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Ethno-science Approach in Making Bamboo Lemang Materials: Implications of Understanding the Concept of Thermal Energy

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ABSTRACT

This study aims to analyze the influence of ethno-science approach through the making of bamboo lemang in improving students' understanding of the concept of thermal energy material at SMPN 17 South Bengkulu. This study uses a quantitative approach with a quasi-experiment method and a Non-Equivalent Control Group design. Creswell states that a pseudo-experiment is an experimental situation in which the researcher assigns, but not randomly, participants to a group because the researcher cannot artificially create a group for the experiment. Data were collected through concept comprehension tests and observations. The results of the study showed a significant improvement in the understanding of students who used the ethno-science approach compared to conventional methods. Based on the results of the normality test with Shapiro-Wilk, it showed a significance value of 0.129 (experimental class) and 0.067 (control class), which means that the data is normally distributed. Based on the results of the homogeneity test with Levene's Test resulting in a significance value of 0.611, indicating that the data variance between the experimental and control groups was homogeneous. Based on the results of the hypothesis test using Independent Samples t-Test, it showed a t-value (-5.42) with p = 0.000, which means that there was a significant difference between the two groups. The average understanding of students in the experimental class was 83.07, while in the control class it was 66.13.These results show that the ethno-science approach through the making of bamboo lemang contributes positively to improving the understanding of the concept of thermal energy.

Keywords*: ethno-science, bamboo lemang, heat energy*

INTRODUCTION

Science education has an important role in building students' understanding of natural phenomena and their application in daily life. However, in many schools, learning science is still considered difficult and less interesting for students. (Hearn, 2024) This is due to the conventional learning method, where scientific concepts are taught in the abstract without any connection to the real experience of the students (Nurrubi et al., 2022). One approach that can be applied to address this challenge is the ethno-science approach, which integrates local culture in science learning to make it more contextual and meaningful. The ethno-science approach connects science with the traditions and culture of local communities, so that students can more easily understand science concepts through experiences close to their lives (Jufrida, 2020). One of the traditions that can be used as a learning medium is the making of bamboo lemang. Lemang bambu is a traditional food that is cooked using the principles of heat energy, such as conduction, convection, and radiation. This process is in accordance with the heat energy material taught in junior high school, so that it

can be used as a more interesting and applicable practice-based learning tool for students (Charoenphun & Wangtueai, 2020).

In South Bengkulu, especially among the Serawai tribe, lemang bambu has a deep cultural significance and is part of various traditional ceremonies and holiday celebrations. This tradition is not just a culinary activity, but also reflects the value of mutual cooperation and respect for ancestors (Dihamri et al., 2021). Integrating the process of making bamboo lemang in science learning can be an innovative approach that connects theory with practice. In education, this method helps students understand the concepts of heat energy, heat transfer, and direct changes in the form of substances. The process of cooking lemang involves the transfer of heat from the fire to the bamboo, which can be explained by the conduction theory (Edward, 2020). In addition to improving the understanding of science, this approach also supports the preservation of local culture. Constructivist theory emphasizes that meaningful learning occurs when students relate new knowledge to previous experiences. Thus, the use of lemang in science learning not only enriches science but also instills awareness of the importance of preserving regional traditions (Chaer et al., 2021).

Several previous studies have highlighted the importance of ethno-science approaches in improving students' understanding of scientific concepts. According to Hasan.S.H.,(2023), "The application of ethno-science in science learning has been shown to increase students' interest and involvement in understanding abstract concepts." Meanwhile, research by Iskandar et al., (2022) Found that the use of local culture in science learning helps students connect theory with real practice, making learning more meaningful. However, until now, research that specifically examines the use of making bamboo lemang in heat energy learning is still very limited. Most ethno-scientific research places more emphasis on the study of culture in general without connecting it to the concept of physics in depth. This makes this research unique because it not only expands the application of ethno science, but also makes a real contribution in utilizing the local culture of South Bengkulu as an innovative learning tool. Alternatively, this study seeks to fill the gap in previous research that has not explored the making of bamboo lemang as a science learning medium that is integrated with the ethno science approach. In addition, this research is expected to provide a new perspective on how local culture is not only a heritage that must be preserved, but can also be used as a means of modern education.

