



Integrating Potential and Local Wisdom: Exploring the Ethnopedagogical Value of the Toraja Tribe in Biology Education

Sunarto Arif Sura¹, Siti Sriyati^{1*}, Widi Purwianingsih¹, Angela Merici Lembang²

¹Faculty of Mathematics and Natural Sciences Education, Universitas Pendidikan Indonesia, Indonesia

²School for Environment and Sustainability, University of Michigan-Ann Arbor, United States of America

*Correspondence to: sriyati@upi.edu

Abstract: The Merdeka Curriculum is designed to provide flexibility and autonomy for schools in Indonesia to create learning experiences that align with local contexts and the individual needs of students. Education plays a vital role in integrating local potential and wisdom to achieve relevance at both the local and individual levels. Indonesia's rich cultural heritage offers numerous opportunities for integration into learning; however, many of these potentials remain underexplored and underutilized in scientific educational contexts. This study aims to identify and examine the potential and local wisdom of the Toraja people relevant to biological concepts and to develop an ethnopedagogical framework as a foundation for contextualized learning materials for senior high school students in Phases E and F. Employing a systematic literature review guided by the PRISMA model, the research screens, selects, and analyzes sources addressing the scientific relevance of the Toraja community's local potential and wisdom on topics such as biodiversity, genetics, anatomy, and more. Findings reveal that the local potential and indigenous knowledge embedded in Toraja wisdom can be adapted into scientific concepts that support the achievement of biology learning outcomes at the senior high school level in Phases E and F. This study contributes to the advancement of ethnopedagogy as an innovative educational approach that aligns teaching practices with local cultural values. Moreover, it provides a framework that can guide the development of learning content, modules, student worksheets, projects, quizzes, and assessment tools to foster meaningful and contextualized learning experiences.

Keywords: ethnopedagogy; local potential; local wisdom; toraja tribe

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INTRODUCTION

The government explicitly demands that every educational institution incorporate local elements into its curriculum, reflecting the uniqueness and potential of the region, and integrate these elements within specific teaching materials or subjects. Law Number 20 of 2003 concerning the National Education System mandates that the education curriculum in Indonesia must be developed based on the principle of diversification. This means that the curriculum at each level and type of education must be tailored to the characteristics of the educational unit, regional potential, and the students' capabilities. To achieve this, the learning process needs to incorporate activities that connect students with their daily lives. In line with this, the Directorate General of Basic and Secondary Education of the Ministry of Education and Culture suggests that schools and their surrounding environments be organized and managed as adequate learning resources (Prihanta et al., 2025; Wilujeng et al., 2020).

Through the Merdeka Curriculum, the government provides educational institutions with the freedom to incorporate local elements in three alternatives: 1) making local content a separate subject; 2) integrating local elements into all subjects; and 3) through projects that support the strengthening of the student profile based on Pancasila values (Carolina et al., 2024; Lidi et al., 2023). The main characteristic of the Merdeka Curriculum is the development of interpersonal skills and character building, aligned with the Pancasila Student Profile. Safitri et al. (2023) state that the aspects of the Pancasila Student Profile consist of six competencies: "Faith, Fear of God Almighty and noble morals, Global Diversity, Mutual Cooperation, Critical Thinking, Independence, and Creativity."

Local potential refers to unique resources specific to a particular area, including natural resources, human resources, geographical features, culture, and history. Natural resources encompass land, water, and air resources that are essential for human life and development. Indonesia, as the largest archipelagic country with thousands of islands, possesses uniqueness in its geographical and socio-cultural diversity, resource potential, and infrastructure that can be explored in every region. By integrating local potential, it is hoped that students can gain knowledge to care for, protect, and improve the quality of their environment (Setiadi, 2019; Wilujeng et al., 2020). Local wisdom, which encompasses living habits and beliefs, serves as a medium for instilling values in every individual within society. This suggests that one form of character in Indonesian society is rooted in

local wisdom, and therefore, it is expected that local wisdom can be incorporated into the education curriculum. Education that contains local wisdom will teach students to remain connected to the concrete situations they face (Hartanti et al., 2024; Syahfitri, 2024).

Incorporating local wisdom values into the curriculum is crucial. Through education, we can utilize an efficient tool to understand and disseminate knowledge about diverse cultures. The education sector plays a key role in instilling vital life values (Annisha, 2024; Yusriya, 2021; Mufihin, 2020). Unique and distinctive values within local or regional cultures need to be preserved and continuously passed on to the younger generation as part of their knowledge and as a source of learning (Ramdani et al., 2021; Verawati et al., 2019). Local wisdom is a collection of knowledge, values, traditions, and practices closely related to local culture and environment. By studying this wisdom, students can gain a broader understanding of the culture, history, and identity of their region (Fadhilah & Rahmawati, 2020).

