



## Exploring Ethnoscience in *Bakpia* Production in Yogyakarta: Can It Be Integrated into Junior High School Science Learning?

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**Abstract:** This study aims to explore the ethnoscientific aspects embedded in the traditional production of *bakpia* in Yogyakarta and examine their potential integration into junior high school science instruction. The study employed a qualitative exploratory design informed by an ethnoscience perspective. Data were collected through field observations and semi-structured interviews with two key informants at a single *bakpia* production site in Kampung Pathuk, Yogyakarta, selected through purposive sampling. The data were analyzed using qualitative data analysis procedures, including data reduction, data display, and conclusion drawing. The findings reveal that the *bakpia* production process encompasses various scientific concepts related to physical, chemical, and biological phenomena. These concepts include heat transfer during baking, gluten formation during dough kneading, chemical reactions such as the Maillard reaction, and environmental issues associated with organic waste management. Furthermore, the analysis indicates that these ethnoscientific elements can be systematically mapped onto several topics in the junior high school science curriculum, including matter and its changes, temperature and heat, force and motion, ecology, and chemical reactions. Integrating *bakpia* production as a contextual learning resource provides opportunities to promote culturally relevant and meaningful science learning. This approach may enhance students' conceptual understanding while simultaneously fostering appreciation for local cultural heritage.

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## Introduction

Science education plays a critical role in equipping students with the ability to understand natural phenomena through scientific inquiry, reasoning, and the application of concepts in everyday life. However, in practice, science instruction at the junior high school level is often delivered in an abstract and decontextualized manner, resulting in fragmented understanding and relatively low levels of scientific literacy (Rahayu et al., 2021; Saputra et al., 2026). Students frequently encounter difficulties in connecting theoretical concepts with real-world situations, leading to a learning process that emphasizes memorization rather than meaningful conceptual understanding (Darling-Hammond et al., 2020; Denervaud et al., 2021; OECD, 2019; Pals et al., 2018; Yin, 2019). This condition reflects a persistent gap between instructional content and students' lived experiences. Consequently, there is a pressing need for instructional approaches that effectively bridge scientific concepts with authentic real-world contexts, thereby enhancing the relevance and meaningfulness of learning.



One promising approach to addressing this issue is contextual learning, which situates scientific knowledge within learners' real-life experiences and sociocultural environments. Within this framework, ethnoscience can be understood as an approach for identifying, interpreting, and connecting scientific knowledge embedded in local cultural practices with concepts taught in formal science education. This perspective is particularly relevant to the broader international discourse on Indigenous Knowledge Systems (IKS) and Culturally Responsive Science Teaching (CRST). IKS encompasses knowledge, practices, observations, and ways of understanding the natural world that are developed and transmitted within particular communities, whereas CRST emphasizes the use of students' cultural backgrounds, community experiences, and knowledge systems as meaningful resources for teaching science. From this perspective, ethnoscience provides a bridge between community-based knowledge and formal scientific concepts, while CRST provides a pedagogical framework for incorporating such culturally situated knowledge into classroom learning. This connection is particularly important in Southeast Asian contexts, where diverse local communities maintain extensive knowledge associated with food production, agriculture, traditional medicine, environmental management, and other everyday practices. Ethnoscience therefore should not be viewed merely as the identification of "science" in traditional activities, but as a means of recognizing culturally situated knowledge and transforming it into meaningful contexts for science learning (Ali et al., 2025; Hikmah et al., 2025; Lubis & Baiduri, 2025; Sutanto et al., 2026).

The educational value of ethnoscience is reflected in its capacity to help students recognize scientific principles within familiar cultural and everyday activities (Sari et al., 2023; Suciwati et al., 2021; Sudirman et al., 2025). By connecting formal scientific concepts with locally situated practices, ethnoscience-based learning can support students' conceptual understanding while simultaneously fostering cultural awareness and appreciation of local wisdom (Hamna & Ummah, 2024; Sihombing et al., 2025). It also provides opportunities for students to construct meaningful connections between scientific knowledge and their sociocultural environment, thereby making science learning more relevant to their lived experiences (Febrian et al., 2024; Nasution & Nasution, 2026). These characteristics are consistent with the principles of culturally responsive science teaching, in which students' cultural experiences and community knowledge are treated as resources for making disciplinary science more meaningful and accessible. As a result, science learning can move beyond the transmission of decontextualized scientific concepts toward learning experiences that connect formal science with the cultural and environmental realities in which students live.

