# Embedding Indigenous Knowledge in Science Curriculum: A Strategy for Contextualizing Science Education at the Junior High School to Prevent Climate Change

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**ABSTRACT**

Climate change is an urgent global challenge that requires multifaceted strategies, including education at the grassroots level. Schools play a critical role in shaping the attitudes and behaviors of younger generations, yet science education often remains disconnected from the cultural values and local knowledge systems of students. To address this gap, the present study explores how embedding indigenous knowledge into the junior high school science curriculum can contextualize learning and strengthen climate change education. Indigenous knowledge, which encompasses ecological wisdom, cultural practices, and sustainable traditions, provides valuable insights into environmental stewardship. Integrating this knowledge into science education helps students understand scientific concepts in relation to their daily lives and cultural contexts, making learning both meaningful and transformative. The study adopts a qualitative approach, using interviews, classroom observations, and curriculum analysis to examine how local ecological practices—such as traditional water management, sustainable farming techniques, and community conservation rituals—can be incorporated into science lessons. Findings suggest that contextualizing science education through indigenous knowledge not only enhances student engagement but also fosters a sense of responsibility toward the environment. Students are more likely to internalize ecological values when scientific learning is reinforced by cultural practices that they recognize and respect. In conclusion, embedding indigenous knowledge within the science curriculum presents a promising strategy for empowering young learners to contribute to climate change mitigation while preserving cultural heritage and strengthening community resilience.

Keywords: Indigenous Knowledge; Contextualized Science Education; Climate Change

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## Introduction

Climate change is arguably the greatest great challenge facing humanity today. The United Nations defines climate change as long-term shifts in temperatures and weather patterns. Climate change is a serious threat to the environment, society and economy. Education plays an essential role in shaping climate change awareness. In Indonesia, efforts to improve the quality of education are continuously being encouraged, one of which is through the integration of local wisdom values into the curriculum. Local wisdom, as a treasure trove of the nation's cultural riches, serves not only as a legacy from our ancestors but also as a guide to life, rich in positive values (Hidayati et al., 2020; Foa et al., 2024). The integration of local wisdom into the learning process, particularly in the field of Natural Sciences, is believed to guide students in scientifically examining environmental phenomena while simultaneously instilling relevant character traits (Foa et al., 2024).

Various studies have shown that implementing local wisdom in science learning can improve understanding of scientific concepts while fostering environmental stewardship. One example of this implementation is linking ecosystem subtopics with cultural practices such as waste management and community-based environmental reforestation or youth activities in the surrounding area (Rahmawati and Taylor, 2018; Hidayati, 2020). In East Java, learning activities that emphasize local wisdom are implemented in the form of organic farming traditions, the use of herbal plants to treat minor ailments, and the determination of planting systems based on traditional weather observations. This can make science learning more meaningful and contextual. This means that integrating local wisdom has the potential to effectively bridge scientific theory with students' social and cultural realities.

Research by Yuiana and Rahmawati (2021) indicates that implementing local wisdom in science learning impacts students' cognitive development. Environmental-based activities, such as composting organic waste, can foster a sense of ownership of the school environment. As UNESCO (2019) has stated, local values-based learning can foster environmental awareness and ecological character. Therefore, schools can be an effective means of internalizing sustainable values that are meaningful for the future (Susanti, D., & Nurhayati, R. (2025).

Schools are important agents in shaping the younger generation's awareness of climate change. However, in learning practice, science material is often taught abstractly and lacks connection to students' daily lives. This leads to low learning motivation and difficulty for students in connecting science concepts to real-world experiences. Indigenous knowledge encompasses ecological wisdom, cultural practices, and sustainability traditions that are relevant to science learning. This research is novel in examining the integration of local wisdom values into the science curriculum.

The implementing of this integrating approach always presents both challenges and opportunities. One challenge teachers face is the difficulty they still have integrating local knowledge and the lack of contextual learning resources to develop this material. Teachers stated that the structure of the science curriculum tends to be Western-based, making it difficult for them to adapt science learning to their curriculum structure. However, the independent curriculum provides flexibility for teachers to collaborate and innovate. This provides teachers with the

opportunity to collaborate with other educators, indigenous communities, and educational institutions. This collaboration can be key to strengthening the implementation of local wisdom so that it can contribute significantly to the development of sustainable and culturally equitable science education.

Furthermore, science learning integrated with indigenous knowledge can serve as a contextual bridge between modern scientific understanding and traditional ecological practices. Students will inherit in-depth knowledge and understanding of natural resource management, natural cycles, and sustainable traditions passed down through generations. By understanding local insights integrated into the science curriculum, students gain a wealth of knowledge to implement these principles in their real-life surroundings. They not only grasp the concepts learned in the classroom but also are able to apply traditional values in their daily lives. This approach supports place-based learning, making scientific concepts more meaningful and relevant to the students' environment and culture (Rahmawati & Taylor, 2018; Mungmachon, 2012).

