

Students' Understanding of Heat Concept of Making Putu Bambu

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Abstract. This study aims to analyze students' concept understanding on the topic of Heat and Heat Transfer from the process of making traditional food Putu Bambu. The research used descriptive method with quantitative approach. The research subjects were 65 grade XI students from one of the high schools in Deli Serdang Regency who were randomly selected. Data collection instruments were in the form of essay test instruments containing Putu Bambu problems and interview instruments that explore students' opinions related to learning. The results showed that 75% of students stated that it was difficult to understand the concept of heat from the Putu Bambu cooking process because they were not accustomed to linking the subject matter with real examples around students. Further research is expected to develop a lesson that can link science with real-world problems so that students can learn about life.

Keywords: Students' Understanding; Heat Transfer; Ethnoscience; Traditional Food.

1 Introduction

Science is one of the subject matter that uses the scientific method so that it can improve thinking skills. Basically, science includes processes, products, and attitudes [1], [2], [3]. Science education in schools is expected to be a vehicle for students to understand themselves, the surrounding environment, and the context of science that is always inseparable in everyday life [4]. Science learning is done by thinking and acting responsively to environmental problems [5]. Effective science learning relies heavily on the use of examples and applications from everyday life, including local culture, as a means to improve students' understanding of abstract scientific concepts. In the science learning process, students must be facilitated in order to improve their knowledge, skills and attitudes as an ability to solve problems in everyday life [6], [7]. This is in line with constructivist theory which states that learning will

be more meaningful if it is connected to experiences and contexts that are relevant to students [8], [9], [10].

The use of examples from everyday life in science learning can help students better understand abstract concepts because students can see the direct relevance of the material being studied [11]. The integration of local culture in science learning not only makes learning more meaningful, but also increases student engagement by making students feel more connected to the material being taught [12], [13]. The application of local culture in science learning is not only beneficial for concept understanding, but can also enrich students' insights into their own cultural values, which in turn can form a stronger character and care for their social environment.

Heat as one of the science materials has very relevant applications in everyday life, especially in the context of food cooking [14]. Heat is energy that moves from one object to another due to temperature differences, which can be observed in various daily activities [15]. The concept of heat can be applied to explain how heat energy affects physical and chemical changes in food ingredients during the cooking process [16], [17]. For example, cooking processes such as boiling, frying or baking involve heat transfer that causes changes in the texture and flavor of food. Understanding the basic principles of heat and heat transfer helps students and the general public to be more aware of the effects of temperature in food processing.

The process of making traditional foods includes cultural examples that apply the concepts of heat and heat transfer. Putu Bambu is a traditional Indonesian food made from rice flour and brown sugar, which is cooked in a bamboo tube. Putu Bambu is cooked using the steaming principle but in an open container, so there may be problems in the cooking process. One problem that is often experienced is that Putu does not cook well. The center to the top of the Putu Bambu cannot be cooked evenly like the bottom which is directly exposed to water vapor. In this condition, the Putu Bambu maker must flip it over so that the putu cooks evenly. Understanding the concept of heat can help solve problems that will arise during the cooking process of Putu Bambu.

Several studies mention that students have difficulty understanding the concepts of heat, heat transfer and thermodynamics [18], [19], [20]. This is because the material presented by the teacher does not link the concept of heat with examples that exist in everyday life. The concepts of heat, heat transfer or thermodynamics are presented theoretically with examples that do not support student interest, too many formulas and mathematical calculations so that students do not understand the basic concepts. Low understanding will cause students to have difficulty explaining the link between the heat concept and examples that exist in everyday life.

Based on this, it is necessary to study students' concept understanding on heat and heat transfer material from the Putu Bambu cooking process to find out how the students' level of understanding. The results of this study are expected to provide recommendations for the design and implementation of future learning. Furthermore, students can understand science materials such as the concept of heat and heat transfer and can relate it to other cultural examples.

2 Methods

The study used a descriptive method with a quantitative approach. Descriptive method is a method used to describe or analyze individuals, events or conditions by studying them as they are [21], [22]. Researchers do not manipulate any variables, but only describe the variables to be measured based on the sample [23]. One of the most frequently used descriptive data collection methods is through observation of individuals or groups [24]. Although this is like a qualitative method, this method is different from the observation used in qualitative design, because the variables measured have quantitative values. The researcher described students' concept understanding on heat transfer material from the problem of cooking Putu Bambu cake based on the average score and quality of students' answers from the description test.