Integrating local materials into all subjects can be implemented by combining them into the learning process using an ethnopedagogical approach (Lidi et al., 2023). According to Sari et al. (2021), ethnopedagogy is the understanding that local knowledge or wisdom serves as a source of innovation and skills that can be utilized to enhance community welfare. In agreement with this statement, Lidi et al. (2023) assert that ethnopedagogy is a learning method that uses culture and the environment as the foundation of education, emphasizing local wisdom values and involving the development of those values to achieve educational goals. Each educational unit can offer learning that aligns with students' interests and talents, as well as local potential, cultural environment, economic conditions, and regional needs, with independently developed competency standards and basic competencies, making the learning process more meaningful. Teachers can develop materials based on local wisdom to create engaging learning activities, which are expected to foster student character traits such as cooperation, tolerance, and caring attitudes (Haka et al., 2020).

Biology as a subject can apply ethnopedagogical methods in its learning process. This field of study examines life, the environment, and the interactions between them. Biology is not only concerned with scientific facts about real natural phenomena but also relates to abstract concepts. The approach to studying biology involves exploring nature in a structured manner, so that learning focuses not only on memorizing facts, concepts, or principles but also on seeking new knowledge. Additionally, the biology learning process emphasizes practical experiences that enable students to develop skills and understand their natural environment through scientific methods (Subrata & Rai, 2022). The biology learning process, viewed through an ethnopedagogical perspective, can bring teachers and students closer to the actual conditions they experience, aligning with the local wisdom present in their surrounding communities (Kurniawan & Toharudin, 2017; Sandoval-Rivera, 2020).

The local potential and wisdom of the Toraja people can be integrated into biology education in schools. The Toraja ethnic group, located in South Sulawesi, possesses a rich cultural heritage. The Toraja community has held beliefs that are thousands of years old, and their rituals are internationally recognized (Tamin et al., 2021). The Toraja people have a vibrant and unique culture, which has made them famous on the global stage. This culture, passed down through generations, has become a distinctive characteristic of the Toraja community as they continue to uphold their local wisdom to this day (Pora et al., 2023). Based on a preliminary study through interviews with several high school biology teachers in Toraja, it was found that teachers have not yet utilized the potential and local wisdom of the Toraja ethnic group in their teaching practices. This is primarily due to a lack of knowledge regarding subject matter that can be linked to local culture and potential, as well as a limited understanding of how to integrate such elements into the learning process effectively. Teachers acknowledge the importance of incorporating local context into education, particularly in Toraja, where cultural traditions remain strong and the region is recognized internationally as a tourist destination. This aligns with Palumpun et al. (2022), who emphasized that Toraja is renowned for its rich cultural heritage and natural beauty. However, learning materials and approaches that integrate Toraja's local potential remain scarce. Furthermore, Sriyati et al. (2021) noted that the potential and local wisdom of various ethnic groups across Indonesia have not been optimally integrated into school curricula as learning resources. In fact, science learning can become more accessible and meaningful to students when teachers incorporate the cultural elements present in their immediate environment (Khusniati, 2017; Nisa et al., 2015; Ramdani et al., 2021).

Based on the explanation, it is therefore crucial to conduct further studies on the potential and local wisdom of the Toraja ethnic group to provide a comprehensive understanding of their indigenous knowledge and local potential. Such insights can be adapted into scientific concepts that support the achievement of biology learning outcomes at the senior high school level, specifically in Phases E and F. Consequently, this study is expected to contribute to the development of ethnopedagogy as an innovative educational approach that harmonizes educational practices with local cultural values. It aims to present a framework that serves as a guide for developing learning content, modules, student worksheets, projects, quizzes, and assessment tools that promote meaningful and contextual learning experiences.

METHODS

This study employs the Systematic Literature Review (SLR) method. SLR is defined as a specialized research methodology aimed at collecting and evaluating existing studies related to a specific theme that serves as the central focus of the research (Triandini et al., 2019). The literature collection process in this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This method is widely recognized as a reliable tool for conducting literature reviews across various fields of research, including studies in ethnopedagogy. The primary objective of using this method is to ensure that the selection and analysis of literature are conducted transparently and systematically, thereby enhancing the validity and replicability of the study. The article selection process, based on the PRISMA guidelines, consists of four steps: identification, screening, eligibility assessment, and inclusion (Arianti & Atifah, 2023), as illustrated in Figure 1.

