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Exploring Gethuk-Making Processes: An Ethnoscience Approach to Elementary Science Education

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Abstract: This study aims to enhance science learning in elementary schools by integrating an ethnoscience approach through the traditional process of making gethuk, a renowned food from Central Java. Employing a qualitative method with an ethnographic approach, this research seeks to uncover scientific concepts embedded in the gethuk-making process. Data were analyzed through three stages: data reduction, data presentation in narrative and tabular forms, and conclusion drawing. The findings reveal that the process of making gethuk involves key physical and chemical concepts, including physical changes, heat transfer, mechanical energy, and chemical transformations. These findings highlight the strong connection between local cultural practices and scientific principles, offering students a contextual and meaningful learning experience. The study emphasizes the importance of developing ethnoscience-based curricula, providing teacher training, and utilizing culturally relevant teaching materials to deepen students' understanding of science concepts. Ultimately, integrating ethnoscience into science education not only promotes scientific literacy but also fosters cultural appreciation among elementary school students.

Keywords: Ethnoscience; Gethuk; Science Learning

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INTRODUCTION

Culturally based education is increasingly recognized as a strategic approach to preserving local wisdom while simultaneously enriching the educational experience by making learning more relevant to students' daily lives. In Indonesia, with its rich tapestry of traditions and local knowledge, the integration of cultural elements into formal education holds particular significance. However, in today's era of globalization and multiculturalism, local cultural values are facing serious challenges. Younger generations are more exposed to and often more attracted to global popular culture, which can lead to the gradual erosion of traditional cultural practices and knowledge (Gómez-Baggethun, 2022). This condition presents a critical challenge for educators, who are tasked not only with delivering academic content but also with fostering an appreciation and love for Indonesia’s rich cultural heritage among students. If local wisdom is not systematically preserved and integrated into education, it risks being marginalized and ultimately forgotten by future generations (Bawack et al., 2025).

To address this growing concern, one promising educational approach is ethnoscience, which involves integrating indigenous knowledge systems with formal scientific concepts. Ethnoscience aims to bridge the gap between traditional cultural practices and modern scientific understanding, enabling students to see the relevance of science within their cultural contexts. By connecting science learning with local traditions, students not only gain a deeper conceptual understanding but also develop a sense of cultural pride and identity (Puspasari et al., 2019). In elementary science education, where foundational scientific concepts are introduced, incorporating local culture provides an opportunity to make learning more meaningful, contextual, and engaging (Isa et al., 2022). Traditional activities, such as the making of gethuk—a well-known Central Javanese food made from cassava—offer rich scientific insights into concepts like material changes, heat energy transfer, and chemical reactions, while also connecting students with their cultural heritage.

The theoretical foundation supporting ethnoscience integration in education is constructivist learning theory, which emphasizes that meaningful learning occurs when students actively construct knowledge through direct, relevant experiences (Wiryanto et al., 2024). Constructivism highlights the importance of learning by doing, suggesting that students learn best when they can relate new information to their own lived experiences.

Applying this to science education, ethnoscience enables students to contextualize abstract scientific concepts within the concrete practices of their communities. Indrawati (2017) defines ethnoscience as the study of cultural and natural phenomena transmitted across generations, emphasizing its role in both education and cultural preservation. Thus, embedding ethnoscience within the science curriculum aligns with broader educational goals to instill both scientific literacy and cultural awareness among young learners (Nelmi & Amini, 2023).

Moreover, empirical evidence supports the positive impacts of ethnoscience-based learning. Wahyu (2017) found that integrating local culture into science lessons fosters students' familiarity with their social and cultural environments and nurtures positive attitudes aligned with local values. Students not only learn scientific theories but also develop a deeper respect for the traditions and practices of their communities. Ethnoscience-based learning has been shown to enhance students' scientific process skills, critical thinking, and cultural appreciation (Rahmawati & Ridwan, 2017). Similarly, Lubis, Suryadarma, & Yanto (2022) emphasized that incorporating local wisdom into science learning promotes contextual understanding and motivation to learn.

Despite the growing body of research supporting ethnoscience approaches, significant gaps remain. Most existing studies have focused on broader or generalized aspects of local knowledge, such as agricultural practices or traditional medicines, without a detailed exploration of specific cultural artifacts or practices in the classroom context. Furthermore, there is a limited body of research that systematically maps traditional cultural processes to specific scientific concepts in a way that is directly applicable to elementary science education. While previous studies have demonstrated the benefits of ethnoscience integration, few have provided detailed models or examples that teachers can easily adopt for practical classroom implementation. Particularly, there is a lack of research focusing on culturally rich, yet everyday activities, such as the making of gethuk, to teach core scientific concepts in ways that are both academically rigorous and culturally responsive.