The research sample was students in one of the secondary schools in Deli Serdang Regency, North Sumatra, totaling 32 people who were taken by purposive sampling technique. The sample selection is based on indicators of research needs, namely students with medium and high abilities from schools that have implemented the Merdeka Curriculum. The purposive sampling technique was chosen so that the sample could meet the research data needs [25].

The data collection technique uses a description test and interview which contains the problem of cooking Putu Bambu. The data collection instrument is an essay test instrument that contains Putu Bambu cooking problems and an interview instrument that explores students' opinions regarding learning. These two instruments are used to determine students' concept understanding on the material of Heat and Heat Transfer.

3 Result and Discussion

The cultural context raised to explore students' understanding of heat transfer material is the cooking process of traditional Putu Bambu cake from Java. Quoting [26], the origin of Putu Bambu comes from the acculturation of Chinese culture since the Ming Dynasty hundreds of years ago. The initial designation was XianRoe Xiao Long which means a cake made from rice flour filled with fine mung beans and then steamed in a bamboo container. In Indonesia, the name "putu" appeared in a manuscript entitled Serat Centhini in 1814 AD during the reign of Sunan Pakubuwana IV, susuhunan of Surakarta. The manuscript tells the story of a man named Ki Bayi Panurta-a shaman and spiritual teacher. He asks his student for help in providing breakfast and serving side dishes, such as putu and serabi. The putu filling, which was originally fine mung beans, was changed to coconut sugar because it was easier to obtain.

Local wisdom is a view of life and knowledge, as well as various life strategies in the form of activities carried out by local communities, to answer various problems in meeting their needs. This is also the case with this typical East Javanese snack. Putu Bambu elevates local specialties using the natural resources available at that time. Eventually, Putu Bambu became a culture that was passed down from generation to generation. There are various types of putu cakes, such as Putu Bambu, Putu Ayu, Putu Mangkok, Putu Mayang, and Putu Pesse. In any form, the cake is often available during wedding ceremonies. The meaning is that the married couple can soon have offspring. Not only that, putu cakes are also usually available during religious celebrations and traditional ceremonies held by rural communities.

Today, Putu Bambu is available as a traditional snack that is widely sold in both urban and rural areas. This traditional cake uses rice flour and tapioca flour, grated coconut and brown sugar. How to make it begins with preparing a Putu Bambu cake mold, filling half of the mold with dough and adding brown sugar then covering it again with dough. Steam for 10 minutes until the cake is cooked while flipping it over so that the center of the cake is perfectly cooked. Traditionally, Putu Bambu is cooked using a pot with holes in the top to place the Putu Bambu. The pot contains boiled water so that the hot steam from the boiled water flows towards the holes and makes the Putu Bambu cooked. The process of cooking Putu Bambu applies the concept of heat transfer that students need to understand in order to overcome problems that may occur when cooking Putu Bambu. Conversely, students can also understand the concept of heat transfer through the process of cooking the Putu Bambu.

The Putu Bambu process uses a water cooking container with a hole in the top. This hole is used for the flow of heat coming from the boiled water in the container to the Putu Bambu. The heat from the heat source (stove) moves to the pot by conduction and then moves to the water which causes the water to move up and down. Furthermore, the water experiences an increase in temperature and when the water reaches a temperature of 100⁰C, the water will boil and evaporate. During the evaporation process, heat is transferred through the water vapor to the Putu Bambu so that the Putu Bambu can be cooked even though it is not in direct contact with the heat source. The flow of heat whose intermediary substance moves to the Putu Bambu is an example of convection heat transfer. The up and down movement of water when heated (receiving heat) is also an example of convection heat transfer.

When the holes in the cooking container are increased and when putting the Putu Bambu does not cover all the holes, the open holes will become a way for heat to flow through the water vapor to flow freely into the open air which has a lower temperature. These holes will also cause the water vapor rate to weaken so that it cannot transfer heat to the Putu Bambu optimally. Therefore, if you want to add holes to the cooking container, you must measure the surface area of the container and adjust the amount of Putu Bambu that can be cooked using the container. When placing the Putu Bambu, no holes should be left open so that the heat flow through the water vapor can fully transfer to this cake until it is fully cooked. Another way to make the Putu Bambu perfectly cooked is by flipping the Putu during the cooking process.

The description of the concept of heat from the cooking process of Putu Bambu can be a source of learning for students and an example that whatever is around students can be studied scientifically. Problems around students can be solved by linking it with daily lives. Concept understanding data is obtained from the results of student answers to the description test given. The results of students' answers were analyzed and presented in Table 1.

