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Analysis of Ethnostem Content in Making Jenang Kudus A Science Learning Resource for Junior High School Students

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Abstract

Implementing meaningful learning for students is a challenge in science learning in junior high schools. One solution is integrating the ethnoSTEM approach to connect science concepts with local culture. This study aims to analyze the ethnoSTEM content in the production process of Jenang Kudus as a source of science learning on additives in junior high schools. The study used a descriptive qualitative approach with data collection through observation, interviews, documentation, and literature studies. The research sample involved 15 people from a population of 36 workers at the Jenang Kudus Garuda and Kharisma production houses in the Kudus Regency. The results showed that the manufacture of Jenang Kudus integrates science, technology, engineering, and mathematics with local wisdom. The production process uses natural ingredients such as glutinous rice flour, brown sugar, coconut milk, and natural thickeners, which support students' understanding of natural and artificial additives. Using modern production tools such as mixers and flour grinding machines increases production efficiency, reflecting the elements of technology and engineering in ethnoSTEM-based learning. The process of making Jenang Kudus can be an effective source of science learning, support STEM literacy, and preserve local culture, thus motivating students to understand and apply science concepts in everyday life. This study is limited to providing learning resources in the form of ethnoSTEM content in the production process of Jenang Kudus. Further research is needed to analyze the influence of the ethnoSTEM approach on science learning outcomes and the development of learning tools and media that support the ethnoSTEM approach in junior high school science learning.

Keywords: Additives, EthnoSTEM, Jenang Kudus, STEM literacy

1. Introduction

Science plays a very large role in the lives of students so that they can maintain the safety of themselves, others, and the environment, and can form individuals who can face the development of the times. This is also reflected in the achievement of learning the material on additives at the junior high school level. The learning achievement in this material is that students have the determination to make the right decisions to avoid additives that are harmful to themselves and the environment Kemendikbudristek, 2022). In learning additives, participants are encouraged to maintain the health of themselves and others by being careful in consuming food (Mardin et al., 2022). Through this learning, students are expected to be more selective in choosing food with safe ingredients.

To achieve the learning objectives above, teachers must present meaningful learning that is appropriate to the characteristics of the additive material and students at the junior high school. Additive learning is learning that discusses ingredients added to food and drinks for certain purposes (Ratnasari & Erman, 2017) The use of additives is often found in traditional culinary practices that are rich in local cultural values. However, currently many students are starting to become unfamiliar with the culinary culture in their respective regions. They are more familiar with modern or Western cuisine than traditional (Dharline, 2020; Untari et al., 2019). There needs to be integration of science learning with local wisdom, to improve science literacy in students and encourage students to participate in preserving local cultural (Harefa, 2017; Irsan Kadir et al., 2022).

One approach that can be applied to learning additive material is the ethnoSTEM approach. This approach is an approach that combines science, technology, engineering, and mathematics with the local wisdom of the community (Laily & Fawaida, 2024; Sutaphan & Yuenyong, 2019). STEM in education is often used in modern examples (Kasimatis et al., 2019; Ramazonovna & Zainura, 2024; Usembayeva et al., 2024). However, the process of making traditional culinary contains science (additives), technology (production tools), engineering (manufacturing process), and mathematics (ingredient proportions). The ethnoSTEM approach provides an understanding that STEM is not only rooted in modern technology but also in local traditions and wisdom. The integration of STEM here is important in preparing the younger generation to overcome the challenges faced by society (Afkarina et al., 2024; Arjaya et al., 2024). Thus, in the learning of additive substances, a more holistic ethnoSTEM approach can be applied and adapted to current developments compared to the ethnoscience approach which only combines science with local community wisdom.

The ethnoSTEM approach can apply contextual learning through students' real experiences of the culture in their surrounding environment (Sarwendah et al., 2022; Wulandari & Hanim, 2023). This makes students feel that the material being studied is closer to their lives so and it can increase students' motivation to be involved in learning. In addition, the ethnoSTEM approach can encourage students to develop STEM literacy towards the objects being studied and encourage students to recognize cultural heritage in the surrounding environment (Suryani, 2024). STEM literacy and cultural literacy obtained by students can encourage them to apply what they have learned to improve their quality of life.

