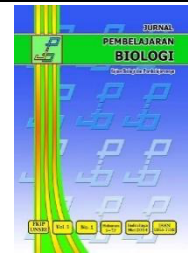


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An Ethnoscience-Based Analysis of Biology Learning Materials in the Context of the Munyirih Tradition

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Abstract: Indonesia has variety of cultural traditions that contain scientific knowledge relevant to science learning, one of which is through the Munyirih tradition. Ethnoscience activities in the Munyirih tradition can enrich biology learning by linking local knowledge with scientific concepts. This research aims to explore the potential of the Munyirih tradition as a source of ethnoscience-based biology learning. This research uses a descriptive qualitative approach, data collected through literature studies with relevant academic sources. This research is (1) explaining ethnoscience-based biology learning; (2) Identification of Natural Materials in the Munyirih Tradition; (3) Relevance of the Munyirih Tradition in Biology Learning. The results showed that integrating Munyirih tradition in biology learning can enrich students' understanding, strengthen the relationship between science and local culture, and support sustainable education practices. In conclusion, the application of the Munyirih tradition in biology learning has great potential to create a more inclusive, relevant and culturally value-based education.

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Introduction

Indonesia is rich in cultural heritage and diverse traditional knowledge. Each region has its own unique way of understanding and interacting with nature, passed down from generation to generation. This knowledge, known as ethnoscience, knowledge that develops within societies through everyday experiences (Lestari & Nabila, 2024). Ethnoscience plays a crucial role in connecting scientific concepts with local culture, providing a deeper understanding of the interaction between humans and their surrounding environment. Many ethnoscience practices reflect how communities understand nature and preserve scientific values that are worth further exploration (Putra et al., 2024). Even though it originates from local traditions, ethnoscience greatly contributes to biology education by providing tangible examples of scientific theories taught in schools. For example, the use of traditional medicinal plants that have proven benefits for health can be studied through the lens of modern biology.

The potential of ethnoscience in science education in Indonesia has not been fully maximized. The national curriculum prioritizes a general, global approach and offers little space for local wisdom (Mumpuni et al., 2013). As a result, there is a gap between the scientific knowledge students receive in schools and the local knowledge they possess, which is often closely tied to their everyday lives. However, ethnoscience can serve as an effective bridge between scientific concepts and real-life practices (Novianti & Khusniati, 2022). By incorporating local wisdom into teaching, students can more easily connect biological theory with their daily experiences. This approach not only enriches their understanding of the subject matter but also increases the relevance of biology education to the socio-cultural context they live in. In addition, students are taught to appreciate their own culture while developing a more reflective scientific attitude (Sukomardojo, 2023).

One example of an Indonesian tradition that can be linked to ethnoscience is the practice of *munyirih*. This involves chewing a mixture of betel leaves, lime, areca nut, tobacco, and other ingredients, a custom passed down through generations in Indonesian communities (Hamidah et al., 2022). While

often viewed as a cultural habit, *munyirih* holds significant scientific information related to oral health and the use of natural substances in medicine. This practice serves not only as a means to maintain oral hygiene but also plays a social role, carrying certain cultural symbols (Unbanu et al., 2019). Moreover, betel leaves, one of the key ingredients in *munyirih*, are known to possess antiseptic properties that help in maintaining oral cleanliness. Communities that continue this tradition regard it as a valuable cultural heritage. This makes *munyirih* an ideal example for study within the context of ethnoscience (Rizaldi et al., 2021).

Munyirih involves not only cultural aspects but also has a scientific foundation related to biology and human health. For instance, betel leaves used in this tradition are known to contain compounds with antiseptic and anti-inflammatory properties (Maulidiah, 2021). These compounds provide scientific evidence that plants used in local culture not only hold cultural value but also offer proven medical benefits. Ongoing scientific research reinforces the understanding that local knowledge, as reflected in traditions like *munyirih*, contains valid scientific principles. Therefore, *munyirih* can be analyzed scientifically and serve as an ethnoscience-based learning resource (Gulo, 2024). Through this approach, students learn about cultural values and gain insight into the scientific applications underlying these practices.

Integrating ethnoscience into biology education offers significant benefits. By utilizing local wisdom in teaching, students can understand the biological concepts taught in class in a more relevant and contextual way (Novianti & Khusniati, 2022). They can see how the biological theories learned in school are applied daily, especially in traditional practices such as herbal medicine and environmental management. Through this integration, students develop a deeper understanding of science and begin to appreciate their culture and foster a more critical and reflective scientific attitude. This supports creating of an educational system that is more inclusive, relevant, and grounded in local values (Sukomardojo, 2023).

