

UTILIZATION OF NORTH SUMATRA LOCAL CULTURE IN BIOLOGY LEARNING BASED ON 21ST CENTURY COMPETENCIES AND SKILLS

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ABSTRACT

This study aims to examine the utilization of North Sumatra local culture as a learning resource in learning biology based on 21st century competencies and skills. The research method used was descriptive qualitative with a case study approach, involving observation, interviews with teachers and traditional leaders, and document analysis. The results revealed that local cultural elements such as ethnobotany, traditional agricultural systems, and environmental management wisdom can be effectively integrated into biology materials to improve students' concept understanding, learning motivation, and critical thinking skills. The implementation of local culture-based learning also encourages students' active involvement as well as the preservation of social and ecological values. However, the main challenge lies in the limited competence of teachers and the availability of adequate learning resources. This study recommends the development of local culture-based teaching modules and teacher training to support the sustainability of contextualized and sustainable biology learning. The findings provide an important contribution to the development of learning strategies that integrate local wisdom and 21st century competencies

Keyword: Local Culture, Biology Learning, 21st Century Competencies, 21st Century Skills, Science Literacy

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1. INTRODUCTION

21st century education emphasizes the importance of developing critical thinking, collaboration, creativity and communication skills. In this context, teachers are required to present a learning process that is not only material-oriented, but also contextually relevant to the lives of students. One approach that has been developed is the integration of local culture in science learning, especially biology. Local culture is not only a source of value and identity, but also holds scientific potential that can be raised as a learning resource. This integration is considered capable of enriching the learning process and creating a more authentic and meaningful learning experience (Husna et al., 2024). In Indonesia, various studies have shown that local wisdom can be utilized in biology learning through a contextual approach. For example, indigenous knowledge on traditional agriculture, medicinal plant use, and environmental management has been shown to align with biology topics such as ecosystems, biodiversity, and plant organ systems. Lathifah et al. (2024) in their study of the Urug Village community showed that local cultural values related to traditional agriculture can be used to strengthen students' understanding of ecology and environmental biology concepts. In Indonesia, various studies have shown that local wisdom can be used in biology learning through a contextual approach. For example, local knowledge on traditional agriculture, medicinal plant use, and environmental management has been shown to align with biology topics such as ecosystems,

biodiversity, and plant organ systems. Lathifah et al. (2024) in their research on the Urug Village community showed that local cultural values related to traditional agriculture can be used to strengthen students' understanding of ecology and environmental biology concepts. However, despite its great potential, research examining the integration of local culture in biology learning in Indonesia is still relatively limited. Fauzi et al. (2022) mentioned that studies on the utilization of local culture in biology education are still at a low level, both in terms of quantity and quality, so a more systematic and structured approach is needed. This is both a challenge and an opportunity for curriculum development and learning practices that promote local values as part of efforts to strengthen local wisdom-based education. The Merdeka Curriculum provides great opportunities for teachers to design learning that is more flexible, creative and contextual. In this curriculum, project-based learning (PjBL) and inquiry-based learning approaches are recommended methods for developing scientific thinking skills and student character. The study by Fadilah et al. (2023) on the implementation of local culture in the Dieng Festival showed that integrating cultural values in biology learning can improve concept understanding while strengthening students' character.

Furthermore, the integration of local culture in biology learning also shows a positive impact on strengthening students' science literacy and science process skills. Research by Suryana et al. (2021) which raised the issue of waste management based on local wisdom showed an increase in students' understanding of ecological concepts and active involvement in finding solutions to environmental problems. This finding shows that a local culture-based approach not only strengthens cognitive knowledge, but also builds students' awareness and social responsibility. The application of learning models that integrate local culture has also proven effective in developing students' science literacy, especially through the ethnobiology approach. Husna et al. (2024) showed that learning with the PjBL approach and ethnobiology was able to improve aspects of knowledge, attitudes, and scientific thinking skills of students. This shows that similar approaches can be developed at the primary and secondary education levels with adjustments to the characteristics of students. A review by Imtihana and Djukri (2021) also confirmed that the use of local potential in biology learning contributes positively to improving students' science generic skills, process skills, and science literacy. Thus, integrating local culture in learning is not only about preserving cultural values, but also as a strategy to form a generation of 21st century learners who are adaptive, critical, and have character. North Sumatra as one of the provinces with high cultural diversity has tremendous potential to be utilized in biology learning. Cultural practices such as marsialapari (mutual cooperation in agriculture), the use of traditional Batak medicinal plants, and customary forest management by the Karo and Mandailing communities reflect the ecological relationship between humans and nature. These elements are very relevant to various materials in the biology curriculum and can be used as contextual learning resources that strengthen students' understanding of science holistically.