Yogyakarta, as a region rich in cultural heritage, offers a wide range of local potentials that can be utilized as contextual resources in science education. One such example is *bakpia*, a traditional food that functions not only as a cultural icon but also as a significant economic commodity for the local community (Nihayati, 2020; Yuwanto et al., 2024). What distinguishes *bakpia* production as a potential ethnoscientific context is the combination of several sequential and interdependent processes, particularly the preparation of layered dough, manual kneading and shaping, mung bean filling preparation, and controlled baking. The layered dough-making process requires producers to manage the consistency and thickness of the dough while incorporating fat between dough layers, whereas the filling and shaping stages require experiential judgments regarding moisture, texture, proportion, and distribution. During baking, these material conditions interact with heat transfer and moisture changes to produce the characteristic texture, color, and aroma of *bakpia*. Such processes



provide interconnected examples of physical, chemical, and biological phenomena within a single traditional food-production practice. These include physical and chemical changes during ingredient preparation and baking, mechanical processes during kneading and shaping, and heat transfer through conduction, convection, and radiation during baking. Biological aspects are also evident in the use and processing of mung beans and their nutritional components. The integration of these processes with producers' experience-based decision-making makes bakpia production a particularly relevant local context for examining how community knowledge can be connected with formal science concepts in junior high school learning.

Despite the increasing attention to ethnoscience-based learning, existing studies have predominantly focused on domains such as agriculture, traditional medicine, and environmental management (Fernández-Llamazares et al., 2024; Iskandar et al., 2022; Kasim et al., 2025). In contrast, the exploration of traditional food production as a comprehensive context for science learning remains relatively limited. This indicates a significant gap in the utilization of everyday cultural practices as meaningful resources for science education (Muyassaroh et al., 2025; Sudirman et al., 2025). Furthermore, there is still a lack of studies that systematically map ethnoscientific knowledge onto the junior high school science curriculum (Tyas et al., 2024). The absence of such structured mapping constrains the effective integration of local knowledge into formal instruction. Consequently, local potentials such as bakpia production have not yet been optimally leveraged as contextual learning resources in science education.

In response to this gap, the present study aims to explore the ethnoscientific aspects embedded in the traditional production of bakpia in Yogyakarta and to examine their potential integration into junior high school science learning. Specifically, this study seeks to identify the scientific concepts inherent in each stage of the bakpia production process and to analyze their alignment with the junior high school science curriculum. By doing so, this research intends to contribute to the development of culturally relevant and context-based science learning approaches. Furthermore, the findings are expected to provide alternative instructional resources that can enhance students' conceptual understanding and scientific literacy. Ultimately, this study offers a pathway toward more meaningful, relevant, and contextually grounded science learning.

## **Research Method**

This study employed a qualitative exploratory design to investigate the ethnoscientific aspects embedded in the traditional production of bakpia in Yogyakarta. A qualitative approach was considered appropriate as this study aims to explore, interpret, and understand phenomena within their natural context, particularly in relation to local knowledge and cultural practices (John W. Creswell, 2018).

The study was conducted at one bakpia production site in Kampung Pathuk, Yogyakarta, which was purposively selected because of its relevance as a cultural and economic center of bakpia production. Two key informants from the production site participated in the study. They were purposively selected based on their direct involvement in the bakpia production process, practical knowledge and experience of the production stages, familiarity with the traditional practices involved in bakpia production, and willingness to provide detailed information through interviews. These criteria ensured that the selected informants could provide relevant and information-rich accounts of the local knowledge and



practices embedded in bakpia production. The two informants served as the primary sources for identifying and interpreting ethnoscientific elements throughout the production process.