Research on the application of the ethnoSTEM approach shows a positive influence on science learning. These positive influences include: developing analytical thinking skills (Sartika et al., 2022), creative thinking skills (Karim et al., 2022), creative problem-solving skills (Babalola & Keku, 2024), logical thinking skills (Ainuzzahroh et al., 2024), students' scientific literacy skills (Bramastia et al., 2023), increasing students' learning motivation, critical, creative, innovative, and entrepreneurial characters (Dewy et al., 2022), increasing students' conceptual understanding (Marufi et al., 2021), and supporting the implementation of education for sustainable development (Sudarmin & Sumarni, 2021).

Learning additive material with an ethnoSTEM approach can be carried out well if learning resources are available and easily obtained by teachers and students. Learning resources are all sources such as people, messages, goods, tools, techniques, facts, data, and ideas that students use as sources for learning activities that can improve the quality of their learning (Abdullah, 2012; Samsinar, 2019). Learning resources in science learning can be in the form of ethnoSTEM content analysis results in traditional culinary that uses additives as one of its compositions. This ethnoSTEM content analysis is carried out by analyzing the reconstruction of indigenous knowledgeand scientific science using STEM in the culinary production process using additives.

Analysis of ethnoSTEM content as a source of ethnoSTEM learning in culinary production containing additives can be done by directly observing the food-making process. One of the traditional culinary specialties of Kudus is Jenang Kudus (Fibriyanti & Listyorini, 2019; Sari et al., 2023). This culinary is in the form of snacks or snacks served at religious events or traditional parties in the Kudus area. Jenang is also available in other areas, but Jenang Kudus has characteristics that are not found in other areas. STEM content can be seen from the Jenang Kudus production process which requires production tools and materials. Jenang Kudus is made from the main ingredients of glutinous rice flour, brown sugar, coconut milk, and other additives that have nutritional value and benefits for the human body. Jenang Kudus has a distinctive texture and taste obtained from special ingredients and processing processes that make Jenang Kudus different from other jenang (Ainuzzahroh et al., 2024; Winarti et al., 2024).

In addition to STEM content, the production of Jenang Kudus also has cultural content. Jenang Kudus is a culinary culture that has been passed down from generation to generation (Istiqomah & Andriyanto, 2017; Viqriani & Falaq, 2023). According to local folklore, the origin of Jenang Kudus is closely related to Sunan Kudus, one of the members of the Wali Songo, and his student, Syekh Jangkung. It is said that one day, they were walking on the banks of the Kaliputu River and saw a child, the grandson of Mbah Dempok Soponyono, who fell into the river while playing pigeons. The child was successfully rescued but experienced a state of clinical death. Syekh Jangkung then asked the mothers in the village to make limestone porridge (so called because its color is similar to white chalk) made from rice flour, salt, and coconut milk. After the child ate the jenang, he regained consciousness. This event is believed to be the beginning of the tradition of making jenang in Kaliputu Village (Hanifah et al., 2020). So since then, Jenang Kudus has become one of the economic sectors of the Kudus people. In addition, Jenang Kudus is also a traditional symbol during important events in Kudus, especially weddings (Amalia, 2020; Saifuddin, 2013). The presence of Jenang Kudus at every event is a form of respect for the traditions that have existed before.

Based on the search results, there are several studies on Jenang Kudus in science learning. Research by Sari et al. (2023) shows that the video of making Jenang Kudus is effective for science learning outcomes, research by Ainuzzahroh et al. (2024) shows that the analysis of scientific knowledge in making Jenang Kudus can improve logical thinking skills, and research by Muliyah et al. (2020)shows that concept analysis in the practicum of making Jenang Kudus can encourage students to develop an understanding of science concepts. These studies can be used as learning resources, but none have analyzed the ethnoSTEM content in the process of making Jenang Kudus. Therefore, it is necessary to conduct research that aims to analyze the ethnoSTEM content in the process of making Jenang Kudus using additive materials as a learning resource for science learning.