Ethnoscience-based biology learning can enrich students' science literacy more contextually (Subrata & Rai, 2023). In this context, students do not merely learn biological theory abstractly, but also relate that knowledge to their daily lives. When students learn biological concepts through real-life practices within their culture, such as in activities like *munyirih*, they can more easily understand the connection between the theory taught and its application. This provides a more meaningful learning experience, increases their motivation, and strengthens their deeper conceptual understanding.

The practice of *munyirih* is closely related to various biological processes that are relevant to the biology topics taught in school, such as the human digestive system, the bioactive compounds found in plants, and their effects on the body's health (Sumarni et al., 2022). The biological processes during this activity, such as the absorption of active compounds by the body and digestion, can be further explained using basic biology concepts. By linking this tradition to biology lessons, students can learn about how the body digests and utilizes the active compounds from plants used in their culture. This helps them learn theory and understand how local culture applies biological science in daily life. Therefore, practices like *munyirih* have great potential to be used as interesting and relevant teaching material in biology education.

Designing biology teaching materials that integrate the *munyirih* tradition is a strategic step in creating more contextual learning. This approach not only enriches the content of the material being taught but also strengthens students' connection to their social and cultural environment (BK, 2024). When biology lessons are linked to local cultural practices, students will feel a stronger connection to the material because they can relate the knowledge to their experiences. This leads to the creation of education that not only imparts scientific knowledge but is also rooted in the values and cultural identities present in the community (Jacinda & Surtikanti, 2023).

This study aims to explore the *munyirih* tradition's potential as a source of ethnoscience-based biology learning. Specifically, this research seeks to identify the biological elements contained within the *munyirih* tradition, explain the ethnoscience values embedded in it, and analyze the relationship between the tradition and the core competencies in the biology curriculum. The study hopes to uncover new ways to integrate local knowledge into the biology curriculum by analyzing this tradition. This research also aims to develop a teaching material concept relevant to the *munyirih* tradition, in biology learning materials can enrich students' understanding, strengthen the connection between science and culture, and support sustainable practices in education.

Method

This study adopts a **descriptive qualitative approach**, aiming to explore and interpret the content of biology learning materials through an ethnoscience lens, with particular attention to the traditional practice of *Munyirih* (chewing betel) as a form of local wisdom. This research design was chosen for its capacity to uncover how cultural traditions can be meaningfully integrated into science education, especially in biology classrooms. Data were collected through literature review, examining scholarly sources such as journal articles, proceedings, and academic reports published over the last five years (2019–2024). Literature was retrieved from Google Scholar using targeted keywords, including “ethnoscience,” “biology learning materials,” “local wisdom,” and “nyirih tradition.” To ensure data validity, this study used data triangulation by combining different sources and types of relevant data. In addition to the literature study, the research findings were compared with previous studies to ensure consistency of results. Triangulation was also done by comparing theoretical information about ethnoscience with empirical data related to the use of *Munyirih* tradition in biology learning, thus strengthening the validity of the research findings.

The inclusion criteria for selected literature were as follows: (1) studies addressing ethnosciences-based approaches in science or biology education; (2) works discussing the cultural practice of chewing betel or related local traditions; and (3) publications within the defined five-year range. Research such as (Amalina et al., 2024; Rizaldi et al., 2021) serves as key references, offering empirical insights into the use of betel leaves in traditional settings and their potential to enrich science lessons, particularly in topics such as plant morphology, human digestion, and chemical substances.

Data analysis was conducted using content analysis, following a multi-step process: (1) explain ethnosciences-based biology learning; (2) Identification of Natural Materials in the Munyirih Tradition; (3) The Relevance of the Munyirih Tradition in Biology Education. The analytical procedure was adapted from literacy study models outlined by Setyosari (Azrai et al., 2020) and implemented in similar ethnosciences research (Rizaldi et al., 2021), which emphasize topic selection, source compilation, thematic structuring, and interpretation of literature-based findings.

Results and Discussion

Ethno-science-Based Biology Learning

Ethnosciences-based biology learning is an approach that links traditional knowledge with scientific knowledge in the material and practices of biology education (Nilamsari, 2021), explains that ethnosciences allows knowledge developed in society (traditional science) to be integrated with scientific knowledge that is relevant to the learning material. This approach to biology learning does not only focus on scientific theories detached from students' daily lives, however it connects them to the culture and local knowledge that students are already familiar with. Therefore, ethnosciences-based biology learning can potentially enhance student engagement, as it enables them to more easily understand biological concepts through a more personal and contextual approach. Additionally, (Putri & Darussyamsu, 2021) highlight the importance of local wisdom in biology education, where ethnosciences-based learning can make students more active in linking scientific knowledge to their life context. In this approach, students do not only learn about science as an abstract concept separated from their culture, but also see it as part of their everyday life. Thus, ethnosciences encourages students to think more critically about how science can be applied in real-life situations, making it more meaningful and easier to comprehend.