Local wisdom values can foster critical thinking skills and environmental responsibility in students. Environmental-based activities such as water conservation practices, forest protection, or sustainable agricultural techniques explored through local traditions serve as a means of internalizing moral values related to environmental sustainability. This can strengthen cognitive, affective, and behavioral aspects, thereby fostering a caring attitude toward the environment in students. Ultimately, educational transformation can produce a generation that is scientifically literate, rooted in sustainable cultural values, and resilient in comprehensively addressing the challenges of climate change (Tilbury, 2011; UNESCO, 2021).

The implementation of local wisdom in science education aligns with global educational goals, one of which is found in UNESCO's education for sustainable development (ESD) framework. This integration can empower students and communities to take concrete steps towards environmental sustainability without losing their local or national cultural identities. Furthermore, recognizing indigenous perspectives contributes to the decolonization of science education, creating more inclusive learning and respecting epistemological diversity. Thus, the synergy between scientific inquiry and local knowledge not only enriches classroom learning experiences but also strengthens community resilience in the face of global environmental change (UNESCO, 2019; Aikenhead & Ogawa, 2007).

Therefore, this research focuses on The main focus of the study is the process of integrating local values into various subjects and their impact on student understanding and community involvement. This study aims to describe how the implementation of a local wisdom-based curriculum is carried out in one of the Junior High Schools. This research is also expected to provide practical benefits for various parties. For teachers, the research results can serve as a reference in designing more contextual and inclusive science learning strategies. For students, this research can enrich scientific understanding while fostering awareness of the importance of environmental conservation.

## Method

Data collection for this study was conducted at twelve junior high schools in Ponorogo, Madiun, Magetan, and Ngawi in the first term of 2025/2026 academic year. The study used a qualitative approach with a descriptive design aimed at deeply exploring the potential for integrating local wisdom values into the Natural Sciences (IPA) curriculum (Fitriyah & Wardani, 2022). The local wisdom in question encompasses the values, practices, and knowledge of traditional communities that are relevant to concepts in science learning (Setiawati, 2024). The qualitative approach was chosen because it was able to capture the contextual meaning and experiences of the informants in connecting local wisdom with science education (Carolina & Riandi, 2024). This research also provided space to explore the social and cultural dynamics that influence educational practices. Data collection was conducted using four main techniques: direct observation, in-depth interviews, questionnaires, and photo documentation. The research sample consisted of a science teacher, local residents, and students. The science teacher and local residents were selected using purposive sampling based on their understanding and relevant experience related to local wisdom, while students were randomly selected from the student population. Semi-structured interviews were conducted with the science teacher and local residents to explore perceptions and strategies for integrating local knowledge into science learning, in line with a qualitative approach (Indrawan & Mahendra, 2021). Additionally, questionnaires were distributed to students to gauge their understanding, attitudes, and readiness for a local wisdom-based curriculum (Aji, 2024). Documentation in the form of photographs of school activities and the environment was also collected as supporting data in the analysis process. This data will be analyzed qualitatively through data reduction, data presentation, and conclusion drawing/verification using triangulation of sources (teachers, community members, students) and methods (observation, interviews, questionnaires). The criteria for successful analysis are based on an in-depth description of the potential for integrating local wisdom into science curriculum development.

## Results

Based on the interview and observation analysis the result can be reveal such in this tabel below:

Table 1. Integration of Local Wisdom in Junior High Schools Curriculum

| No. | School Name | Integration of Local Wisdom in School Curriculum | Findings |
|---|---|---|---|
| 1. | SMPN 1 Nguntoronadi, Magetan | Batik ciprat, traditional dances, the "Rabu Anjawani" program (habituation to Javanese language and traditional clothing), and the "Twodarling" environmental movement. | Students reported that they became more aware of the environment and had a deeper understanding of scientific ideas |