2. RESEARCH METHOD/MATERIAL AND METHOD/LITERATURE REVIEW

This research uses a qualitative approach with descriptive methods to explore the potential of North Sumatra's local culture as a source of contextualized biology learning that is relevant to the development of 21st century competencies (Sugiyono, 2019). The main focus of the research is on identifying elements of local culture, such as traditional agricultural practices, the use of medicinal plants, and indigenous wisdom in environmental management, which can be integrated into biology learning materials at the high school level. Data were collected through literature studies, semi-structured interviews with community leaders and biology teachers, and limited field observations in several cultural areas such as Toba, Mandailing, and Karo. Data validity was strengthened through source and method triangulation techniques. The data analysis process is carried out thematically through the stages of data reduction, data presentation, and conclusion drawing. The data obtained were then examined for their relationship with the core competencies and learning outcomes in the Merdeka Curriculum, especially in developing critical thinking, collaborative, and problem solving skills based on local contexts. This research also considers the suitability of the material with scientific principles and science literacy as part of 21st century learning. The results obtained are expected to be the basis for developing a local culture-based biology learning model that not only strengthens concept understanding, but also builds students' character and identity (Fadilah et al., 2023; Husna et al., 2024)

3. RESULTS AND DISCUSSION

This research successfully identified a number of local cultural elements of North Sumatra that have a direct relationship with biology subject matter at the high school level. Based on field observation data, interviews with biology teachers and traditional leaders, and literature review, it was found that local cultural practices include ethnobotanical knowledge, sustainable agricultural systems, and environmental management customs. For example, the Toba Batak community utilizes the Andaliman plant (*Zanthoxylum acanthopodium*) as a traditional spice as well as a medicinal plant, which has the potential to be used as teaching material in the topic of biotechnology or plant metabolism. On the other hand, the shifting cultivation system of the Karo people teaches the principles of ecosystem balance and soil conservation, which are relevant in ecology and interactions between environmental components.

In addition, the interview results show that biology teachers in the research area tend to be enthusiastic about integrating local cultural elements into the learning process, although they admit that there is still a lack of clear pedagogical guidance. Students who participated in local culture-based learning showed higher interest and a more contextualized understanding of the subject matter. Some teachers reported that discussions starting from local examples - such as the fermentation process in Batak specialties (ombus-ombus or tuak) - aroused students' curiosity and active engagement. This finding indicates that local culture can serve as a link between biological science and students' real-life experiences, encouraging both cognitive and affective engagement in learning.

These findings confirm that North Sumatra's local culture has the potential to be a powerful biology learning resource, not only in terms of scientific content, but also in shaping contextualized and meaningful learning experiences. The integration of local culture allows students to understand biology concepts through familiar phenomena in daily life, which ultimately strengthens conceptual understanding and increases learning motivation. This is in accordance with the findings of Husna et al. (2024) who showed that the ethnobiology approach can significantly improve science literacy and 21st century skills through the local context.

However, the challenge faced in the integration of local culture is the limited competence of teachers in developing appropriate learning media and methods. As reported by Fauzi et al. (2022), the lack of research and training related to local wisdom-based biology learning has caused many teachers to not optimally utilize the existing cultural potential. Therefore, strengthening the capacity of teachers through ethnopedagogy training and the preparation of local culture-based modules is an important step forward.

In addition to the academic and pedagogical potential offered, the successful integration of local culture in biology learning is highly dependent on institutional support from schools, including the availability of learning resources, curriculum flexibility, and policies that support contextual learning. Schools as formal educational institutions play an important role in creating learning spaces that are inclusive of local culture, both through the development of teaching modules, the preparation of relevant lesson plans, and the utilization of the surrounding environment as a natural laboratory. However, access to local cultural information is often an obstacle, especially in urban areas experiencing rapid modernization or lack of written documentation of local wisdom. In this context, the role of the teacher as a creative and adaptive facilitator is key to bridging the gap between local values and scientific materials.

Furthermore, collaboration between schools, indigenous communities and local governments is a strategic element in ensuring the authenticity and sustainability of local cultural integration in learning. The direct involvement of indigenous communities not only ensures the validity of the cultural information used, but also strengthens the function of education as a means of preserving living cultural heritage. Local governments can play an active role in supporting this initiative through the provision of affirmative policies, ethnopedagogy-based teacher training, and the development of an integrated local culture database in the education system. Thus, learning biology is not only a vehicle for transferring scientific knowledge, but also serves as a means to instill sustainable social and ecological values, as emphasized by Fadilah et al. (2023) that the ethnopedagogical approach is able to strengthen students' cognitive and affective dimensions simultaneously in the local context.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the utilization of North Sumatra local culture in biology learning has great potential to improve the quality of learning

that is contextual, meaningful, and relevant to the development of 21st century competencies and skills. Elements of local culture such as ethnobotanical practices, traditional agricultural systems, and environmental management wisdom are proven to be integrated into biology materials to strengthen understanding of scientific concepts while shaping student character and identity. This integration also encourages the development of critical thinking, collaborative, and problem solving skills, although there are still challenges in pedagogical aspects and resource availability. Therefore, systematic support is needed through teacher training, preparation of culture-based teaching modules, and cross-party collaboration so that local culture-based biology learning can be implemented optimally and sustainably.

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