Ethnosciences-based learning plays a vital role in shaping students' character. (Yuslih & Yulien, 2021) argue that ethnosciences encompasses social and spiritual values crucial in fostering positive attitudes in students, such as valuing cooperation and honesty. These values help strengthen students' character, both in social and personal contexts. (Nilamsari, 2021) further emphasizes that ethnosciences-based learning can deepen students' understanding of their own culture. By introducing local traditions that hold social and spiritual significance, students learn scientific concepts and cultivate positive attitudes toward their culture and society. This approach fosters stronger character development in students, which positively influences their social interactions. In this way, applying ethnosciences in education can produce students who are not only well-informed but also carry a strong sense of responsibility and empathy towards their culture.

In addition to fostering character development, ethnosciences-based biology learning plays a crucial role in enhancing students' scientific literacy. (Rahayu & Sudarmin, 2015) explain that ethnosciences helps students connect scientific knowledge with their real-life experiences, making biology learning more relevant and applicable. This enables students to see science as a tool that can be used to solve real-world problems. Furthermore, (Putri & Darussyamsu, 2021) mention that learning based on local wisdom improves scientific literacy and enhances critical thinking skills and the ability to apply scientific knowledge in everyday life. Ethnosciences-based learning introduces students to scientific concepts and encourages them to view science as a tool for addressing daily challenges. Thus, ethnosciences plays an important role in improving students' overall scientific literacy, preparing them to face real-world scientific challenges.

Identification of Natural Materials in the Munyirih Tradition

The Munyirih tradition, which is practiced by various communities across Indonesia, involves the chewing of natural ingredients like betel leaves, areca nuts, lime, and gambir (Kamisoirei & Devy, 2017).

Betel Leaves (*Piper betle* L)

Betel leaves serve as the primary component in the Munyirih practice. These leaves come from the *Piper betle* L. plant and are characterized by their simple morphology, consisting of single leaves that vary in shape from ovate to obcordate (heart-shaped with the tip facing downward), depending on the variety (Astuti & Munawaroh, 2011). Betel leaves are rich in secondary metabolites, which include: (1) Phenols (cavicol): known for their antimicrobial effects; (2) Flavonoids and tannins: which provide antioxidant and antiseptic properties; (3) Sesquiterpenes and eugenol: which act as anti-inflammatory agents. These metabolites are essential for the plant's defense mechanism against pathogens and are also utilized in traditional medicine (Nurlita et al., 2024).

Areca Nut (*Areca catechu*)

The areca nut is a monocot plant from the Arecaceae family (palm family). Its fruit is a drupe with thin flesh and a large, hard single seed. The type of areca nut used is the young nut, as it is softer and sweeter. Both the fruit and seed of the areca nut contain: (1) Alkaloids (arecoline, arecadine), which have a mild stimulating effect on the central nervous system; (2) Tannins, which are astringent compounds that help strengthen the gum and tooth tissues; (3) Polyphenols and flavonoids, which act as radical

scavengers. These compounds are biologically active and play a role in plant protection and traditional medicine, making them relevant in plant bioactive substances and secondary metabolites (Hamidah et al., 2022).

Lime (Ca(OH)_2)

Lime, made from burned and soaked limestone, is a key ingredient in the Munyirih tradition. The lime used in this tradition is calcium hydroxide (Ca(OH)_2), a strong base with a pH ranging from 11 to 12.5. This alkaline property helps neutralize acids in the mouth, supporting a healthy oral pH. Lime also facilitates chemical reactions in the mouth, optimizing the effectiveness of other ingredients in the mixture (Sabila et al., 2024). Lime plays an essential role in enhancing the effectiveness of the other ingredients in the Munyirih mix. It is also believed to possess healing properties and is used for gum care.

Gambir (*Uncaria gambir*)

Gambir is an extract derived from the leaves and young twigs of the *Uncaria gambir* plant, resulting in a reddish-brown solid obtained through boiling and sedimentation. The bioactive compounds in gambir include: (1) Catechins and tannins, which are antioxidants and antibacterial agents; (2) Flavonoids and mild alkaloids, which provide a bitter taste and astringent effects. These compounds are relevant for oral health, particularly for the teeth and gums, and can be associated with plant physiology and the use of herbal compounds (Listantia et al., 2023).