Data were collected through observations and semi-structured interviews. Observations were conducted to systematically document each stage of the bakpia production process, including material preparation, dough processing, filling, shaping, and baking. During the observation process, the researcher recorded activities, tools, and techniques that potentially reflect scientific concepts. Semi-structured interviews were conducted to gain deeper insights into the knowledge, reasoning, and practices of bakpia producers. The interview format allowed flexibility for participants to elaborate on their experiences while still maintaining a focused discussion. All interviews were audio-recorded and transcribed for analysis. Field notes and documentation were also used to support the data obtained.

The data were analyzed using qualitative data analysis techniques, following the stages of data reduction, data display, and conclusion drawing (Miles et al., 2014). Initially, the collected data were organized and reduced by selecting relevant information related to ethnoscientific aspects. Subsequently, the data were categorized and displayed in the form of thematic groupings based on identified scientific concepts. The analysis focused on mapping local knowledge and practices to formal science concepts within the junior high school curriculum. Furthermore, an interpretative approach was used to understand the meaning behind participants' practices and explanations. This process enabled the identification of connections between traditional knowledge and scientific principles. The results were then synthesized to generate meaningful findings.

To ensure the trustworthiness of the data, this study employed several validation techniques, including triangulation and member checking. Triangulation was achieved by comparing data obtained from observations and interviews (John W. Creswell, 2018). Member checking was conducted by confirming the findings with participants to ensure the accuracy of interpretations. In addition, prolonged engagement in the field helped the researcher gain a deeper understanding of the context. Detailed documentation was also maintained to support transparency in the research process. These strategies enhance the credibility and reliability of the study findings.

## **Results and Discussion**

### **Overview of Bakpia Production**

Bakpia is one of the traditional culinary products that has become an important cultural identity of Yogyakarta. Over time, bakpia has evolved not only as a traditional snack but also as a widely recognized souvenir purchased by tourists visiting the region. The existence of bakpia production centers, particularly in the Pathuk area, reflects the strong relationship between local culinary traditions and community-based economic activities. The bakpia industry in this area is predominantly managed through small-scale home industries that rely on family labor and traditional production techniques. These small enterprises play a significant role in sustaining the local economy while simultaneously preserving culinary heritage.

What distinguishes *bakpia* production as a potential ethnoscientific context is the combination of a layered production process, manual sensory-based decision making, and the transformation of simple plant- and cereal-based ingredients into a culturally recognizable product. In particular, producers continuously judge dough consistency through touch, control dough thickness and filling distribution during shaping, and determine baking readiness through changes in color, aroma, and texture. These practices involve observable



transformations that can be connected to concepts of material properties, force, heat transfer, moisture change, and chemical transformation. Unlike using a traditional food merely as an illustration of local culture, *bakpia* production provides a sequence of culturally embedded practices in which scientific phenomena can be observed directly and discussed in relation to the producers' experiential knowledge.

Based on field observations conducted in one of the *bakpia* production houses in Kampung Pathuk, the production activities are carried out in a home-based kitchen setting that functions as both a household and production space. The production environment is relatively simple, utilizing basic cooking utensils such as mixing bowls, rolling tools, baking trays, and traditional ovens. Despite the modest production setting, the process is organized and systematic, reflecting the accumulated experience and practical knowledge of the producers. The production activities typically involve several workers who share responsibilities in different stages of the process, including dough preparation, filling preparation, shaping, and baking. The *bakpia* production business observed in this study has been operating for more than two decades and has been passed down across generations within the family. This long-standing practice indicates that *bakpia* production is not merely an economic activity but also a form of inherited local knowledge. The sustainability of this business is strongly influenced by market demand, particularly from tourists who visit Yogyakarta. As explained by the producer during the interview:

*"This bakpia business has been running for more than twenty years. Production usually increases during holiday seasons because many tourists buy bakpia as souvenirs."*

The of production is supported by ongoing market demand, particularly from tourists visiting Yogyakarta. Under normal conditions, the producer is able to produce approximately 50 boxes of *bakpia* per day, with each box containing around 20 pieces. The production process is carried out daily to ensure that the products remain fresh when distributed to consumers. The production process is carried out daily to maintain product freshness and consistency before distribution to consumers. From the observations, the *bakpia* production process consists of several main stages, including the preparation of raw materials, dough preparation, filling preparation, shaping of the *bakpia*, and baking. Most of these processes are still performed manually using hand-based techniques. The producers believe that manual processing helps maintain the texture and quality of the product, especially during the shaping of the dough and the baking stage. As stated by the informant:

*"Most of the process is still done manually so that the quality remains consistent, especially when shaping the dough and controlling the baking process."*

The statement indicates that manual processing is not simply a consequence of limited technological equipment. Rather, it represents a deliberate production practice associated with the producers' experience and their ability to control product characteristics through direct sensory observation. Through repeated practice, producers develop practical judgments concerning dough consistency, filling proportion, shaping, and baking conditions. From an ethnoscience perspective, these practices are important because they demonstrate how knowledge about materials and processes can be developed and transmitted through community experience. Producers do not necessarily describe their practices using formal scientific terminology such as *gluten network*, *thermal conduction*, or *chemical reaction*. Nevertheless, their decisions are based on repeated observations of material behavior and the consequences of particular production conditions. Ethnoscience analysis therefore does not imply that producers are consciously applying formal school science. Instead, it provides an



analytical bridge through which locally situated practices can be interpreted in relation to formal scientific concepts.

### **Stages of Bakpia Production and Local Experiential Knowledge**

The production of bakpia involves a sequence of interconnected activities through which raw materials are transformed into a finished culinary product. Based on field observations and interviews with the key informants, the observed production process consisted principally of raw-material preparation, dough preparation and kneading, mung bean filling preparation, shaping, and baking. Although these stages may appear straightforward, each requires practical knowledge concerning ingredient proportions, dough consistency, texture, shape, and heating conditions. The findings indicate that producers rely substantially on sensory judgment and accumulated experience when making decisions throughout the production process.

The first stage involves the preparation of raw materials. The main ingredients observed included wheat flour, mung beans, sugar, vegetable oil, and water. Each ingredient contributes to the characteristics of the final product, and the producers carefully prepare the ingredients before beginning the mixing process. During the observation, attention was given to the preparation and proportioning of the ingredients because these factors were considered important for maintaining the consistency of the final product. This practical consideration was confirmed by the informant:

*"The ingredients must be prepared carefully because they determine the final taste and texture of the bakpia. If the proportions are not balanced, the dough will not form properly."*

The statement indicates that ingredient proportion represents an important component of the producers' experiential knowledge. Although the explanation is expressed in practical rather than formal scientific terminology, it reflects an understanding of the relationship between material composition and the physical characteristics of dough. In this sense, the producers' experience provides a locally situated basis for discussing material properties and changes in material characteristics. The next stage involves mixing and kneading the dough. The dough is manually manipulated through pressing, folding, and stretching until it reaches the desired consistency. During observation, the researchers found that producers did not rely solely on fixed measurements to determine whether the dough was ready. Instead, they used tactile perception to evaluate its softness, elasticity, and workability. This practice was explained by the informant:

*"We usually know the dough is ready by feeling it with our hands. If it is too soft, it will stick; if it is too hard, it will crack when shaped."*

This explanation demonstrates how sensory knowledge functions as an important decision-making mechanism in traditional production. The producer uses tactile information to infer the physical condition of the dough and determine whether additional manipulation is required. Scientifically, the process can be interpreted in relation to mechanical force, deformation, friction, and changes in the physical properties and structure of wheat-based dough. Nevertheless, the ethnoscientific interpretation should maintain a distinction between the producer's experiential explanation and formal scientific explanation. The producer's knowledge is grounded in repeated practical experience, whereas scientific concepts provide an analytical framework for explaining the material phenomena associated with the practice. The observed dough-mixing and kneading process is illustrated in Figure 1. The photograph provides visual documentation of the manual manipulation of the dough and supports the observation that tactile assessment is an integral part of the production process.



**Figure 1. Manual dough mixing and kneading during bakpia production**

The visual documentation shows the direct interaction between the producer and the dough during the preparation stage. This interaction is significant because the producer's hands function not only as tools for mechanically manipulating the dough but also as a means of assessing its physical condition. The producer can identify whether the dough is too soft, too hard, or sufficiently workable through tactile feedback. Such practice illustrates how practical knowledge is embodied in routine production activities and transmitted through experience and observation.