Table 1. Percentage of Student Answers

Stages of Putu Cooking	Concept of Heat	Description Explanation of the Concept of Heat	Students Answering Correctly	Percentage Students Answered Wrong	No Answer
Flour dough fills half the mold	Effect of heat on expansion	When Putu is cooked, there is a transfer of heat from the cooking	9%	60%	31%

Stages of Putu Cooking	Concept of Heat	Description Explanation of the Concept of Heat	Students Answering Correctly	Percentage Students Answered Wrong	No Answer
		water to the Putu , increasing the temperature which causes expansion of the flour mixture so that if the flour mixture is filled too full, it will cause the dough to spill due to expansion.			
Aluminum water cooking pot	Heat transfer by conduction	During water cooking, heat from a high-temperature heat source (stove fire) interacts with a low-temperature pan, resulting in conduction heat transfer that causes a change in water temperature. The aluminum material of the pan is a good absorber and conductor of heat.	63%	23%	14%
Water boiling in pot	Effect of heat on temperature change	Heat causes a change in the temperature of water. During the process of boiling water, the amount of heat needed to raise the temperature of water is proportional to the mass of water and the temperature change that occurs.	70%	20%	10%
	The effect of heat on changes in the form of substances	When the heat applied to water has reached the boiling point at 1000 C and is still heated continuously, the temperature will not change anymore so what happens next is the process of changing the form of water into water vapor and the volume of water will decrease.	63%	12%	25%
	Heat transfer	In the process of	7%	65%	28%

Stages of Putu Cooking	Concept of Heat	Description Explanation of the Concept of Heat	Students Answering Correctly	Percentage Students Answered Wrong	No Answer
	by convection	boiling water, the up and down movement of water (receiving and releasing heat) is an example of convection heat transfer.			
Cooking Putu Bambu	Heat transfer by convection	During the evaporation process, heat is transferred through water vapor to the Putu so that the Putu can be cooked even though it is not in direct contact with the heat source. The flow of heat, in which the intermediary substance moves to the Putu until the Putu is cooked, is an example of convection heat transfer.	0%	72%	28%
Average			35%	42%	23%

Based on Table 1, it is known that 35% of the 32 students gave the correct answer at each stage of Putu cooking, meaning that students can correctly describe the concept of heat in all processes, while 42% gave the wrong answer and 23% did not give an answer at all. Even for the concept of heat in making Putu Bambu, no student managed to give the correct answer that cooking Putu Bambu applies the concept of heat transfer by convection. These results show that students' understanding of the concept of heat associated with cooking Putu Bambu is low. Students have difficulty in understanding heat material [27], [28]. Students have difficulty applying the concepts of temperature and heat in everyday life that are related to culture or local wisdom [29], [30], [31], [32]. This gives the possibility that students are also unable to understand physics concepts in other cultural examples.

The test results are in line with the results of interviews with students using five open-ended questions that explore students' opinions about the difficulty of students understanding the concept of heat, the need to link the concept of heat with real-world problems such as the cooking process of traditional Putu Bambu, the reasons for the need for learning that raises real-world problems such as cultural problems and the impact of culture-based learning on students' understanding of the material. Based on the interview results, 75% of students stated that they had difficulty understanding the concept of heat from the Putu Bambu cooking process because they were not accustomed to linking the subject matter with examples around the students. As many as 92% of students stated that it is very necessary to link physics concepts with real-world problems such as cultural problems in classroom learning so that abstract physics concepts are more easily understood through direct observation. The design of

materials related to students' daily lives such as local culture around them will create more meaningful learning [32], [33].

In an effort to help students understand science materials such as the concept of heat and heat transfer, learning should be able to build student interest and have a connection to life such as students' local culture so that students can digest the subject matter well. Learning that integrates culture has a positive impact on the learning process, including being easier to understand because of the application in everyday life and the emergence of student appreciation for their local culture if learning at school is in line with students' daily culture [34], [35], [36].

4 Conclusion

The results showed that 35% of students gave the correct answer at each stage of cooking the Putu Bambu. Students could correctly describe the concept of heat in all processes, while 42% gave the wrong answer and 23% did not give an answer at all. Even for the concept of heat in cooking the Putu Bambu, students cannot give the correct answer that it applies the concept of heat transfer by convection. From the interview results, 75% of students stated that it was difficult to understand the concept of heat from the Putu Bambu process because they were not accustomed to linking the subject matter with real examples around students. Meanwhile, 92% of students stated that it is very necessary to link science concepts with real-world problems such as cultural problems in classroom learning so that abstract science concepts are more easily understood through direct observation. These results provide the possibility that students are also unable to understand science concepts in other cultural examples. The results of this study are expected to provide recommendations for the design and implementation of future lessons so that students can understand science material and can relate it to other cultural examples.

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