Based on preliminary data obtained from SMPN 17 South Bengkulu, students' understanding of the concept of thermal energy is still relatively low, with only around 50% of students achieving scores above the Minimum Completeness Criteria (KKM). One of the main factors that causes this low understanding is the lack of learning methods that are contextual and relevant to students' daily lives. Abstract learning often makes it difficult for students to connect theory with real experience, so their understanding of the concept of thermal energy becomes less than optimal (Mukti et al., 2022). Therefore, this study aims to examine the influence of ethno-science approaches through the making of bamboo lemang in improving students' understanding of the concept of thermal energy. By applying this approach, learning is expected to be more interesting and interactive, so that students can more easily understand the concepts learned. In addition, these activities can also increase students' motivation in learning science because they are directly involved in practical activities related to the local culture. The ethno-science approach not only contributes to the improvement of the understanding of the concept of thermal energy, but also to the preservation of local wisdom among the younger generation (Watts, 2021).

The approach in this study aims to create a more fun and interactive learning atmosphere. By engaging students in practical activities such as making bamboo lemang more easily, they will more easily interact with the subject matter and relate it to their personal experiences. In addition, this activity also provides added value in the form of preserving local culture that can be increasingly understood and appreciated by the younger generation. The context of this research focuses on students of SMPN 17 South Bengkulu, who are in areas with a culture of making

bamboo lemang that is still preserved. The unit of analysis in this study is students who participate in science learning with a hands-on, hands-on, practice-based ethno-science method. The methods used in this study include an experimental approach by comparing students' understanding before and after the application of this method.

METHODOLOGY

This study uses a quantitative approach with quasi-experiment methods and design **Non-Equivalent Control Group Design** (W.Creswell., 2018). Creswell states that a pseudo-experiment is an experimental situation in which researchers assign, but not randomly, participants to groups because researchers cannot artificially create groups for experiments. The ethnoscience approach through the making of bamboo lemang was applied to the experimental group, while the control group used conventional learning methods. Effectiveness measurement was carried out through a posttest to compare the understanding of the concept of thermal energy between the two groups. Data were collected through tests and analyzed to see the influence of ethnoscience approaches on students' improved understanding of science.

The population in this study is all grade VIII students at SMPN 17 South Bengkulu, because thermal energy materials are part of the curriculum taught at this level. The research sample consisted of two classes selected using *purposive sampling* techniques, namely class VIII A as a control group consisting of 30 students, namely 10 males and 20 females and class VIII B as an experimental group which also consisted of 30 students, namely 23 females and 7 males, so that the total number of samples in this study was 60 students. The selection of grade VIII students at SMPN 17 South Bengkulu as a research sample was based on the relevance of the material taught, namely thermal energy, which is part of the curriculum at that level

The *purposive sampling* technique aims to ensure that both groups, both control and experimental, have equal academic characteristics, so that the research results can be more valid and representative. By considering the gender composition and the balanced number of students in each class, this study can obtain a more accurate picture of the influence of ethnoscience approaches in improving the understanding of the concept of heat energy among students. The *purposive sampling technique* was chosen with the consideration that the class used has equivalent academic characteristics, so that the research results can be more valid and can provide a more accurate picture of the influence of the ethnho science approach on the understanding of the concept of thermal energy. In this study, the experimental class received learning with an ethnoscience approach through making bamboo lemang bambo, while the control class continued to use conventional learning methods. The selection of this technique allows the research to focus more on measuring differences in learning outcomes based on the approach applied.

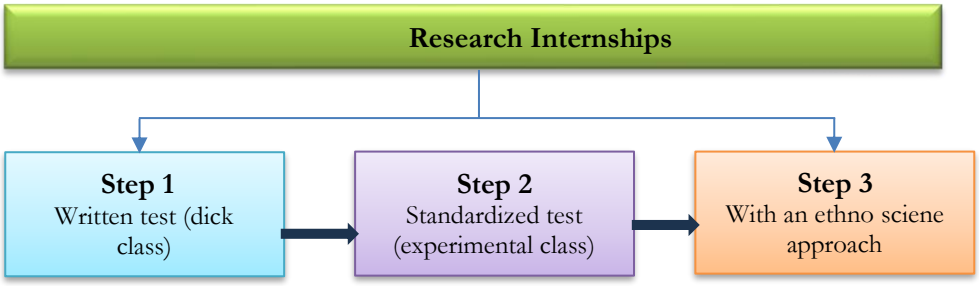

Figure 1. Measures of The Level of Trust in The Data

This study uses three data collection techniques, namely a written test (posttest question items) to measure students' understanding before and after the application of the ethnoscience approach through the manufacture of bamboo lemang bamboo, observation to assess student

involvement in learning, and documentation as supporting data. The research instrument consisted of a concept comprehension test used to measure students' improvement in understanding of the concept of thermal energy, as well as an observation sheet to assess student activities during the learning process with an ethnoscience approach. Before the test sheet is given, the question sheet and instrument are tested first to determine the level of validity and reliability. From the test results, the instrument was declared valid and reliable.