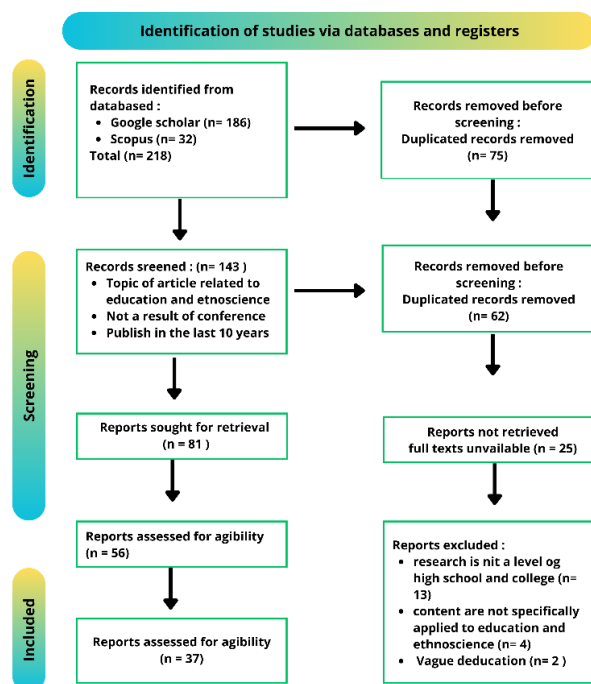


Figure 1. PRISMA Flowchart Process of Source Searching

In the identification phase, the researchers searched for articles relevant to the study subject, focusing on local wisdom related to the ritual practices of the Toraja ethnic group. Data sources were gathered by exploring various databases, books, and digital repositories. Journal articles were retrieved from libraries, including both national and international publications, using search tools such as Google Scholar and Publish or Perish, covering the period from 2016 to 2024. The next phase is screening, where the researchers performed an initial filter by analyzing article titles and abstracts, searching for phrases such as *"local potential," "local wisdom," "ethnopedagogy," "Toraja ethnic group,"* and *"biology education."* This search yielded 218 articles, of which only 81 were deemed most relevant to the topic and selected for further consideration. In the third phase, the researchers applied additional filters based on publication within the last eight years, peer-reviewed articles, and officially published papers. This resulted in 37 articles that were deemed suitable for in-depth analysis. The data derived from these 37 selected articles were analyzed using content analysis. This method was employed to identify key themes relevant to the potential and local wisdom of the Toraja ethnic group in the context of ethnopedagogy. The selected articles were thoroughly reviewed to extract information related to the phenomena of local potential and wisdom, the cultural values they embody, and their relevance to biology education. Thematic analysis categorized the data into several topics, including biodiversity, genetics, digestive systems, respiratory systems, locomotion systems, Animalia, bacteria, and growth and development, which correspond to curriculum topics for Phases E and F of the Merdeka Curriculum. The goal of this analysis was to generate findings that support the integration of local potential and wisdom into modern science education.

Participants in this systematic review are defined as data sources, including scholarly journal articles, books, and digital repositories, all of which are relevant to the research topic. The inclusion criteria applied were: (1) articles published within the last ten years (2016–2024), (2) articles containing terms such as *local potential, local wisdom, ethnopedagogy, Toraja ethnic group, biology education,* and (3) peer-reviewed articles that have been officially published. Conversely, articles published more than ten years ago, those irrelevant to the keywords, or unpublished articles were excluded from the analysis. Of the 218 articles identified in the initial search, 37 articles met the criteria and were selected for further analysis. The primary instruments used in this

study were the Publish or Perish application and the Google Scholar database. *Publish or Perish* was used to obtain bibliographic data from articles indexed in Scopus and Sinta, while *Google Scholar* provided access to additional relevant scientific literature. Keywords such as *local potential*, *local wisdom*, *ethnopedagogy*, *Toraja ethnic group*, and *biology education* were employed in the search to ensure comprehensive coverage. These tools were chosen for their ability to provide broad and relevant data aligned with the research focus.

RESULT AND DISCUSSION

In 2020, the Indonesian Minister of Education and Culture introduced a new education curriculum known as the Merdeka Curriculum. Its practicality and depth of content distinguish this curriculum. In the Merdeka Curriculum, a project-based learning approach is adopted to provide students with opportunities to actively explore and understand current issues, including sanitation, economics, and the environment. This is designed to develop students' critical thinking skills, social awareness, and their ability to solve complex problems, as part of character development and competencies aligned with the Pancasila Student Profile (Priantini et al., 2022).

Integrating local wisdom into the learning curriculum is a key step in developing education and preserving culture, as it helps revitalize knowledge and traditions rooted in local communities. The necessary local wisdom comprises traditional knowledge relevant to the principles of scientific education, which can be integrated into the learning process. Local wisdom is a concept that continues to exist and evolve within the awareness of community members, playing a crucial role in nurturing and managing the social life of the community (Sudarmin, 2014). Furthermore, Tomi et al. (2018) add that local wisdom is a truth that has become a tradition in a particular area. Utilizing local wisdom as a learning material is an innovation that can strengthen the cultural identity of the community.