Tobacco (*Nicotiana tabacum*)

Tobacco belongs to the Solanaceae family and is an annual plant. Its leaves are large, hairy, and contain various chemical compounds. Tobacco, which is sometimes added to the mixture in the Munyirih tradition, contains nicotine, a stimulant, although it is traditionally used in this practice to refresh the mouth after chewing. The chemical contents of tobacco include: (1) Nicotine (the main alkaloid), which is addictive and stimulates the nervous system; (2) Flavonoids and phenols, which exhibit antibacterial properties; (3) Essential oils and other aromatic compounds. In biological contexts, tobacco is also used in biotechnology as a transgenic expression system and as a model in genetic studies (Hamidah et al., 2022; Rizaldi et al., 2021).

Munyirih Process

The first step in the Munyirih tradition is the preparation of the ingredients to be used. The main ingredients include betel leaves, areca nuts, lime, and gambir. Betel leaves are carefully selected, typically those that are green, as they are believed to offer the best benefits in this tradition (Putri & Darussyamsu, 2021). The second step is the chewing stage. During this stage, the ingredients, including betel leaves, areca nuts, lime, and gambir, are chewed together to form a mixture known as "pinyang." The final step in the Munyirih tradition is the process of menyusur, which involves cleaning the mouth by rubbing a wad of tobacco on the teeth. This process is considered a substitute for brushing teeth and provides a refreshing effect to the mouth after chewing the mixture of ingredients (Listantia & Sarjan, 2023; Yuslih & Yulien, 2021).

The Relevance of the Munyirih Tradition in Biology Education

The Munyirih tradition closely aligns with biology topics typically taught in schools, such as the digestive system, the bioactive compounds found in plants, and their effects on human health (Sumarni et al., 2022). The biological mechanisms involved in this practice, including the absorption of active compounds and digestion, can be explored through fundamental biological concepts. By incorporating this tradition into biology lessons, students gain insight into how the body processes and benefits from the active compounds in the natural ingredients that are part of their cultural practices. This approach not only aids in understanding theoretical concepts but also illustrates the practical application of biology in everyday life, rooted in local culture. As a result, the Munyirih tradition offers significant potential as an engaging and relevant teaching tool in biology, especially in bridging scientific knowledge with cultural practices (Putri & Darussyamsu, 2021).

Students can gain a deeper understanding of how the compounds in natural ingredients used in Munyirih, such as the antibacterial compounds in betel leaves and the stimulating substances in areca nuts, contribute to the health of their mouth and body. This approach makes biology lessons more contextual, linking scientific knowledge to students' daily lives while fostering greater appreciation for local culture (Yuslih & Yulien, 2021). Furthermore, the Munyirih tradition offers valuable insights into the use of active compounds in traditional medicine, which is relevant to the study of plant secondary metabolites and plant physiology. This provides an opportunity for students to explore the interaction between traditional knowledge and modern biological science, as well as its practical applications in everyday life (Listantia et al., 2023).

The Merdeka Curriculum embraces the principle of contextualized learning by strengthening the Pancasila Student Profile, particularly in the elements of: Critical Thinking, Scientific Reasoning, Cooperation, Global Diversity, Independence, and Creativity. Biology learning that incorporates the Munyirih tradition as an ethnoscience practice supports this achievement by bridging scientific knowledge with local culture. Below is a table outlining the relevance of the Munyirih tradition in the Merdeka Curriculum.

Table 1. Middle School Level (Phase D – Grades VII – IX)

Biology Element	Learning Achievement (LA) Phase D	Context of Munyirih Tradition	Learning Objectives (LO) to be Developed	Values to be Transferred to Students
Structure and Function of Living Organisms	Analyze the structure and function of human and plant organs and their relation to health	Betel leaf, areca nut, and gambir: morphology, tissue, and their health benefits	Students can explain the structure of the betel leaf and link it to its function in maintaining oral hygiene	Care for personal health and natural body care. Appreciate local wisdom in maintaining health.
Human Digestive System	Understand the digestive system and its relation to a healthy lifestyle	The role of teeth in the act of chewing betel, active natural compounds that maintain oral cavity health	Students can explain the importance of teeth as a mechanical digestive tool and their connection to the Munyirih tradition	Personal responsibility in maintaining body health and diligence in maintaining personal hygiene.
Substances and Their Changes	Explain the properties of substances and their use in daily life	Betel lime ($\text{Ca}(\text{OH})_2$) and the reaction of alkalinity in the oral cavity during Munyirih	Students can identify the natural chemical compounds in the Munyirih tradition	Awareness of natural chemistry in daily life and critical thinking about the natural substances used in culture.
Environmental Balance and Biodiversity	Describe the role of living organisms in maintaining ecosystem balance	Conservation of betel and areca nut plants as sources of traditional health	Students can explain the importance of conserving local plants as part of biodiversity	Care for the environment and sustainability of natural resources through biodiversity conservation.