Data analysis was carried out through several stages, namely descriptive statistics to describe student learning outcomes, normality tests to ensure data distribution in accordance with statistical assumptions, homogeneity tests to see similarities in variance between groups, and hypothesis tests using *Independent Sample t-Test* with the help of IBM SPSS Statistics version 25 output. This analysis aims to find out whether the ethnoscience approach through the manufacture of bamboo lemang has a significant effect on the understanding of the concept of thermal energy compared to conventional learning methods.

RESULT AND DISCUSSION

Based on the results of research, experiments, and test of question instruments conducted by grade VIII students, it is known that the process of making bamboo lemang is carried out traditionally and has been inherited from generation to generation by the people in South Bengkulu. This tradition reflects local wisdom in processing food using natural ingredients, such as bamboo, glutinous rice, and coconut milk, as well as applying the principle of heat transfer through conduction and radiation in the maturation process.

1. Bamboo cutting *2. Bamboo drying* *3. Put glutinous rice into the bamboo* *4. Put in coconut milk* *5. Burning bamboo lemang*

Figure 2. The Process of Making Bamboo Lemang

From Figure 2, it can be seen that the process of making bamboo lemang begins with cutting the bamboo according to the desired size. After that, the cut bamboo is dried to reduce the moisture content in it, so that it is more optimal when used as a container for cooking lemang. The next step is to put the glutinous rice that has previously been washed into the bamboo. After the glutinous rice is added, the coconut milk is poured into the bamboo to give it a savory taste and improve the texture of the lemang. The last stage in this process is the burning of bamboo that has been filled with glutinous rice and coconut milk over a fire using traditional methods. The burning process is carried out evenly by rotating the bamboo so that the lemang cooks perfectly without burning (Puspasari et al., 2020). The traditional pattern in making bamboo lemang turns out to contain a lot of the concept of heat energy due to temperature differences, with the main mechanisms being conduction, convection, and radiation. In the manufacture of bamboo lemang, the concept of heat energy is clearly visible, where the heat from the fire is transferred to the bamboo and its contents through conduction, the heat from coconut milk to the rice is transferred through convection, and the heat from the fire spreads to the surface of the bamboo through radiation (Setyoko, 2022).

The following are the results of the reconstruction of the conceptual understanding of thermal energy that has been carried out by class VIII in two groups, namely the experimental class

and the control class which leads to the influence of the use of the ethno science approach on the two classes.

Normality Test

The normality test aims to determine whether the data collected is normally distributed or not. Normal distribution is a basic assumption in many parametric statistical analyses. In this study, the Shapiro-Wilk Test was used. (Quraisy, 2020). The application of the Shapiro-Wilk test will help ensure that the data collected meets the normality assumptions required for parametric statistical analysis (Zakirman, 2020). The Shapiro-Wilk test is a statistical method designed to test whether a dataset comes from a normal distribution. This test is very effective and valid to use especially for small samples, generally less than <50 data. The Shapiro-Wilk test procedure involves testing a null hypothesis (H_0) which states that the data is normally distributed, against the alternative hypothesis (H_1) which states otherwise. After calculation, if the resulting p-value is greater than the set significance level (e.g., >0.05), then H_0 accepted, which means the data is considered to be normally distributed. On the other hand, if the value of p is less than <0.05, H_0 rejected, indicating that the data is not normally distributed (Sari et al., 2024).

Table 1. Normality Test Results

Tests of Normality							
Class					**Shapiro-Wilk**		
					Statistics	**Df**	**Sig.**
Result	Control Class A	0,162	30	0,044	0,935	30	0,067
	Experimental Class B	0,171	30	0,025	0,946	30	0,129

a. Lilliefors Significance Correction

In this study, the normality test was carried out using *Shapiro-Wilk,* because the sample number was less than <50 students. Based on the results of the *Shapiro-Wilk test*, a significance value of 0.129 was obtained for the experimental class and 0.067 for the control class. Since the significance value of the two groups is greater than >0.05, it can be concluded that the data is normally distributed, so the Independent Samples t-Test can be used."