| No. | **School Name** | **Integration of Local Wisdom in School Curriculum** | **Findings** |
|---|---|---|---|
| 2. | SMP Katolik Slamet Riyadi, Ponorogo | "The Power of Empon-Empon", traditional arts such as Reog and campursari | Students responded positively, as the lessons were relevant to daily life and involved the local community |
| 3. | SMPN 6 Ponorogo | The traditional Reog art | This integration has proven effective in fostering students' character, cultural pride, and improving the relevance of science learning to everyday life |
| 4. | SMP Muhammadiyah 2 Ponorogo | Local wisdom-based learning | This integration also supports the realization of more contextual, adaptive, and inclusive learning. |
| 5. | SMPN 1 Kauman, Ponorogo | Identifying cultural potential | This approach not only improves students' contextual understanding of science concepts, but also fosters positive character and instills awareness of environmental and cultural preservation |
| 6. | SMPN 3 Karangjati, Ngawi | The connection of science topics such as ecosystems, material cycles, environmental pollution, and natural resource conservation with real practices in the village clean tradition, such as communal river and drainage cleaning | The results show that this integration enhances students' ecological awareness, strengthens environmental care character, and fosters respect for local culture. |
| 7. | SMP Negeri 1 Geger, Madiun | The use of local plants, pencak silat in sports, and batik in art and extracurricular activities. Furthermore, involved extracurricular activities such as visits to MSMEs (UMKM), goat farms, and making agricultural tools. | Increasing students's interest in learning, strengthening students' conceptual understanding, and raising awareness of the natural and cultural wealth of the surrounding area. |
| 8. | MTsN 3 Ponorogo | Activities of planting, caring for, and processing Aloe vera | Increasing student's motivation, scientific literacy, and fostering the Pancasila Student Profile, particularly environmental awareness, mutual cooperation, and pride in local culture. |
| 9. | SMP Katolik Slahung, Ponorogo | The use of traditional media in learning about plants and making cassava tape in biotechnology | This integration enhances students' critical thinking skills and environmental and cultural awareness |
| 10. | MTs Al Islam Joresan, Ponorogo | The use of local culture such as Reog Ponorogo in the material of biodiversity, traditional Dawet food in the material of mixed substances and their changes, and Eco Brick and Eco Print making activoties. | This integration has positive impact on students understanding and interest in learning |
| 11. | SMPN 2 Babadan, Ponorogo | Water filtration and orchid planting activities | can increase students' awareness of local culture and the environment. |

| No. | School Name | Integration of Local Wisdom in School Curriculum | Findings |
|---|---|---|---|
| 12. | SMPN 1 Ponorogo | Studying traditional foods related to acid-base properties and classifying Ponorogo area flora and fauna | With an increase in ecological consciousness, cultural concern, and active participation in learning activities and school activities based on local culture, students have very good opinions of learning based on local wisdom |

## Discussion

Research on the integration of local wisdom values into the science curriculum at the junior high schools demonstrated a significant positive impact on learning motivation, deepened understanding of scientific concepts, and fostered a love and pride for local culture. Questionnaire data showed that the majority of students found it easier to understand science material when it was connected to their daily lives and the surrounding environment. Students also demonstrated an increased awareness of sustainability values after participating in local wisdom-oriented learning.

Based on the analysis, the findings indicate that almost all of the observed subjects have attempted to integrate local wisdom values into science learning. Although the forms of implementation have different characteristics and distinctive features. Some examples of this integration include activities based on local traditions, such as introducing medicinal plants, environmental management practices, and utilizing local culture integrated into scientific experiments. Understanding science contextualized with local wisdom brings students closer to nature and increases their environmental awareness. This aligns with previous research stating that integrating local wisdom can contextualize learning so that it is closer to students' lives. Thus, science learning becomes more meaningful and provides a deeper understanding, because students can connect scientific concepts explained in school with their cultural experiences and the environment around them (Taylor, 2018; Ausubel, 1968).

The data obtained show that the impact of integrating local wisdom into science education is reflected in students' motivation and scientific attitudes. Students taught with this integration responded positively to local wisdom-based learning. Students felt more enthusiastic, motivated, and demonstrated a better understanding of the scientific concepts taught in class. This is in line with Piaget's and Vygotsky's constructivist theories, which construct knowledge based on students' social and cultural experiences. Furthermore, local wisdom-based education serves as a scaffolding that connects abstract scientific concepts with concrete experiences in students' homes. Thus, this approach not only increases learning motivation but also strengthens students' critical and reflective thinking skills (Tilbury, 2011; Vygotsky, 1978).

Education that integrates local knowledge can increase environmental awareness and foster sustainable, environmentally conscious behavior. Several schools, such as SMPN 1 Ngawi and SMPN 3 Nganjuk, have integrated local wisdom into environmental conservation activities, such as waste management. The goal of

these activities is to increase students' awareness and consistency in reducing plastic waste. Most students, and even their communities, understand that improperly managed waste contributes to global warming, which leads to climate change. However, few are consistent in implementing prevention efforts or managing waste properly.