The novelty of this research lies in its focused analysis of the gethuk-making process as a context for ethnoscience-based learning in elementary schools. This study not only identifies the scientific principles embedded in the traditional practice—such as physical changes, heat transfer, mechanical energy, and chemical transformations—but also demonstrates how these can be utilized pedagogically to enrich science learning experiences. By doing so, this research offers a concrete example of culturally contextualized science instruction that addresses both scientific competencies and cultural literacy. Furthermore, this study proposes the development of ethnoscience-based teaching materials and teacher training programs, emphasizing the role of local cultural practices in enhancing students' engagement, understanding, and appreciation of science.

Based on this background and gap analysis, the objective of this study is to explore how the traditional process of making gethuk can be effectively employed as an ethnoscience approach in elementary science education. The study aims to contribute to the development of culturally responsive science education models that make learning more relevant, meaningful, and sustainable for young learners. Ultimately, this research advocates for an educational paradigm that not only advances scientific knowledge but also preserves and revitalizes Indonesia's invaluable cultural heritage.

METHODS

This research employed a qualitative method with an ethnoscience approach, aiming to explore the scientific concepts embedded in traditional gethuk-making practices and their potential integration into elementary science education. The study was conducted at Pondok Gethuk Coklat Pak San, located in Kajar Village, Dawe District, Kudus Regency, Central Java. The site was purposefully selected due to its reputation for preserving traditional methods of gethuk production, making it a rich source for ethnoscientific exploration.

Data collection was carried out through direct field observations, in-depth interviews, and documentation during November 2024. The observation phase involved systematically observing the entire process of making gethuk, starting from the washing of cassava to the final preparation of the ready-to-eat product. Particular attention was given to identifying physical changes, heat applications, and mechanical processes that could be linked to elementary scientific concepts. In-depth interviews were conducted with Pak San, a renowned gethuk artisan in Kajar Village, to gain detailed insights into the traditional techniques, tools, and cultural meanings associated with gethuk-making. The interviews were semi-structured, allowing flexibility to explore emerging themes while ensuring coverage of key topics relevant to the research objectives. Additionally, photographs and field notes were collected as part of the documentation process to complement and validate data obtained through observations and interviews.

The data analysis was conducted in three systematic stages, following the interactive model proposed by Fadli (2021). The first stage was data reduction, where raw data obtained from observations and interviews were organized and filtered to highlight relevant information about scientific concepts and cultural meanings within the gethuk-making process. Unnecessary or repetitive data were discarded to focus on significant findings. The second stage was data presentation, where the reduced data were arranged in descriptive narratives and tabular forms to facilitate better understanding and interpretation. This stage aimed to illustrate the relationship between traditional practices and scientific principles clearly. The final stage was drawing conclusions and verification, in which key findings were synthesized to generate a coherent description of how the gethuk-making process embodies local wisdom and scientific concepts. This stage also involved cross-checking data from different sources to ensure validity and reliability.

Through this methodological framework, the research not only documented the traditional gethuk-making process but also illuminated the embedded local wisdom and scientific knowledge, contributing valuable insights for the development of culturally responsive science education in elementary schools.

RESULTS

The findings of this study reveal that the traditional process of making gethuk in Kajar Village, Kudus Regency, embodies both scientific concepts and cultural values that are highly relevant for integration into elementary science education through an ethnoscience approach. The observations and interviews conducted at Pondok Gethuk Coklat Pak San identified several stages in the gethuk-making process that illustrate fundamental scientific principles, while simultaneously reflecting local wisdom and cultural practices that persist across generations.

The process of making gethuk begins with selecting and preparing cassava, specifically the ketan variety, which is known for its sticky and soft texture after cooking. The preparation starts with peeling the cassava's outer skin, which requires the application of mechanical force. This process involves manually removing the tough outer layer using traditional tools, such as knives or peelers, to separate the inedible parts from the cassava flesh. The act of peeling exemplifies the concept of mechanical energy transformation, where human physical effort is converted into kinetic energy to perform work on the cassava surface (see Figure 1). After peeling, the cassava is washed thoroughly to remove any remaining dirt or impurities, ensuring hygiene and preparing the cassava for the next processing stage. This initial step not only reflects a daily life application of mechanical physics but also represents traditional food preparation techniques that have been passed down through generations.

Figure 1. Mechanical Force in the Cassava Outer Skin Peeling Process

Once the cassava is cleaned, it undergoes the steaming process using a large traditional steamer (dandang) that can accommodate approximately 15 kg of cassava and 22 liters of water. Steaming involves essential scientific principles, particularly heat transfer through conduction and convection (see Figure 2). As water in the steamer reaches its boiling point (approximately 100°C), steam rises and circulates the cassava pieces, facilitating convection heat transfer. This movement of hot steam ensures uniform heat distribution in the steamer. Simultaneously, conduction occurs as the heat from the steam is transferred directly from the cassava's surface to its core, gradually softening the entire root. The process requires about 90 minutes to achieve the desired texture, where the cassava becomes soft but retains its structural integrity, making it suitable for further processing into gethuk. This step offers a concrete, real-life example of thermodynamic principles that can be linked to elementary science concepts.