Homogeneity Test

Homogeneity testing is a statistical procedure that aims to test for similarity of variance between data groups. This assumption of variance homogeneity is very important in various parametric statistical analyses, such as Analysis of Variance (ANOVA) and t-test, where the similarity of variance between groups is a major prerequisite for the validity of the results of the analysis (Usmadi, 2020). By ensuring that the variance between groups is homogeneous, researchers can improve the accuracy and reliability of the conclusions drawn from the data. There are several commonly used methods to test the homogeneity of variance, including the *Living* and Test *Bartlett.*

Table 2.Homogeneity Test Results

Test of Homogeneity of Variance					
		Living Statistic	**df1**	**df2**	**Sig.**
Control	Based on Mean	0,682	4	24	0,611
	Based on Median	0,315	4	24	0,865
	Based on Median and with adjusted df	0,315	4	19,324	0,865
	Based on trimmed mean	0,650	4	24	0,632

In this study, the homogeneity test was carried out using Levene's Test, because it is more robust against data that is not completely normal."" Based on the results of the Levene's Test, a significance value of 0.611 was obtained. Since this value is greater than >0.05, it can be concluded that the variance of data between the experimental and control groups is homogeneous, so the Independent Samples t-Test can be used.

Hypothesis Test Results

The hypothesis test in this study used the t-test (Independent Sample t-Test) to compare the posttest results between the experimental group and the control group. This test aims to find out if there is a significant difference in students' understanding of concepts after being treated with the Ethnoscience approach through the manufacture of bamboo lemang In contrast to the study that used pretest and posttest, this study directly compared the posttest results of the two groups to see the effectiveness of the approach applied. The decision-making criteria in this test were based on a significance value (p-value) of 0.05 (5%) (Sari et al., 2024).

If the significance value < 0.05, then H_0 is rejected and H_a is accepted, which means that there is a significant difference between the experimental group and the control group, so that the Ethnosains approach has been shown to have an effect on students' understanding of concepts. Instead, if the significance value ≥ 0.05, then H_0 accepted and H_a rejected, which indicates that there is no significant difference between the two groups, so the Ethnosains approach does not have a significant influence on students' conceptual understanding. (Putri et al., 2022).

Group Statistics

Class		N	Mean	Std. Deviation	Std. Error Mean
Results Of Researcher Scores	Control	30	66,13	15,393	2,810
	Experiment	30	83,07	7,478	1,365

Table 3. Independent Samples t-Test

Independent Samples Test

		Levene's Test for Equality of Variances	t-test for Equality of Means						
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HASIL PENELITIAN	Equal variances assumed	6,835	,011	-5,420	58	,000	-16,933	3,124	-23,188	-10,679
	Equal variances not assumed			-5,420	41,967	,000	-16,933	3,124	-23,239	-10,628

After conducting the normality test and homogeneity test, the next step is the Independent Samples t-Test. This test is used to compare the average of two different groups (experimental class and control class) after the treatment is given. The Independent Samples t-Test is used to find out if there is a significant difference between the two independent groups (experiment vs. control) in the understanding of the concept of thermal energy.

The results of the Independent Samples t-Test showed a value of t (-5.42) with p = 0.000, which is smaller than <0.05. This means that there are significant differences between the experimental and control groups in understanding the concept of thermal energy. The average student understanding in the experimental class (83.07) was higher than that of the control class (66.13). These results indicate that the Ethno-Science approach through bamboo lemang making activities contributes positively to improving students' understanding of the concept of thermal energy.

Figure 2. Processed Bamboo Lemang

This study aims to examine the application of ethnoscience approaches in the process of making bamboo lemang and its implications for understanding the concept of heat energy (Diani et al., 2020). The ethnoscience approach integrates local cultural knowledge and practices into science learning, so that students can understand scientific concepts through a cultural context close to their lives. In this case, the making of bamboo lemang is a traditional food that involves the process of cooking glutinous rice in bamboo as a learning medium to teach the concept of heat energy (Dewi & Ibrahim, 2019). By linking the process of making bamboo lemang to science learning, students are expected to be able to relate their daily experiences to scientific theories, thereby increasing their understanding and appreciation of science. In addition, this approach also contributes to the preservation of local wisdom, as students not only learn science concepts, but also understand and appreciate their own culture. This integration is in line with efforts to create contextual and meaningful learning, which can improve student motivation and learning outcomes (Nurrubi et al., 2022).