2. Research Method

The research was conducted at the Jenang Kudus Garuda and Kharisma production house in Bancak, Payaman, Mejobo District, Kudus Regency, Central Java Indonesia. This type of research is descriptive qualitative research. The data sources used are primary data and secondary data. The collection of primary data was carried out through observation and interviews which aimed to obtain data directly from the subjects and objects of the research. The subjects in this study were the owners and employees of the Jenang Kudus

Garuda and Kharisma production houses. Interviews were conducted to explore indigenous knowledge in the Jenang Kudus production process. The object of this study is the Jenang Kudus production process with an ethnoSTEM approach. The sampling technique in this study was convenience sampling. The business owner determines who will be the sample. The sample taken was 15 people from a population of 36 people. Secondary data collection was carried out through literature studies to obtain theoretical foundations and supporting data related to the Jenang Kudus making process. In this study, the researcher is the main instrument for collecting data based on indigenous knowledge, conducting verification, reconstruction, formulation, and conceptualization into scientific knowledge.

3. Research Results and Discussion

The results of in-depth observations and interviews with the producers of Jenang Kudus Garuda and Kharisma obtained information that the community's knowledge about the process of making Jenang Kudus was obtained based on experience. This Jenang Kudus production house was established in 2016. The respondents' knowledge about making Jenang Kudus was obtained from their parents' inheritance from generation to generation.

The production site of Jenang Kudus Garuda and Kharisma has its own composition in producing quality Jenang Kudus. The tools and ingredients for making Jenang Kudus can be seen in Table 1.

Table 1. Materials and Production Tools for Kudus Jenang

Category	Type	Amount
Material	Glutinous rice flour	30 kg
	Brown sugar	40 kg
	Granulated sugar	30 kg
	Coconut milk	2 large buckets
Production Tools	Flour milling machine	To make sticky rice flour
	Coconut grater	To grate coconut
	Coconut squeezer	To make coconut milk
	Mixer	To stir jenang dough
Production Results	Jenang	80 kg

The first process carried out in making Jenang Kudus is to make sticky rice flour first using a milling machine. After that, the coconut is grated and squeezed into coconut milk. Brown sugar is melted first and then filtered, then the sticky rice that has become sticky rice flour is dissolved first with coconut milk. Then the filtered Brown sugar is mixed with margarine, granulated sugar, sticky rice flour, and also coconut milk. All ingredients are stirred together using a mixer machine continuously. After cooking, the dough is poured into a tray and then cut into pieces, and then packaged for marketing.

Preparation of materials

Making glutinous rice flour

Mix glutinous rice flour with coconut milk

Preparing the flavor (aroma)

Diluting brown sugar

Filtering brown sugar

Mix the brown sugar, margarine, glutinous rice flour mixture and coconut milk in a mixer, and cook until thick.

The processed jenang is placed on a baking sheet and cooled until it hardens slightly.

Jenang is cut and packed

The final appearance of the Jenang Kudus product

Figure 1. Jenang Making Process

Based on the results of observations and interviews with Jenang Kudus producers, it can be linked to indigenous knowledge with scientific knowledge (Table 2 and Table 3). Indigenous knowledge is knowledge that is owned and applied by the community from generation to generation. This knowledge is often translated into practical experience in dealing with and utilizing the natural environment, local resources, and cultural and spiritual values held by a community. Indigenous knowledge was obtained through in-depth interviews with the owners and employees of Jenang Kudus production. Scientific knowledge refers to knowledge obtained through systematic scientific methods, such as observation, experimentation, and data analysis (Agrawal, 2014). Scientific knowledge in this study was obtained through direct observation in the field and analysis of STEM content through literature studies.

Table 2. Transformation of Indigenous Knowledge into Scientific Knowledge about the Addition of Additives in Making Jenang Kudus

