateau can Carica trees bear fruit". Students are required to study the height of the plains using the concept of Braak Theory. Air temperature in various regions is not the same, because it is influenced by several factors which are explained through Braak's Theory. The height of a place on the earth's surface influences the high and low temperatures and pressure of an area, the higher an area, the lower the air temperature will be. Every time the ground height rises by 100m, there will be a decrease of 0.61°C. The rate of decrease in air temperature with height follows two concepts, namely dry adiabatic and wet adiabatic. The dry adiabatic concept means that air is considered dry without water vapor, where for every 100 m increase in height the air temperature will decrease by 1°C. For every 100 m in height the air temperature will rise by 1°C, mathematically it can be formulated as follows:

$$t_x : 26{,}3°C \; - \frac{0{,}61°C(h)}{100} \qquad (1)$$

Information:
t_x : air temperature at altitude (°C)
26.3°C : air temperature at sea level
H : Height of the place (m)

Social issues in the Dieng Plateau with an altitude of 2400 meters above sea level. Carica trees (Carica pubescens) can grow and bear Carica fruit, but if the Carica tree is planted in a different place it will generally only bear papaya fruit. Facts show that the Carica tree cannot grow just anywhere, so it can be called an endemic plant with a height criterion of ± 1500-3000 meters above sea level.

The Carica tree which only lives on the Dieng plateau, is a unique event that can be studied through Braak's theory. The results of the research determined three sample villages in the Dieng Plateau area based on regional altitude. Garung Village with an altitude of 1019 meters above sea level (Zone 1) produces a temperature of 22.3°C, Kejajar Village's altitude of 1379 meters above sea level (Zone 2) produces a temperature of 20.1°C and Dieng Village's altitude (Zone 3) is 2306 meters above sea level 14.0°C (Khoiri & Sunarno, 2019). The results of different temperature conditions show that the higher the area, the lower the surrounding temperature, so the Carica tree only lives in the Dieng area, Wonosobo. Based on the social environmental issue of the Carica Tree, the temperature is a measure of how hot or cold a system.

Ethnoscience as a form of strategy for creating and designing a learning environment that integrates

Table 4: Identification of the original science of the endemic Carica tree (Carica pubescens) and its relationship to physics concepts.

Issues	The original science of society	Physics Content
Endemic Carica Tree	Carica is an endemic tree because it can only grow at a height above sea level.	Air pressure and temperature
	Carica will turn into ordinary papaya if the specific temperature is not met.	
	Carica is used by native people as candied carica, a typical Wonosobo food.	

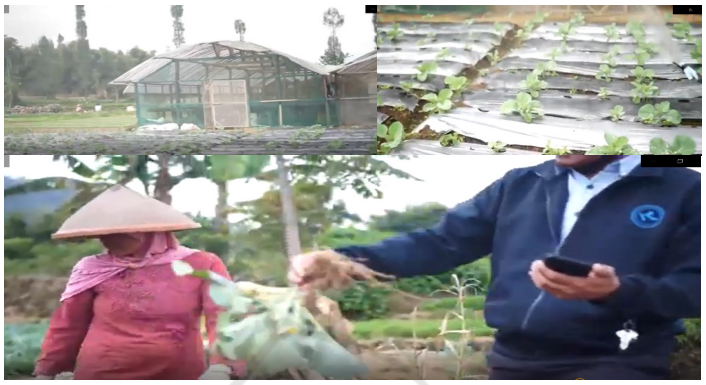

Figure 5: Pranotomongso System Agriculture (personal documentation).

community culture through the endemic Carica tree which only lives in the Dieng Plateau is studied using the concept of Braak's theory. Even though it has been proven to be good to apply, ethnoscience-based learning is still very rarely done in Indonesia. Knowledge about how much ethnoscience learning influences creative thinking abilities, and the processes of implementing ethnoscience in learning through identifying native science of the endemic Carica tree are presented in Table 4.

3.2.5 Pranotomongso System Agriculture

Climate deviation is a natural problem that humans cannot avoid due to their actions. The climate changes that are felt on Earth have an impact on nature and human activities. The striking temperature deviation called global warming has a strong influence on the climate in Indonesia. Reduced rainfall and long dry seasons are direct impacts that can trigger problems in the agricultural sector. The occurrence of global warming has an impact on the prolonged dry season, making it difficult for farmers to predict rain using the Pranotomongso calendar.

The natural situation is increasingly unbalanced, the climate can no longer be predicted using natural signs. Humans prefer a modern lifestyle which is unfriendly to nature, causing further damage to the environment. Modernity, besides being able to cause seasonal changes, causes the disappearance of a cultural richness that has long supported and guided Javanese farmers in farming, as presented in Figure 5.