Education can incorporate the values of local wisdom as a way to preserve and nurture the culture present in a region (Wafiqni & Nurani, 2018). Local wisdom can serve as an effective tool in education, particularly in Biology, to convey the values embedded in biological concepts reflected in that wisdom. This is also related to the implementation of the Pancasila Student Profile, which can be realized through cultural initiatives in schools, encompassing both curricular and extracurricular activities, aimed at fostering students' character in daily life (Lubaba & Alfiansyah, 2022). Through lessons that highlight local wisdom, students' character values can be strengthened in accordance with Indonesian cultural values, which align with the principles of Pancasila (Santika & Eka, 2022). In this process, place-based biology becomes a tool for nurturing students' character in line with the formation of the Pancasila Student Profile under the Merdeka Curriculum.

Adopting an approach based on local wisdom and culture is crucial given the many traditional values and cultural aspects of society that are beginning to fade. The diversity of ethnic groups and cultures in Indonesia often faces obstacles due to immature attitudes in addressing social issues, which ultimately erodes the noble values of the nation. At the same time, the influence of foreign cultures, which some people perceive as superior, has the potential to create divisions and conflicts within society. According to Sularso (2016), local wisdom and uniqueness are often overwhelmed by lifestyles shaped by pragmatic and capitalist values. Reevaluating and understanding local wisdom and culture will encourage students to reconnect with their roots. Knowledge of the wisdom and culture of their upbringing will foster a sense of appreciation and love for their region and culture.

The culture of a region, including Toraja, is reflected in various traditional ceremonies, polite behaviors, caste structures, and the norms and etiquette practiced by the local community. Toraja is an area in South Sulawesi that is rich in natural diversity, as well as deeply rooted cultural traditions, which are evident in the traditional activities of its people. The natural wealth and cultural heritage of Toraja are sources of pride for its inhabitants. This heritage, which has existed for centuries, is reflected in the way the people of Tana Toraja uphold familial values and cross-group cooperation without allowing differences to become barriers to their solidarity (Winowatan & Anneke, 2023).

Researchers assess the need for detailed studies on the potential and local wisdom, and their application in education, amid concerns about the diminishing values of local wisdom and culture within the community. For example, the traditional rituals of the Toraja people are beginning to be forgotten by the younger generation, especially among youth. The most well-known traditional rituals of the Toraja, even reaching international recognition, are the rambu tuka' mangrara banua and rambu solo', where each stage of these rituals contains a wealth of local values that are preserved. The rambu tuka' ritual is an expression of gratitude for the completion of building a traditional tongkonan house, while the rambu solo' ceremony is a traditional funeral ritual. In addition to these rituals, several local potentials can be implemented into learning. The stages of traditional rituals as forms of local wisdom, along with various local potentials, can be implemented in biology learning, as shown in Table 1.

Table 1. Ethnoscience Study of Potential and Local Wisdom of the Toraja Tribe

1. Rambu Tuka' (Thanksgiving for the Traditional House)/ Mangrara Banua		
Phenomena	Original Science	Scientific Science
<i>Ma' Tarampak</i> (Installation of the Roof of the Traditional Tongkonan House - Lower Part)	Plants hold a distinct meaning in ritual practices and are believed to ward off supernatural beings or spirits that may disrupt the course of traditional ceremonies.	There are 23 types of plants used in the <i>mangrara banua</i> traditional ritual (Tandirerung et al., 2023). Some plants are symbolized as representations of nobility, protection, warding off misfortune, joy, safety, blessings, unity among different social groups, and the completeness of the ritual (Sampe et al., 2022).
	Bamboo serves as a measure and the focal point of activities during the Rambu Solo' and Rambu Tuka' traditional ceremonies, as bamboo is regarded as a source of life.	Bamboo has been utilized in various ways, including as a building material, for crafting, as a musical instrument, and in numerous industrial sectors. Bamboo possesses characteristics similar to both wood and non-wood materials. The young shoots of bamboo, also known as rebung, can be processed into food, including chips, and used as an ingredient in various vegetable dishes (Jannah et al., 2019).
	Dozens of pigs prepared by the family are slaughtered as part of the ritual. The meat is then cut into cube-shaped pieces with varying thicknesses. The thickest parts are typically found in the muscle tissue, with a thickness ranging from 2 to 4 cm. The meat is then cooked inside bamboo tubes (known locally as <i>piong</i> or <i>lemang</i>). The blackening of the bamboo indicates that the meat is fully cooked.	Pork is a source of various essential nutrients, containing fats such as oleic acid, which is an unsaturated fat (Maiyena & Mawarnis, 2022). Samples of raw pork may be contaminated with cysts of the <i>Taenia solium</i> tapeworm (Tangkeallo, 2021). If the thickness of the meat slices is 3 cm, it is recommended to extend the cooking time to ensure thorough cooking. This is in line with Jang et al. (2019), who state that microbial safety and the nutritional benefits of moderately cooked pork with a thickness of 1.5 to 2.0 cm are optimal.
<i>Massomba Tedong</i> (Prayer of Worship and Praise to the Buffalo)	The buffalo to be sacrificed must have eight marks resembling white spots on its body.	The swamp buffalo has predominantly black skin with white spots on its forehead, face, and tail (Aprinaldi et al., 2018). According to Alikhani et al. (2018), river buffaloes possess 50 chromosomes and are often black in color, occasionally exhibiting white patches on their bodies.
<i>Ma' Bubung</i> (Series of Thanksgiving Worship with the Extended Family)	Planting sandalwood trees is regarded as a sacred act, as its sap is believed to resemble human blood.	Sandalwood (<i>Santalum albus</i>) contains tannin compounds, which give its sap a red color. It also possesses potent antioxidant properties and plays a role in the plant's defense mechanisms against pests and diseases. The sap obtained from sandalwood trees is often used as a component in perfume production, while the bark is utilized as a source of tannin or dye (Pangestika, 2021).
	Sandalwood trees that shed their leaves are believed to symbolize a family group that is willing to give or share its blessings with others.	Leaf abscission is a physiological process regulated by hormones, including ethylene and abscisic acid. This abscission process is closely related to the interaction of the hormone indole-3-acetic acid in the cells of the abscission zone (Asra et al., 2020).
2. Rambu Solo' (Funeral Ceremony)/ Ma' tomate		
Phenomena	Original Science	Scientific Science
<i>Ma' Pasa' Tedong</i> (Gathering Buffalo for Sacrifice in	Collecting buffalo with distinctive patterns and horn shapes according to the level of the <i>Rambu Solo'</i> ceremony being held. The patterns and horn shapes serve as a	Distinct patterns, eye color, horn shape, and horn color are caused by genetic diversity. A specific genotype may exhibit different phenotypes, and a particular phenotype may be associated with different genotypes (de Vienne, 2022). According