Figure 2. Conduction and Convection in the Cassava Steaming Process

Once the cassava is softened after steaming, it is carefully lifted from the steamer and placed on a woven bamboo tray (tampah). This stage requires not only attention to hygiene and preparation but also involves the application of force and balance in daily activities (see Figure 3). Lifting hot, softened cassava requires careful handling to avoid breaking the structure of the cassava and to prevent injury from the heat. The workers must distribute their strength evenly to maintain the cassava's form during transfer, reflecting a practical application of the physics concepts of force, load distribution, and equilibrium. Once the cassava is placed on the tampah, it is spread out evenly to facilitate cooling. This cooling stage is crucial to prepare the cassava for subsequent grinding and also provides time for manually removing the fibrous roots, ensuring a smoother final product. This manual separation process reflects traditional knowledge passed down through generations, where cultural practices align with practical considerations of food texture and quality.

Figure 3. Force and Balance in the Process of Lifting Steamed and Flattened Cassava on a Tampah

Following the cooling process, salt is added to the cassava, introducing the concept of solution formation and taste balance, where sodium chloride dissolves and interacts with the cassava to enhance flavor. This reflects local wisdom in maintaining harmony between sweetness, saltiness, and texture, a culinary principle embedded in Javanese food traditions. The next step involves grinding the cassava using a mechanical grinder, which transforms the softened cassava into a homogeneous, fine-textured dough (see Figure 4). This process exemplifies the application of mechanical energy, where the rotational force generated by the machine's motor is transferred to grind the cassava. Scientifically, this step demonstrates a physical change, as the cassava shifts from a solid and fibrous structure into a soft, malleable mass. The grinding process also illustrates the concept of energy transformation, where electrical or manual energy is converted into kinetic energy to perform mechanical work. For elementary-level education, this stage serves as a tangible example of how simple machines assist in daily life and how matter can change form without altering its chemical structure.

Figure 4. Mechanical Energy and Change of Form in the Process of Adding Salt and Grinding with a Machine

The final stage in the gethuk preparation process is shaping the cassava dough and adding fillings, such as palm sugar and chocolate. This step requires careful manual work to mold the dough into uniform shapes and insert the filling evenly. From a scientific perspective, this step still involves physical changes, as the cassava dough is manipulated without altering its chemical composition. The addition of sugar and chocolate introduces concepts of mass transfer and diffusion, where flavors from the filling will eventually diffuse into the gethuk matrix during subsequent cooking processes. Furthermore, the practice of balancing the sweet filling with the cassava dough maintains local culinary values related to taste harmony, texture, and food aesthetics—important cultural considerations in traditional Javanese cuisine.

Figure 5. Heat Transfer (Conduction), Physical and Chemical Changes in the Process of Filling Gethuk with Sugar and Chocolate, and Frying Gethuk

Following the shaping process, the gethuk is fried in hot oil, marking a stage rich in scientific phenomena (see Figure 5). During frying, heat transfer by conduction occurs as the hot oil comes into direct contact with the gethuk's surface, transferring energy that rapidly raises the food's temperature. This process induces both physical and chemical changes. Physically, the texture of the gethuk transforms from soft to crispy as the water content evaporates and the outer layer becomes hardened. Simultaneously, chemical reactions occur, notably the Maillard reaction and caramelization, which contribute to the development of brown coloration, an enhanced aroma, and a more complex flavor profile. These reactions occur when amino acids and reducing sugars interact under high heat, a phenomenon widely studied in food chemistry. Additionally, evaporation is observed as water from the dough escapes in the form of steam, and the frying oil may also release vapor at high temperatures. The frying process demonstrates how everyday culinary practices can serve as real-life examples of thermodynamics, phase changes, and food science principles, making it an ideal medium for introducing these concepts to elementary students within an ethnoscience-based learning framework.

DISCUSSION

This study highlights that the traditional process of making gethuk is not merely a cultural practice but also a rich medium for introducing scientific concepts to elementary students through an ethnoscience-based learning approach. The detailed observations of the gethuk-making process uncovered various scientific phenomena, such as heat transfer, mechanical energy, changes in material state, and chemical reactions, all of which are integral to the natural sciences curriculum in primary education. These findings align with previous ethnoscience studies but differ in their focus. Unlike prior research that primarily explored agricultural practices or traditional medicine, this study offers a novel exploration of food processing as a learning resource. The integration of culinary practices into science learning provides a contextual and meaningful way for students to grasp abstract scientific concepts through experiences rooted in their own culture (Sakti et al., 2024).