(Gulo, 2024; Hamidah et al., 2022; Nurlita et al., 2024; Putra et al., 2024; Putri et al., 2023; Putri & Darussyamsu, 2021).

Table 2. Senior High School Level (Phase E – Grade X) and Phase F (Grade XI – XII)

Biology Element	Learning Achievement (LA) Phase E/F	Relevance of Munyirih Tradition	Learning Objectives (LO) to be Developed	Values to be Transferred to Students
Structure and Function of Plants	Analyze plant tissue structure and physiological functions	Betel leaf: epidermis, collenchyma, and secondary metabolite content	Students can analyze plant tissues relevant to the Munyirih practice	Care for personal health and natural body care. Appreciate local wisdom in maintaining health.
Regulation and Response Systems	Analyze human regulatory systems and their relationship to homeostasis	Nicotine content in tobacco as an addictive substance and its effect on the nervous system	Students can explain the impact of natural addictive compounds on the human body	Personal responsibility in maintaining body health and diligence in maintaining personal hygiene.
Biotechnology	Explain the application of biotechnology in various fields	Utilization of natural plant compounds for health and herbal industries	Students can identify the biotechnological potential of local plants in the Munyirih practice	Awareness of natural chemistry in daily life and critical thinking about the natural substances used in culture.
Biodiversity and Conservation	Analyze biodiversity and the conservation of biological resources	Local plants in the Munyirih tradition as part of culture-based conservation	Students can conclude the importance of ethnobotany for cultural and environmental preservation	Care for the environment and sustainability of natural resources through biodiversity conservation.
Metabolism	Analyze pathways and products of secondary metabolism	Flavonoids, tannins, alkaloids as secondary metabolites	Students can explain the role of secondary metabolites in plant defense and human health	Regulation and understanding of biological processes through the application of scientific knowledge.

(Böhlen & Sujarwo, 2020; Gulo, 2024; Hamidah et al., 2022; Putra et al., 2024; Putri & Darussyamsu, 2021; Sumarni et al., 2022)

Based on table 1 and table 2, it can be concluded that ethnoscience learning that integrates the Munyirih tradition has great potential to improve the effectiveness of biology learning. This approach offers several advantages that can enrich students' learning experience. First, learning becomes more contextual and relevant because it connects biological concepts with the cultural context and daily experiences of students, which can increase their motivation and involvement in the learning process

(Sumarni et al., 2022). Second, by learning biology through concrete and familiar traditional practices, students can build a deeper and longer-lasting understanding of concepts. The Munyirih tradition provides concrete examples of abstract concepts, making it easier for students to understand (Nilamsari, 2021). Third, ethnoscience learning encourages the development of important 21st century skills such as critical thinking, problem solving, collaboration and communication, as students are invited to analyze, interpret and apply scientific knowledge in their cultural context (Sukomardojo, 2023; Yuslih & Yulien, 2021). Fourth, the integration of Munyirih traditions in learning helps students appreciate and preserve their local wisdom and cultural identity, which is relevant to the goals of inclusive and value-based education (Putri et al., 2023). Fifth, ethnoscience learning helps students develop contextualized science literacy, enabling them to see the relevance of science in everyday life and improving their ability to make decisions based on scientific evidence (Putri & Darussyamsu, 2021). Thus, Munyirih tradition-based ethnoscience learning is not only effective in conveying biological knowledge, but also in shaping students who have a strong cultural understanding and relevant 21st century skills.

Conclusion

Ethnoscience-based biology learning that integrates the Munyirih tradition has great potential in improving learning effectiveness. This approach connects scientific knowledge with local wisdom, allowing students to more easily understand biology concepts in a contextualized and applicable way. The Munyirih tradition, which involves natural materials such as betel leaves, areca nut, lime and gambier, not only has cultural value, but also underlies scientific concepts related to plant physiology, bioactive compounds and their impact on human health. By using these traditions in learning, students not only enrich their biological knowledge, but also develop 21st century skills such as critical thinking, problem solving and collaboration. This ethnoscience integration strengthens students' appreciation of their local culture and enhances more contextualized science literacy. Therefore, the application of the Munyirih tradition in biology learning has the potential to be an effective tool in creating a more inclusive, relevant and culturally value-based education.

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