the Traditional Ceremony)	benchmark in determining the price of the buffalo.	to Cichorek (2013), white color indicates a disruption in the development and movement of melanocytes, which are the cells responsible for producing the pigment melanin.
<i>Ma' Pasilaga Tedong</i> (Buffalo Fighting)	The care of fighting buffalo is not done haphazardly. Buffalo prepared for fights become stronger if they are fed not only grass but also milk and eggs several times a day. Additionally, the buffalo are often trained to run to build muscle strength.	Fighting buffalo have a strong physique due to their dense and powerful muscles, particularly in the neck and shoulder areas (Syarif & Maddatuang, 2021). The high protein content plays a role as a substrate for protein synthesis, which can influence body structure and contribute to an increase in body mass index (Harna et al., 2017).
<i>Mantunu Tedong</i> (Slaughtering of Sacrificial Buffalo)	A buffalo can be immediately killed by slashing its neck with a sharp machete, performed by a professional.	According to Dewi (2021), traditional slaughter is a technique of animal cutting performed directly using a sharp knife. The most effective method of slaughter is to separate the esophagus, throat, and blood vessels simultaneously in a single, quick incision (Damayanti, 2016).
	The large spillage of blood at the ceremonial site produces an unpleasant odor, which is then sprinkled with lime and salt, based on the belief that it will prevent the <i>poppo'</i> or <i>kuyang</i> from coming and sucking the blood.	The unpleasant odor from the blood is caused by a chemical reaction between the proteins in the blood and the bacteria present in the surrounding environment (Rorong & Wilar, 2020).
<i>Ma' Badong</i> (Singing Lamentations in Death)	This ritual is performed exclusively by men because only men's voices are considered suitable for the <i>kadong-kadong badong</i> (the lyrics sung during the ritual).	The difference in vocal anatomical size between men and women contributes to the variation in their voices (Karenina et al., 2023).
<i>Ma' Kaburu'</i> (Burial of the Deceased)	During the procession of carrying the coffin, the men push each other and shout to provide strength to the bearers.	Shouting increases hand grip strength during sustained maximal effort by reducing periods of silence (Takarada & Nozaki, 2021). In line with this, Chen et al. (2016) state that shouting enhances maximal muscle strength and significantly affects the intensity of the cardiorespiratory response.

3. The Philosophy of Tallu Lolona

Original Science

The Toraja people live by practicing the philosophy of "Tallu Lolona." Tallu Lolona encompasses three meanings of life: the life of humans, the life of animals, and the life of plants in the environment.

Scientific Science

Tallu Lolona serves to preserve Torajan customs and traditions, foster community solidarity, and cultivate respect for nature and the environment. Tallu Lolona emphasizes the importance of equality and harmony between humans, the universe, and all living beings (Sumiaty et al., 2023).