The cultural aspects embedded in the gethuk-making process are equally significant. The collaborative nature of preparing gethuk fosters gotong royong (cooperation), a fundamental value in Javanese society (Rohmadi et al., 2021). Additionally, the continued use of traditional tools in the face of modernization reflects cultural resilience and highlights the community's commitment to preserving local heritage (Maulana & Ardiati, 2023). Incorporating this cultural dimension into science learning fosters not only scientific literacy but also cultural appreciation, contributing to a more holistic educational experience (Mayasari & Hanim, 2024). This dual approach is essential in the era of globalization, where there is a risk of cultural erosion among younger generations.

From a pedagogical perspective, integrating local practices like gethuk production into elementary science lessons can promote experiential and inquiry-based learning. Students are not merely passive recipients of information but become active participants who observe, analyze, and relate scientific concepts to real-life situations. According to constructivist learning theory, this process facilitates deeper understanding because students can link new knowledge to prior experiences (Kong & Wang, 2024). For instance, through observing the steaming of cassava, students can learn about heat transfer by conduction and convection, while the grinding process demonstrates mechanical energy and physical changes. Frying introduces students to chemical changes and phase transitions, including evaporation and the Maillard reaction, commonly discussed in food science. These concepts are directly relevant to the primary science curriculum, making the gethuk-making process an ideal educational context.

Moreover, this research emphasizes the role of local potential as a learning resource. Fawaida et al. (2023) suggest that local practices can serve as sources for teaching materials, enriching the curriculum with culturally relevant content (Solihin et al., 2024). The integration of ethnoscience in teaching encourages the use of culturally contextualized problem-solving tasks and discussion prompts, which, according to Mulyatna et al. (2021), can enhance students' analytical thinking, evaluative skills, and creativity. For example, teachers can create inquiry-based questions related to the energy transformations during steaming and frying, or ask students to compare traditional and modern cooking methods in terms of energy efficiency and environmental impact. This approach aligns with the goals of problem-based learning, which leverages socio-scientific issues and local wisdom to improve students' conceptual knowledge and environmental literacy (Lubis, Suryadarma, Paidi, et al., 2022).

Additionally, the gethuk-making process provides an opportunity for intergenerational knowledge transfer, ensuring that students not only learn scientific concepts but also absorb cultural values and traditional knowledge (Ueangchokchai, 2022). This is crucial in preserving intangible cultural heritage while building students' scientific competencies. Teachers can facilitate projects where students interview local artisans or family members about traditional food processing, fostering community engagement and cultural continuity (Bhaskar, 2021).

Based on the findings, several scientific concepts can be systematically integrated into elementary science lessons using the Gethuk-making process. These include:

1. Heat Transfer (Conduction and Convection): Observed during the steaming and frying stages, where heat moves through materials and fluids.
2. Physical Change: Identified in the transformation of cassava from solid roots into soft dough, and during texture changes in frying.
3. States of Matter and Their Changes: Demonstrated by the evaporation of water during steaming and frying, and the phase changes of cooking oil.
4. Mechanical Energy: Applied during cassava peeling and grinding, where physical force converts cassava into dough.
5. Force and Balance: Evident in the lifting and transferring of hot cassava using traditional tools, requiring equilibrium and control.

This study not only supports the integration of ethnoscience into science education but also contributes a new model of culture-based science learning through culinary practices. By embedding these local activities into the science curriculum, educators can promote meaningful learning experiences that connect scientific knowledge with daily life and cultural heritage. Ultimately, this approach may help foster a generation of students who are both scientifically literate and culturally grounded.

CONCLUSION

This study concludes that the traditional gethuk-making process in Central Java offers a meaningful and innovative model for integrating ethnoscience into elementary science education. The findings reveal that gethuk production involves various scientific concepts such as heat transfer (conduction and convection), mechanical energy application, material transformation, phase changes, and chemical reactions, all of which are directly relevant to the elementary science curriculum. At the same time, the process embodies local cultural values like gotong royong (cooperation), culinary balance, and intergenerational knowledge transmission, making it a culturally responsive educational tool. Unlike previous studies that primarily focused on agricultural or medicinal ethnoscience practices, this research highlights the potential of food processing as a medium for science learning, expanding the scope of ethnoscience integration in education. The practical application of this approach allows students to connect scientific concepts with everyday life, fostering deeper understanding, critical thinking, and cultural awareness. Therefore, the integration of gethuk-making into science lessons not only enhances students' scientific literacy but also contributes to cultural preservation and social values education. Future research should explore similar models across different cultural contexts and investigate the long-term impact of ethnoscience-based education on students' conceptual mastery, cultural sensitivity, and environmental literacy.

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