No.	Additives in Jenang	Indigenous Knowledge	Scientific Knowledge
1.	Jenang Kudus coloring	Does not use artificial coloring, only uses brown sugar as coloring.	The brown color of Jenang Kudus is the result of the coloring process that occurs when brown sugar is added. Brown sugar here functions as a natural dye. Where the brown color of brown sugar itself is made from coconut or aren sap through a very long cooking process (Muchaymien et al., 2014).The quality and type of sap used also affect the color of the sugar produced later (Hasan et al., 2020).
2.	Jenang Kudus sweetener	In making jenang, no artificial sweeteners are used. The sweet taste of jenang is obtained from brown sugar.	The sweet taste of jenang is obtained from the process of adding coconut sugar. Coconut sugar as a natural sweetener from Jenang Kudus, because coconut sugar is made from aren tree sap. If the sap is processed directly after being taken down from the tree, it will produce a sweeter taste than sap that is processed too late (Heryani, 2016. Sap contains 11.8% carbohydrates. The carbohydrate content in the sap that has been distributed to the seeds through the phloem network will naturally turn into glucose (sugar) (Hartina et al., 2017). This is what makes coconut sugar made from sap taste sweet.
3.	Jenang Kudus preservative	What makes jenang last is the cooking process which is carried out for quite a long time.	Jenang has a fairly long shelf life. This is due to the mixture of sugar and salt. Sugar and salt not only function as flavorings, but can make food last longer (Lubis, 2009). Sugar and salt have hygroscopic properties. This property can bind water contained in food (Hafizah et al., 2018). The less water content in food, the longer the food can last.

Table 2. (Cont')

No.	Additives in Jenang	Indigenous Knowledge	Scientific Knowledge
4.	Flavor and Aroma enhancer	Using essence, nuts and sesame	In the making of Jenang Kudus, the addition of salt and sugar functions as a natural flavor enhancer. In addition, the nuts and sesame used are useful as a natural flavor and aroma enhancer. Jenang now also has several flavor variants such as milk, mocha, and durian. The flavor/aroma used is in the form of essence. Essence itself functions as an artificial aroma giver (Pradita & Eddy, 2016)
5.	Thickener	The process of thickening Jenang Kudus is done by mixing boiled sticky rice flour and brown sugar, then adding coconut milk as a thickener for the jenang and water.	In the making of Jenang Kudus, the addition of salt and sugar functions as a natural flavor enhancer. In addition, the nuts and sesame used are useful as a natural flavor and aroma enhancer. Jenang now also has several flavor variants such as milk, mocha, and durian. The flavor/aroma used is in the form of essence. Essence itself functions as an artificial aroma giver (Imanningsih, 2012).
6.	Use of firewood	To be more economical and not easily burnt	Firewood is used as a source of fuel in the process of making Jenang Kudus. Firewood gives aroma to the ingredients being cooked (Piochi, 2024). The heat generated from the firewood is used in the process of cooking jenang. After the jenang thickens, the warm temperature of the charcoal from the firewood is used in the final process so that the cooked jenang is perfectly cooked and does not burn quickly.

Table 3. Analysis of The Reconstruction Of Indigenous Knowledge And Scientific Knowledge Using the EthnoSTEM Approach.

No.	STEM Components	Indigenous Knowledge	Scientific Knowledge
1.	***Science*** Use of raw materials a. Glutinous rice flour b. Brown sugar c. Granulated sugar d. Coconut milk e. Margarine	The raw materials used in making jenang consist of sticky rice flour, Brown sugar, white sugar, and coconut milk.	a. Glutinous rice flour contains amylopectin, which has the property of being able to bind water. So that in the storage process, food products that use glutinous rice flour can be stable. The amylose content in it will also affect the texture of jenang (Hafizah et al., 2018). b. Brown sugar is sugar that comes from sap. Sago contains 11.18% carbohydrates. In addition to containing carbohydrates, the

No.	STEM Components	Indigenous Knowledge	Scientific Knowledge
			nutritional content of sap is protein, fat, and minerals (Heryani, 2016). c. Granulated sugar is a type of carbohydrate in the form of disaccharides. The content in disaccharides is sucrose. Granulated sugar contains 99% sucrose (Siregar, 2014). d. Coconut milk is a mixture of two phases, namely fat in water. Scientifically stabilized by protein and phospholipids (Kumolontang, 2015). e. Margarine functions as an emulsifier in food. Margarine is composed of 20% water and 80% oil. Margarine also contains unsaturated fatty acids (Fitriana & Fitri, 2020)
2.	***Technology*** Use of tools a. Coconut grater b. Coconut milk squeezer c. Selep machine d. Mixer machine	A tool used to simplify and speed up the process of making jenang.	a. The coconut grater machine uses an electric motor as a drive for the grater blade. The rotation of the grater blade is influenced by the torque force. Where the grated coconut is produced by the rotating grater blade (centrifungal force) and the calculation between the distance of the coconut and the center of rotation of the machine (Gundara & Riyadi, 2017). Can be written with the equation $T = F \times d$. b. The coconut milk squeezer here uses a hydraulic system. Where the nature of the liquid is that pressure will be transmitted in all directions. So it can be said that liquid is related to pressure and force (Firmanda & Saputra, 2021). With the equation that $P = F / A$ c. The milling machine has a motor drive component, which results in force and tension. The shaft on the drive motor will produce pressure, moment force, and friction force (Tambunan et al., 2021). Friction occurs between the rotating shaft and the glutinous rice grains, causing the glutinous rice to be crushed and become flour. d. The mixer machine has a shaft on the electric motor that causes centrifugal force, causing the mixer to rotate (Sifa et al., 2020).