4. Planting Hangjuang *Cordyline fruticosa* and Puring *Codiaeum variegatum* Trees

Original Science

It is obligatory to plant Hangjuang (*Cordyline fruticosa*) and Puring (*Codiaeum variegatum*) in the yard or courtyard of Torajan traditional houses (Tongkonan), as they are believed to ward off evil spirits or supernatural beings that may disturb the lives of the Torajan community.

Scientific Science

These plants are also frequently used in the traditional ceremony of Mangrara Banua (Sampe et al., 2022).

5. Toraja Woven Cloth

Original Science

Toraja woven cloth is used in traditional activities or ceremonies.

Scientific Science

The potential of the original woven cloth of the Toraja tribe in the Sa'dan area, made from natural

	materials and natural dyes (Nisa, 2023; Sosang, 2017).
6. Medicinal Plants of the Toraja Tribe	
Original Science	Scientific Science
The Toraja tribe utilizes a variety of medicinal plants in their healing practices.	The local community of the Toraja tribe utilizes various medicinal plants (Layukan et al., 2016).
7. Tourism	
Original Science	Scientific Science
Toraja as a Tourist Destination	The tourism potential in Toraja serves as an attraction for both domestic and international tourists, classified into four types: nature tourism, historical tourism, arts and cultural tourism, and agro-tourism (Rambulangi & Batara, 2021).

The phenomena discussed in the potential and local wisdom of the Toraja ethnic group encompass an explanation of several local potentials and indigenous knowledge passed down by the local community, supported by scientific knowledge within the context of biology. These local potentials reflect a profound understanding of biodiversity, particularly in terms of its utilization and conservation. Local wisdom embodies knowledge related to biodiversity, genetics, digestive, respiratory, and locomotor systems, as well as animalia and bacteria. The local potential and wisdom found within the Toraja community significantly contribute to educational practices, particularly in the teaching of biology. According to Usmeldi and Amini (2020), science education integrated with local wisdom can stimulate students to actively participate in learning and enhance their character, thereby encouraging them to improve their capabilities. Locally grounded learning can help preserve indigenous knowledge, enable students to connect biology lessons with real-life contexts, strengthen their relationship with the surrounding community, and bridge indigenous knowledge with modern science (Ramdiah et al., 2020). Local wisdom takes many forms and is passed down through generations. This knowledge serves as a vital foundation in the daily lives of the community (Rahmadani et al., 2024).

In line with its contributions to biology education, the local potential and wisdom of the Toraja ethnic group also possess strong relevance for integration into biology subjects at the secondary education level. Discussions on the local potential and wisdom of the Toraja people can be incorporated into various topics within biology education. According to Adinugraha and Ratnapuri (2020), biology is highly compatible with the integration of local content, particularly local wisdom and culture, as high school biology covers topics such as biodiversity (from bacteria to plants), human body systems, diseases and their prevention, biotechnology, evolution, classification of organisms, and genetics. Long before the establishment of formal education, the ancestors of the Indonesian people had already applied biological knowledge, primarily for medicinal purposes. Moreover, various forms of local wisdom and cultural practices have continued to preserve nature by establishing rules and traditions regarding environmental conservation, including attitudes and behaviors in human-environment interactions (Siswadi et al., 2012). The implementation of studies on the local potential and wisdom of the Toraja people within the *Merdeka Belajar* (Freedom to Learn) curriculum provides a strong foundation for achieving holistic biology education and for developing the integrated profile of Pancasila students. A curriculum is considered successful when it embodies cultural values that can enhance students' potential, enabling them to develop character that reflects both local and universal cultural values (Barab & Luehmann, 2003; Rahmadani et al., 2024). In biology education, the integration of Toraja local potential and wisdom into the *Merdeka Belajar* framework can be effectively applied at phases E and F. The analysis of biology learning outcomes and subject matter integrated with the phenomena of local potential and the wisdom of the Toraja people is presented in Table 2.

Table 2. Analysis of Learning Outcomes and Biology Materials in the Potential and Local Wisdom of the Toraja Tribe

Learning Outcomes	Phenomena	Biology Material
In Phase E, learners can solve problems based on local, national, or global issues related to understanding the diversity of living things and their roles, viruses and their roles, biological technology innovation,	<i>Ma' Tarampak</i> (Installation of the Roof of the Traditional Tongkonan House - Lower Part)	Biodiversity, Animal
	<i>Massomba Tedong</i> (Prayer of Worship and Praise to the Buffalo)	Biodiversity
	<i>Ma' Bubung</i> (Series of Thanksgiving Worship with the Extended Family)	Biodiversity
	<i>Ma' Pasa' Tedong</i> (Gathering Buffalo for Sacrifice in the Traditional Ceremony)	Biodiversity