Figure 5 is a portrait of agriculture in the Dieng Plateau. The disappearance of Pranotomongso was lost to time because Dieng farmers used modern systems to cultivate their plantations. Farmers do not realize that the use of chemical fertilizers and modern agricultural equipment is not environmentally friendly, which has an impact on soil fertility and damages the ecosystem. Agricultural activities using fuel-based tools produce various waste products, one of which is gas. Farmers think the gas just disappears, and the atmosphere can absorb it indefinitely and not have a bad impact on life. Exhaust gases can cause fundamental changes in the atmosphere and living conditions on earth, as presented in Table 5.

3.2.6 Sikidang Crateris

Another social issue at the Dieng tourist location, precisely in Dieng Kulon Village, Wonosobo, is the Sikidang Crateris which is presented in Figure 6.

Figure 6 is an ethnoscience study of the Sikidang Crater, where natural boiling water contains high levels of sulfur, and the formation of the crater moves from place to place. A strategic source of information through environmental issues developing in society. Students learn more meaningfully because it is contextual and can equip students' character through cultural preservation [26]. The importance of

Table 5: Identification of the original science of the Pranotomongso system of agriculture and its relationship to physics concepts.

Issues	The original science of society	Physics Content
Pranotomongso System Agriculture	The farmers' vegetable planting system still uses the pranotomongso system	Air pressure and temperature
	There are restrictions on planting vegetables in certain seasons	Temperature factor in plant growth
	Plants or vegetables that do not use the pranotomongso system are carrots	
	Different uses of plastic mulch and UV have been passed down from generation to generation	Radiation heat transfer

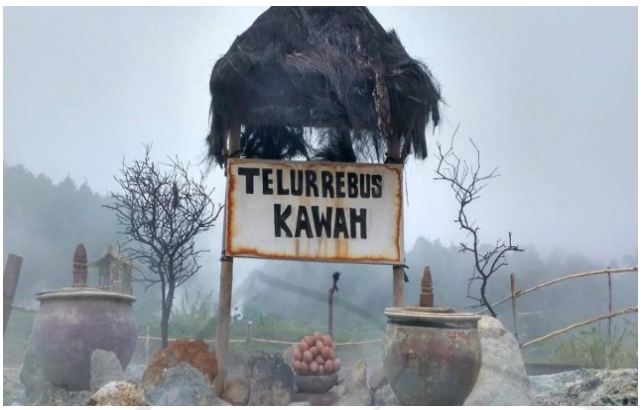

Figure 6: Sikidang Crateris (personal documentation).

Table 6: Identification of the original science of Sikidang Crateris and its relationship to physics concepts.

Issues	The original science of society	Physics Content
Sikidang Crateris	A crater is an event of earth activity that releases hot water naturally	The concept of boiling point and freezing point of liquids
	It is called Sikidang because the hot water moves from place to place like the feet of the Kidang	Heat transfer by convection
	Sikidang Crater is on the Dieng Plateau	

strategies in the inquiry learning model through environmental sources that still uphold the cultural character of the community is the ethnoscience learning approach.

Sikidang Crater in studying the boiling point of liquid water which can be differentiated from ordinary water. Contradictory social issues can foster students' creative ideas. Ethnoscience learning has been proven to increase students' creativity through environmental learning resources. Based on the identification of ethnoscience studies related to physics topics, is presented in Table 6.

Based on the description of environmental ethnoscience activities, students can learn physics concepts more realistically in the culture of society by reconstructing original science into scientific science through students' creative ideas to find solutions to environmental problems, as well as introducing the culture and traditions of society which must be maintained and preserved from generation to generation continuously.

4 CONCLUSION

Science reconstruction can provide opportunities for students to think through recognizing issues that are developing in society and turning them into scientific knowledge. Science reconstruction training equips students' character to respond to the environment. Ethnoscientific reconstruction in Wonosobo Regency includes: 1) In the dreadlock hair ruwatan tradition there is a scientific concept regarding measuring body temperature; 2) Dieng plateau house roofs using zinc can explain thermal conductivity; 3) The dew phenomenon identifies changes in the form of objects; 4) The endemic Carica tree expresses the air

pressure and temperature conditions of the highlands; 5) Pranotomongso agricultural system in explaining the concept of factors that influence environmental temperature; 6) Sikidang Crater shows heat transfer by convection. The potential for local wisdom to be studied continuously creates a habitual pattern for students to respond to the surrounding environment while at the same time practicing awareness and respect for the traditions and culture of the community.

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