No.	STEM Components	Indigenous Knowledge	Scientific Knowledge
3.	***Engeneering*** a. Changing sticky rice into sticky rice flour. b. The process of grating coconut until it becomes coconut milk. c. The process of cooking jenang.	All ingredients are mixed together and then cooked until the jenang thickens and is cooked.	a. The process of making jenang begins with the making of glutinous rice flour from glutinous rice. b. The process of grating and squeezing coconut in the form of a substance into coconut milk in the form of a liquid substance. c. The process of melting Brown sugar which requires heat. d. The process of gelatinization when cooking jenang which is caused by the presence of glutinous rice flour in the dough.
4.	***Mathematic*** a. Comparison of the composition of the ingredients used. b. The duration of the jenang cooking process.	The cooking process for jenang takes around 4-5 hours.	a. Comparison of the composition of ingredients used in one production of jenang, namely 30 kg of glutinous rice flour, 40 kg of brown sugar, 30 kg of white sugar, and 2 large buckets of coconut milk. In measuring the ingredients, the units used are standard units (kg) and non-standard units (buckets). b. The cooking process of jenang can take a long time, depending on the amount of heat produced by the burning wood. The higher the calorific value produced, the faster the cooking process will be (Faisol et al., 2014)

The results of the analysis above show that there are differences between indigenous knowledge and scientific knowledge on the role of additives (Table 2) and STEM content (Table 3) in the Jenang Kudus production process. Indigenous knowledge is more practical, the explanation is simple and empirical. This knowledge is based on experiences passed down from generation to generation in traditional practices. Scandura (2019) emphasized that in addition to these characteristics, local wisdom also plays an important role in the practice of transfer, especially in terms of cultural preservation. Meanwhile, scientific knowledge is based on deeper scientific research and analysis by explaining the process chemically and biologically. Scientific knowledge provides an in-depth explanation of the scientific mechanisms and calculations underlying the process, thus opening up opportunities to increase efficiency and product quality without abandoning traditional values. According to Scandura (2019), this scientific knowledge is very important for the advancement of science and technology.

Through the process of making Jenang Kudus, students can understand that the use of natural additives is maintained in the process. The results of observations show that natural additives such as sweeteners, preservatives, thickeners, and dyes are used as additional ingredients in making jenang (Table 2 and Table 3). Natural additives can be added to provide the taste of Jenang Kudus without the need for artificial additives. However, there are artificial additives used as additional ingredients in making Jenang

Kudus. These artificial additives function as aroma enhancers in jenang. The manufacturer adds essence for mocha and milk flavors, while for peanut and sesame flavors the manufacturer uses natural ingredients. Although there are artificial additives in its composition, Jenang Kudus is still safe to consume. This is because the artificial additives used have been registered with the Food and Drug Supervisory Agency (BPOM). Products registered with BPOM are safe for consumption (Mardesci, 2013).

The above shows that the ethno-STEM content analysis in the production of Jenang Kudus can be used as a source of learning for junior high school science on additives. In learning additives, students can use these learning resources to develop STEM literacy and local cultural literacy. Students can apply meaningful learning by selecting and processing food by adding natural additives. These additives have the functions of sweeteners, preservatives, thickeners, flavorings, and colorings that are safer for health than artificial additives. Students can also consume foods with artificial additives as long as they pay attention to the characteristics of artificial additives that are safe and not excessive (Bialangi et al., 2023). In addition, students can also develop skills and understanding related to the production process of Jenang Kudus as follows.