In implementing local wisdom, teachers act as facilitators, shaping students' character, not only as critical and reflective learners on environmental issues, but also as leaders capable of integrating knowledge and local values. When students develop critical thinking, they will be able to develop solution-oriented individuals when faced with life's challenges. When linked to climate change, they will be able to mobilize others in their communities to take action on climate change. At a minimum, they have the ability to raise awareness among their peers (Hadi, 2020; Tilaar & Nugroho, 2022).

Students can encourage their peers to actively participate in reforestation activities by promoting the planting of endemic plants, traditional-based water conservation, and waste management. This approach allows students to develop a sense of responsibility for the environment and spread positive attitudes to their peers. Science lessons are particularly effective. Science is one subject that can be developed through the application of life skills. In accordance with the nature of science, science subjects study natural phenomena, such as climate change in this context. Therefore, it is hoped that science learning will not only be oriented towards academic competency but also contribute to real-life outcomes from what they learn (Mujakir, 2012).

In several regions, such as the Sea Alms tradition in Teleng Ria Pacitan, the Reog Ponorogo art form, and martial arts in Madiun Regency, these cultural activities are transformed into scientific knowledge that can be conveyed. During science lessons, for example, in the Reog art performance, performers carry a very heavy barongan, or lion's head. This relates to the strength of carrying the barongan, in accordance with the theory of muscle movement. In this context, tree planting activities integrated into cultural activities such as the commemoration of the 10th of Muharram can foster environmental awareness. Establishing school gardens is also a form of food security that can be implemented at the school or home level. Climate change makes it difficult for farmers to grow crops due to weather changes. Finding water to irrigate their rice fields can be a form of anticipation. One way to anticipate this is by starting a garden in the yard.The second activity undertaken was water conservation. It is known that the eastern Ngawi region lies at the foot of a mountain, home to springs. However, these springs are now beginning to dry up due to climate change and the decline of surrounding trees. Therefore, education related to water conservation is needed to ensure the remaining springs remain. Students are also taught about protecting flora and fauna. For example, during the 10th Muharram commemoration, students were encouraged to give back to the earth by planting trees and releasing birds as a way of showing concern for nature. Education that integrates local ecological knowledge can increase environmental awareness and foster sustainable behavior. This also aligns with the concept of Education for Sustainable Development (ESD), which emphasizes the importance of linking modern science with local cultural and ethical values to support socio-ecological sustainability (UNESCO 2019; UNESCO, 2021).

Implementing local wisdom values in science education is not always smooth. Despite positive results, there are indications that this implementation faces several challenges. First, limited human resources, in this case teachers. The lack of teacher training makes the learning process difficult for all students in the classroom. Because this integration is not yet familiar to science teachers, training remains limited. Second, limited learning resources, such as facilities and infrastructure that can be used as learning media, although they can essentially rely on natural materials and direct exposure to the environment during classroom learning, still require appropriate facilities to convey information in class. Some teachers still tend to teach science abstractly without linking it to the local context. This situation demonstrates the need for capacity building for teachers to be able to design learning that integrates local knowledge scientifically and pedagogically (Aikenhead & Ogawa, 2007). Furthermore, policy support from educational units and relevant agencies is needed to provide contextual curriculum guidance based on regional culture (Rahmawati et al., 2020).

The research results also show that the development of a curriculum and science learning that is integrated with science as a whole can strengthen the urgency of developing a culture-based science curriculum (culturally responsive science education). The role of integrating local wisdom can not only be implemented in the form of teaching materials but can also play a role in fostering the ecological identity and character of students. In the context of climate change, developing teaching materials based on local wisdom that aims to prevent and reduce climate change is very relevant and important to develop. This can be a relevant strategy to shape the younger generation and foster awareness in protecting the environment and appreciating noble culture. In line with the views of Foa et al. (2024), a curriculum that combines science and local wisdom is able to produce more contextual, collaborative, and sustainability-oriented learning. Therefore, this approach can be an effective science education model in facing the environmental challenges of the 21st century.

## Conclusion

In conclusion, local wisdom-based learning was able to improve students' critical thinking, ecological awareness, and proactive attitudes essential for addressing climate change challenges at the community level and beyond. This approach bridges the gap between scientific theory and local experiences, empowering learners to apply knowledge in real-life contexts.

However, challenges remain, including limited facilities, students' limited prior knowledge of local culture, and the need for teacher training in managing contextual learning. Therefore, the sustainability of this integration needs to be supported through the development of project-based teaching materials, teacher training, collaboration with local communities, and the use of digital media. Further research is recommended to explore local wisdom-based science learning models that can be applied at other educational levels and in different cultural contexts, as well as to quantitatively test the effectiveness of this integration on students' scientific literacy achievements.

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