After the dough reaches the desired consistency, it is divided into portions and manually rounded into small, relatively uniform pieces before the filling is added. This balling process requires the producer to control the portion size and shape through direct hand manipulation. Although the procedure is simple, the producer relies on repeated experience to produce portions with relatively consistent size and shape, which facilitates the subsequent filling and shaping stages. From an ethnoscientific perspective, this practice can be interpreted in relation to applied force, pressure, deformation, and the physical properties of dough. The process also provides a contextual opportunity for students to observe how manual force influences the shape and form of a material. The manual dough-balling process is documented in Figure 2.



**Figure 2. Manual balling of dough portions during bakpia production**

The photograph illustrates how the producer manually forms portions of dough into relatively uniform shapes before the filling is added. The activity demonstrates that consistency in portion size and shape is achieved through repeated manual practice rather

than solely through standardized measurement. This provides another example of embodied experiential knowledge, in which tactile perception and manual control are used to achieve a desired product characteristic. The dough portions are then combined with the prepared mung bean filling and shaped manually. The shaping process requires careful control of dough thickness and filling distribution. According to the informant:

*"The shaping process must be done carefully so the filling is evenly covered and the dough is not too thick."*

This statement indicates that shaping involves more than simply forming the final product. Producers must make continuous judgments concerning the relationship between the amount of filling, dough thickness, and final shape. From a scientific perspective, this practice can be associated with material properties, force, deformation, and the relationship between structure and physical characteristics. The practice therefore provides another example of how local experiential knowledge can be interpreted through formal scientific concepts. The final major stage is baking. The shaped *bakpia* are placed on baking trays and heated in an oven for a particular period. During observation, the producers continuously monitored the surface color and aroma of the *bakpia* to determine whether the baking process was complete. Rather than relying exclusively on precise instrumental measurements, the producers used sensory indicators developed through repeated experience. The baking activity is documented in Figure 3. The photograph illustrates the production environment and the interaction between the *bakpia* and the heating equipment during the final processing stage.



**Figure 3. Baking process during bakpia production**

The baking process is particularly significant from an ethnoscientific perspective because several observable changes occur simultaneously. Heating causes energy transfer from the oven to the product, resulting in changes in temperature, moisture content, texture, and surface characteristics. The transformation of soft dough into a firmer baked product can therefore be discussed in relation to heat transfer and changes in material structure. The development of color and aroma during heating can also be interpreted through browning reactions, including the Maillard reaction. These scientific interpretations provide a way to connect the producers' sensory observations with concepts addressed in formal school science. The producers' reliance on color and aroma as indicators of baking readiness is particularly important. These sensory cues represent practical indicators developed through repeated production experience. The producer does not necessarily need to identify the exact oven temperature or calculate the rate of a chemical reaction to determine whether the *bakpia* is ready. Instead, visual and olfactory information provides sufficient practical evidence for



making production decisions. From an ethnoscientific perspective, this illustrates how local knowledge can involve systematic observation and empirical decision-making even when it is not expressed using formal scientific terminology.

Taken together, the observations and interview findings demonstrate that bakpia production is characterized by a close interaction between experiential knowledge, sensory judgment, and observable material phenomena. The producers' knowledge is expressed through decisions concerning ingredient proportions, tactile assessment of dough, manual shaping, and sensory evaluation during baking. These practices can subsequently be interpreted through scientific concepts from physics, chemistry, biology, and environmental science. The following section therefore examines these ethnoscientific connections in greater detail and maps them onto relevant junior high school science concepts.

### **Ethnoscientific Concepts Embedded in Bakpia Production**

The observed practices in bakpia production reveal several connections between local experiential knowledge and formal scientific concepts. These connections are reflected in the preparation of materials, dough kneading, shaping, baking, and management of production residues. The scientific interpretations are based on the observed practices and interview findings and are mapped onto relevant junior high school science topics. The relationship among the production stages, local experiential knowledge, scientific phenomena, relevant junior high school science topics, and potential learning activities is summarized in Table 1.