1. Understanding knowledge in a cultural context.

Students can understand the knowledge of the origins, manufacture, community reactions, and distribution of Jenang Kudus. With this, students also understand the values, beliefs, norms, and cultural practices that influence this knowledge. Providing local wisdom teaching and learning resources can increase cultural insight for students (Haq & Raida, 2023; Kurniawan, 2018; Salama & Kadir, 2022).

2. Analyze ethnic perspectives in STEM knowledge.

Students can understand how society views knowledge in the process of making Jenang Kudus. This includes knowledge about the community the tools and materials used, the manufacturing process, packaging, and marketing so that it becomes traditional knowledge. The integration of local wisdom with the STEM approach can holistically connect science, technology, engineering, and mathematics with cultural knowledge so that students gain cross-disciplinary insights (Sudarmin & Sumarni, 2021).

3. Promoting diversity in science

Students can understand the diversity of local cultures and knowledge that develops in society. By understanding and respecting this diversity, students can present and acknowledge knowledge from various cultural groups (Andi et al., 2023; Hoaihongthong & Tuamsuk, 2024).

4. Improving students' interests and skills in science, technology, engineering, and mathematics

Through observation and analysis activities of STEM elements in making Jenang Kudus, students can develop and increase, learning motivation in these fields (Dewy et al., 2022), so that they have science conceptual understanding (Ardianti & Raida, 2022), logical thinking skills (Ainuzzahroh et al., 2024), analysis thinking skills (Sartika et al., 2022), critical thinking skills (Dewy et al., 2022), creative thinking skills and problem-solving (Babalola & Keku, 2024), needed to succeed in a world driven by science and technology.

5. Increasing global competitiveness

The skills of students acquired after ethnoSTEM learning can be used to prepare for the challenges of the global economy that tend to change. By increasing STEM understanding and skills, students have a better chance of contributing to the knowledge-based economy and facing global competition in the fields of science, technology, engineering, and mathematics (Nurbayani et al., 2023).

6. Encourage innovation and discovery

STEM emphasizes creativity, problem-solving, and innovation (Puspita & Raida, 2021). Through an interdisciplinary approach, students are encouraged to think critically, develop new solutions to complex problems, and stimulate interest in new research and discovery. Thus, STEM seeks to create a generation that innovates and contributes to the development of society and technology (Rahma et al., 2024).

7. Supporting the implementation of education for sustainable development

The ethnoSTEM approach to the process of making Jenang Kudus can be used as a means to teach the importance of miscarriage, both in traditional practices and modern technology. In addition, it can also provide an understanding of the importance of maintaining traditions, the environment, and sustainable technology (Sudarmin & Sumarni, 2021).

The description above shows that the results of this study can be used to support the implementation of junior high school science learning on additives with an ethnoSTEM approach. However, this study is limited to providing learning resources in the form of ethnoSTEM content in the production process of Jenang Kudus. Further research is needed to analyze the effect of the ethno-STEM approach on science learning outcomes and the development of learning tools and media that support the ethnoSTEM approach in junior high school science learning.

4. Conclusion

Based on the results of the analysis, it can be concluded that the production process of Jenang Kudus can be used as a source of learning for junior high school science on the material of additives using the ethnoSTEM approach. Jenang Kudus has ethnoSTEM content in its tools, materials, and production process. The materials used are selected materials with the addition of special additives and special production tools to provide a distinctive taste to the production results of Jenang Kudus. In addition, Jenang Kudus has a local wisdom value for the local community so this learning object can provide cultural insight for students so that it can encourage an attitude of preserving culture in the surrounding environment. Thus, the ethnoSTEM content in the production process of Jenang Kudus can be used as a representative source of learning for junior high school science. The original knowledge of the community obtained from generation to generation in the process of making Jenang Kudus can be constructed into scientific knowledge that can be one of the learning sources that has the potential to foster STEM literacy and cultural literacy of students in the use of natural additives in making Jenang Kudus.

This research is limited to the provision of learning resources in the form of ethnoSTEM content in the production process of Jenang Kudus. Further research is needed to analyze the influence of the ethno-STEM approach on science learning outcomes and the development of learning tools and media that support the ethnoSTEM approach in junior high school science learning.

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