ecosystem components and interactions between components, and environmental change.	<i>Ma' Pasilaga Tedong</i> (Buffalo Fighting)	Biodiversity
	<i>Mantunu Tedong</i> (Slaughtering of Sacrificial Buffalo)	Biodiversity, Bacteria
	The philosophy of " <i>Tallu Lolona</i> ."	Biodiversity
	It is obligatory to plant Hangjuang (<i>Cordyline fruticosa</i>) and Puring (<i>Codiaeum variegatum</i>) in the yard or courtyard of Torajan traditional houses.	Biodiversity
	Toraja woven cloth is used in traditional activities or ceremonies.	Biodiversity
	The Toraja tribe utilizes a variety of medicinal plants in their healing practices.	Biodiversity
	Toraja as a Tourist Destination	Biodiversity, Ecosystem
In Phase F, learners can describe the bioprocesses that occur in cells and analyze the relationship between the structure of organs in the organ system and their functions, as well as the abnormalities or disorders that arise within the organ system. Learners can apply the concepts of inheritance of traits, growth, and development in everyday life and evaluate new ideas about evolution.	<i>Ma' Tarampak</i> (Pemasangan Atap Rumah Adat Tongkoanan Bagian Bawah)	Nutrients
	<i>Massomba Tedong</i> (Doa Pemujaan dan Pujian kepada Kerbau)	Genetic
	<i>Ma' Bubung</i> (Rangkaian Ibadah Syukur bersama keluarga besar)	Growth and Development
	<i>Ma' Pasa' Tedong</i> (Mengumpulkan kerbau sebagai kurban dalam upacara adat)	Genetic
	<i>Ma' Pasilaga Tedong</i> (Adu Kerbau)	Musculoskeletal System, Nutrients
	<i>Mantunu Tedong</i> (Penyembelihan kurban kerbau)	Digestive System, Respiratory System, Circulatory System
	<i>Ma' Badong</i> (Singing Lamentations in Death)	Respiratory System
<i>Ma' Kaburu'</i> (Burial of the Deceased)	Respiratory System, Musculoskeletal System	

Based on Table 2, several aspects of local potential and wisdom can be integrated into biology teaching materials, such as biodiversity and its benefits in Phase E of the *Merdeka Curriculum*. According to Berkes (2018), local wisdom plays a crucial role in biodiversity conservation, often in ways that are more sustainable than modern approaches to conservation. Empirical evidence from recent studies shows that indigenous communities practicing local wisdom tend to maintain higher levels of biodiversity in their territories compared to areas managed through conventional means (Myers, 2017). This is primarily due to customary laws embedded within local wisdom, which often regulate resource exploitation and land use in ways that support ecological sustainability (Zent, 2019). Other topics, such as the digestive, locomotor, and respiratory systems, as well as growth, development, and genetics in Phase F of the same curriculum, can also incorporate activities rooted in local wisdom. Adapting the local potential and wisdom of the Toraja people into teaching and learning activities enables innovations that are responsive to classroom needs, making the learning process more contextual, relevant to students, and responsive to issues they face in their surrounding environment. According to Anzelina (2023), local wisdom-based learning is one strategy teachers can employ to present contextual learning experiences enriched with real-life applications, while simultaneously preserving the noble values of local wisdom that younger generations must recognize. Instructional approaches utilizing learning media grounded in local wisdom have been shown to enhance affective learning outcomes, particularly by fostering a love for local culture within students' immediate environment (Sriyati et al., 2022). Therefore, it is essential to integrate local wisdom and potential into teaching practices. The implementation of learning that draws upon local potential and wisdom has been positively received by students, as evidenced by their enthusiasm and active participation in the learning process (Sriyati et al., 2023).

Furthermore, local wisdom, including its embedded local potentials, is one of the phenomena that emerge from the surrounding community environment and can be utilized as a valuable source for biology learning. Forms of local wisdom with the potential to serve as biology learning resources include endemic plants and animals, local norms and values, traditional customs, traditional houses, traditional clothing, regional songs, local cuisine, and various other cultural expressions (Monica et al., 2021). Given this diversity, teachers, as facilitators in the learning process, are expected to possess fundamental competencies in designing and implementing learning activities that are dynamic, innovative, creative, interactive, and meaningful. According

to [Masihu and Augustyn \(2021\)](#), teachers can use teaching materials based on local wisdom as an essential resource to support the success of the learning process. To address the limitations of available learning materials, teachers are also required to develop instructional resources that align with the characteristics of their students and the specific context of their teaching environment. The availability of relevant and adequate teaching materials is expected to facilitate efficient and effective learning processes, ultimately improving student learning outcomes.