**Table 1. Ethnoscience in Bakpia Production and Science Learning**

| <b>Production Stage and Local Experiential Knowledge</b>                                                                                                   | <b>Scientific Phenomenon</b>                                         | <b>Junior High School Science Topic and Grade Level</b>                        | <b>Potential Learning Objective and Pedagogical Activity</b>                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Raw-material preparation. Producers carefully prepare wheat flour, mung beans, sugar, vegetable oil, and water based on established production experience. | Composition and properties of matter; formation of mixtures.         | Matter and Its Changes (Grade 7); Elements, Compounds, and Mixtures (Grade 8). | Students identify materials used in bakpia production, distinguish substances and mixtures, and observe changes occurring during mixing. |
| Dough mixing and kneading. Producers determine dough readiness through tactile perception and repeated manual manipulation.                                | Applied force, friction, deformation, and material properties.       | Force and Motion (Grade 7); Work and Energy (Grade 8).                         | Students investigate how applied force affects the shape and consistency of dough through guided observation or simple investigation.    |
| Mung bean filling preparation. Mung beans are processed into filling according to established production practices.                                        | Plant structure and nutrient storage in seeds.                       | Characteristics and Structure of Living Things (Grade 7–8).                    | Students identify relevant plant structures and discuss the function of stored nutrients in seeds.                                       |
| Shaping. Producers control dough thickness and ensure that the filling is evenly covered.                                                                  | Force, deformation, thickness, and physical properties of materials. | Matter and Its Changes (Grade 7); Force and Motion (Grade 7).                  | Students observe how applied force and material properties influence the shape, thickness, and structure of the product.                 |



| Production Stage and Local Experiential Knowledge                                                                          | Scientific Phenomenon                                                            | Junior High School Science Topic and Grade Level              | Potential Learning Objective and Pedagogical Activity                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Baking. Producers monitor the baking process through changes in color, aroma, texture, and product condition.              | Heat transfer, temperature change, moisture loss, and structural transformation. | Temperature and Heat (Grade 7).                               | Students explain heat transfer and investigate how heating conditions influence changes in food materials.                              |
| Color and aroma development. Producers use sensory changes as indicators of product readiness.                             | Chemical transformation and browning reactions.                                  | Matter and Its Changes (Grade 7); Chemical Changes (Grade 9). | Students distinguish physical and chemical changes and identify observable indicators of chemical transformation.                       |
| Structural changes during baking. Heating alters the moisture and internal structure of the product.                       | Moisture evaporation and changes in material structure.                          | Temperature and Heat (Grade 7)                                | Students investigate how heating influences the structure and physical characteristics of food materials.                               |
| Production residues. Organic residues generated during food preparation provide a context for discussing waste management. | Organic waste management and decomposition as potential environmental processes. | Ecology and Environmental Issues (Grade 7–9).                 | Students identify potential waste-management issues associated with food production and propose appropriate waste-management practices. |

As shown in Table 1, bakpia production provides multiple connections between local experiential knowledge and formal science concepts across physical science, chemistry, biology, and environmental science. The connections are particularly evident in the preparation, kneading, shaping, and baking stages, where producers rely on practical experience and sensory judgment to control material properties and product quality. The tactile assessment of dough readiness can be interpreted through force, deformation, and material properties, while the control of dough thickness and filling distribution provides a contextual example of how applied force affects material form. The baking process further connects local practice with heat transfer, temperature changes, moisture loss, and observable changes in color, aroma, and texture; these changes can also introduce chemical transformation and browning reactions such as the Maillard reaction, although these processes were not experimentally analyzed in the present study. The use of mung beans provides an additional context for discussing plant structures and stored nutrients, while production residues can be used to introduce waste management and environmental conservation. Thus, the ethnoscientific value of bakpia production lies not merely in the presence of science concepts, but in the opportunity to connect students' familiar cultural experiences with observable phenomena and formal scientific explanations.

### **Integration of Bakpia Ethnoscience into Junior High School Science Learning**

The ethnoscientific aspects identified in *bakpia* production provide meaningful opportunities for integrating local cultural practices into junior high school science learning. As summarized in Table 1, the production process offers contextual situations through which students can observe, question, investigate, and explain scientific phenomena based on familiar cultural practices. For example, students can examine changes in dough properties



during kneading, investigate the effects of heating on the physical characteristics of the product, and discuss heat transfer during baking. These activities can be developed through inquiry-based or problem-based learning, in which students begin with observations of *bakpia* production and gradually construct scientific explanations based on evidence. In this way, the local production process functions not merely as an illustration of science concepts but as a contextual learning resource that connects students' everyday experiences with formal science knowledge.