The importance of this research lies in the effort to connect traditional cultural practices with modern science concepts, so that learning becomes more relevant and interesting for students (Mukti et al., 2022). The ethno science approach allows students to understand scientific concepts through a cultural context close to their lives, facilitating more meaningful and contextual learning. Thus, students can relate science knowledge to everyday experience, which in turn increases their motivation and understanding of the material being taught (Rusman, 2023). The main contribution of this research is to provide a learning framework that combines traditional knowledge with the concept of thermal energy, which can be used as a model in the development of ethnoscience-based teaching materials. This framework is designed to assist educators in compiling learning materials that not only teach science concepts, but also value and preserve local wisdom (Watts, 2021).

The results of the study showed that the process of making bamboo lemang involves several concepts of heat energy, such as heat conduction through bamboo, insulation by banana leaves, and evaporation of water from coconut milk which helps control temperature (Frayon et al., 2024). In addition, the integration of the bamboo lemur making process in science learning has proven to be effective in increasing students' understanding of the concept of thermal energy. In addition, the gelatinization process occurs when the starch granules in glutinous rice swell due to heat and liquid from coconut milk, changing the texture and taste of lemang (Sholichah et al., 2020). The integration of the process of making bamboo lemang in science learning has proven to be effective in increasing students' understanding of the concept of thermal energy. This approach not only makes learning more contextual and relevant, but also helps preserve local wisdom in the context of science education (Ardana et al., 2023).

These findings are in line with previous research that suggests that ethnoscience approaches can improve students' understanding of science concepts. For example, a study by (Yuliyanti, 2024). indicates that the ethnoscience approach enriches students' science learning experiences by taking into account their cultural and social contexts. In addition, research by (Suaidin, 2022). emphasizing the importance of integrating local wisdom in science learning to empower students' potential

through learning activities that involve observation and discovery. In this study, all the results obtained are in accordance with the initial hypothesis that the integration of the bamboo lemang making process in science learning can improve students' understanding of the concept of thermal energy. That is, there are no unexpected findings; All results support the initial assumption that ethnoscience approaches through traditional cultural practices are effective in deepening students' understanding of thermal energy.

The implications of this study include several important aspects. First, in the field of education, the integration of local wisdom such as making bamboo lemang into science learning can make the material more relevant and interesting for students, thereby increasing their motivation and understanding of scientific concepts (Commission, 2020). This is in line with research that shows that science learning based on local wisdom can improve the quality of learning and preserve local culture (Kelana et al., 2021). Second, in terms of cultural preservation, this approach helps the younger generation to recognize and appreciate their cultural heritage, which contributes to efforts to preserve local traditions. By involving local cultures in education, students learn about their culture through science, thus better valuing and preserving those traditions, preventing the loss of local culture over time (Zuhdan, 2021).

The limitations in this study include the scope that is still limited to one local cultural context, namely the making of bamboo lemang bamboo, so the results cannot necessarily be generalized to regions with different cultures. In addition, the relatively short duration of implementation limits observations on the long-term impact of ethnoscience approaches on students' understanding and attitudes. The instruments used also emphasized more on cognitive comprehension, so they did not fully record the affective aspects and skills of students' science processes. Support from teachers and the school environment has also not been evaluated in depth, even though these factors affect the success of the implementation of learning based on local wisdom.

CONCLUSION

Based on the results of the research, it can be concluded that the ethno-science approach through the making of bamboo lemang significantly improves students' understanding of the concept of thermal energy at SMPN 17 South Bengkulu. The results of the statistical test showed a significant difference between the experimental group that used the ethno-science approach and the control group that still used conventional learning methods. Based on the statistical test, the results of the normality test with the Shapiro-Wilk *test* were obtained, a significance value of 0.129 was obtained for the experimental class and 0.067 for the control class. Since the significance value of both groups is greater than >0.05, it can be concluded that the data is normally distributed. Based on the results of the homogeneity test using *the Levene's Test*, a significance value of 0.611 was obtained. Since this value is greater than >0.05, it can be concluded that the data variance between the experimental and control groups is homogeneous. Based on the results of the hypothesis test value using *the Independent Samples t-Test* showed a value of t (-5.42) with p = 0.000, which is smaller than <0.05. This means that there are significant differences between the experimental and control groups in understanding the concept of thermal energy. The average student understanding in the experimental class (83.07) was higher than that of the control class (66.13). These results indicate that the Ethno-Science approach through bamboo lemang making activities contributes positively to improving students' understanding of the concept of thermal energy.

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