The integration of local wisdom into biology education not only enriches teaching materials but also cultivates students' environmental awareness and fosters initiatives in biological conservation, as well as the cultural values embedded within that wisdom. Conservation efforts can be internalized through biology learning in schools by utilizing local wisdom as a learning resource, ultimately contributing to the development of national character ([Mukti et al., 2022](#)). Furthermore, the effective incorporation of local wisdom in the classroom has the potential to enhance students' literacy skills. When properly managed, local knowledge can serve as a foundation for developing students' thinking skills through problem-based, collaborative learning. This approach encourages students to critically analyze local wisdom phenomena in order to find creative solutions, while also emphasizing collaboration and interpersonal skills among peers ([Monica et al., 2021](#)). Learning activities designed around group discussions based on local issues can stimulate students to formulate questions or hypotheses, collect data, and propose solutions to the problems being addressed. These processes are highly relevant to fostering students' analytical and critical thinking skills, which are essential for developing creativity. This aligns with [Khaeruddin and Bancong \(2022\)](#), who assert that critical thinking skills can be cultivated in the classroom through instructional strategies that require students to critically analyze problems, evaluate possible solutions, and process information effectively to make rational decisions in problem-solving contexts.

In addition to the aspects, the local potential of a region can also serve as a medium for developing skills related to sustainability concepts, which are integral to the educational process. Education plays a pivotal role in shaping sustainability-oriented behavior and conveying environmental issues to students ([Lace-Jeruma & Birzina, 2019](#)). Sustainable education is recognized as a key component of educational tourism. This form of education not only emphasizes ecological sustainability but also addresses social dimensions. In line with this, Toraja, as a well-known tourism destination, holds great potential to become a platform for educational tourism aimed at fostering skills related to sustainable development. The tourism potential of Toraja, spanning natural landscapes, historical heritage, arts and culture, and agro-tourism, attracts both domestic and international visitors ([Rambulangi & Batara, 2021](#)). Educational tourism in such settings can emphasize environmental sustainability by raising awareness about the importance of local ecosystems and their conservation. Programs that integrate environmental education have been shown to improve both attitudes and behaviors related to conservation ([Ardoin et al., 2015](#); [Sukmana, 2022](#)). For example, activities such as tree planting and wildlife conservation not only educate tourists about local environmental issues but also engage them actively in conservation efforts ([Harun et al., 2018](#); [Unhasuta et al., 2021](#)). These types of activities help foster stronger community bonds and collective commitment toward sustainability-based practices ([Dewi et al., 2019](#); [Risfandini et al., 2023](#)).

Building upon this, the long-term benefits of educational tourism extend beyond economic gains to include social and environmental dimensions. These outcomes contribute to the overall well-being of local communities. By involving residents in tourism management, they receive a fair share of the benefits generated from tourism activities ([Vélez et al., 2023](#)). Such involvement enhances their sense of ownership and pride in their cultural heritage, both of which are key variables in sustainable development ([Ginanjar, 2023](#); [Risfandini et al., 2023](#)). Furthermore, educational tourism can generate employment opportunities and support local small enterprises ([Basri et al., 2023](#)). Collaboration between educational institutions and local communities plays a vital role in implementing educational tourism programs. Schools can partner with local organizations to develop initiatives that not only educate students about environmental issues but also encourage their active participation in local conservation efforts ([Dewi et al., 2019](#); [Ngo et al., 2022](#)). This synergy strengthens community relationships and enhances the effectiveness of educational tourism, ultimately contributing to a more sustainable tourism approach ([Risfandini et al., 2023](#); [Unhasuta et al., 2021](#)).

Various ethnopedagogical approaches that incorporate the local potential and wisdom of the Toraja ethnic group into biology education not only enrich the learning process but also play a vital role in introducing and preserving cultural heritage for younger generations. These local potentials and wisdoms can be integrated into teaching within the framework of the *Merdeka Curriculum* through ethnopedagogical approaches, which demonstrate how traditional values can serve as a source of innovation in the learning process. According to [Adinugraha and Ratnapuri \(2020\)](#), incorporating local wisdom and cultural values into biology education represents an approach that integrates local values through the lenses of ethnobiology and ethnopedagogy. Ethnobiology is the scientific study of local communities' knowledge of living organisms and their environments ([Iskandar, 2017](#)), while ethnopedagogy is the effort to actualize learning through the cultivation of local cultural values ([Oktavianti & Ratnasari, 2018](#)). This approach is crucial to ensure that students not only comprehend biological concepts theoretically but also relate them to their own social and cultural contexts.

CONCLUSION

Local potential and wisdom can be integrated into the teaching of the Merdeka Curriculum as part of an ethnopedagogical approach. This approach reflects how traditional values can serve as a source of innovation in the teaching and learning process. Studies have provided a clear overview of the local potential and indigenous knowledge embedded in the local wisdom of the Toraja ethnic group, enabling these to be adapted into scientific concepts that support the achievement of biology learning outcomes in senior high school (SMA) for Phases E and F. Thus, this study will contribute to the development of ethnopedagogy as an innovative approach in education, aligning educational practices with local cultural values, fostering meaningful and contextual learning experiences.

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