Previous research has demonstrated the potential of *bakpia* as a context for junior high school science learning. Nisa & Wilujeng (2020) developed a science textbook integrated with *bakpia* local potential and reported improvements in students' critical thinking and communication skills. However, their study did not involve direct investigation of *bakpia* production practices. The present study extends this line of research by examining *bakpia* production directly through an ethnoscientific perspective, focusing not only on the scientific concepts that can be identified but also on the experiential knowledge and sensory-based practices through which producers make production decisions. This perspective provides a more practice-oriented understanding of how local knowledge embedded in *bakpia* production can be connected with junior high school science learning. It is also consistent with the principles of Culturally Responsive Science Teaching (CRST), which emphasizes the use of students' cultural experiences, community knowledge, and familiar contexts as meaningful resources for science learning. In the context of *bakpia* production, local culinary practices can provide a culturally relevant entry point for discussing scientific phenomena while allowing students to recognize the presence of science in their surrounding community. Such integration can help position students' cultural experiences as legitimate starting points for inquiry rather than treating local knowledge as separate from school science.

The integration can further be understood through Aikenhead's concept of cultural border crossing, in which students move between different cultural domains, including their everyday or community knowledge and the culture of school science (Aikenhead, 1996). In this framework, ethnoscience serves to identify and interpret scientific dimensions embedded in local practices, while culturally responsive science teaching provides a pedagogical orientation for bringing these cultural resources into classroom learning. *Bakpia* production therefore provides a familiar cultural context from which students can gradually interpret local practices using formal scientific concepts. The teacher's role is important in facilitating this transition by helping students connect their existing cultural experiences with the scientific explanations introduced in the classroom. Rather than replacing local knowledge with formal science, the learning process creates a bridge between the two domains and enables students to recognize how scientific concepts can be used to interpret phenomena within their own cultural surroundings. Thus, the integration of *bakpia* ethnoscience illustrates how local cultural knowledge can function as a starting point for culturally responsive science learning and facilitate students' movement across the boundary between everyday experience and school science.

## Conclusion

The findings indicate that various stages of *bakpia* production contain scientific concepts related to heat transfer, physical and chemical properties of materials, and environmental issues associated with organic waste. These concepts can be systematically aligned with topics in the junior high school science curriculum, demonstrating that local cultural practices can function as meaningful contexts for contextual and inquiry-based



science learning. The integration of ethnoscience into science education therefore provides important pedagogical implications by supporting culturally responsive learning and helping students connect abstract scientific concepts with real-life experiences in their local environment. Furthermore, the findings suggest that teachers can utilize local cultural resources such as traditional food production to design more engaging and contextual learning activities. Future research is recommended to develop ethnoscience-based learning models or instructional media that incorporate local cultural practices and to investigate their effectiveness in improving students' scientific understanding, environmental awareness, and appreciation of cultural heritage.

### Recommendation

Future recommendations can be directed toward three main groups: science practitioners/teachers, curriculum developers and education authorities, and future researchers. Science teachers are encouraged to use local cultural practices, such as *bakpia* production, as contextual resources for inquiry-based, problem-based, or project-based science learning, enabling students to observe local practices and connect them with formal scientific concepts while developing conceptual understanding and scientific inquiry skills. Curriculum developers and education authorities are encouraged to provide guidance, curriculum-support materials, and teacher resources that facilitate the integration of ethnoscience while maintaining alignment with formal science competencies and learning outcomes, with collaboration among educators, researchers, and local communities to ensure that local knowledge is accurately documented and appropriately represented. Future researchers may further develop and empirically examine ethnoscience-based instructional models, learning media, or science modules through experimental or quasi-experimental designs, including investigations of conceptual understanding, scientific inquiry skills, scientific literacy, and environmental awareness, while also exploring ethnoscientific practices from different cultural communities and examining challenges in transforming local knowledge into scientifically appropriate and pedagogically meaningful learning resources.

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