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Contextual Science Learning Based on Local Wisdom: An Effort to Improve Science Process Skills in Primary Schools

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Abstract

This study aims to examine the effect of contextual science learning based on local wisdom on improving the science process skills of primary school students. The local context used in this study is the cultural practice of the Malind community in processing sagu sep using the stone-burning technique, which correlates with the subject matter of heat transfer. The research was conducted at SD YPK Tanas, involving 20 fifth-grade students as participants. A pre-experimental approach with a one-group pre-test and post-test design was employed. The research instrument consisted of essay-based tests covering five indicators of science process skills: problem formulation, hypothesis development, variable identification, data analysis, and drawing conclusions. Data analysis revealed a significant improvement across all indicators, with an average N-Gain of 0.82, categorized as high. The highest increase was observed in data analysis (N-Gain 0.88), followed by variable identification (0.85) and problem formulation (0.81). These findings indicate that science learning integrated with local cultural practices can enhance students' understanding of heat transfer concepts and foster meaningful mastery of science process skills. Contextual learning based on local wisdom not only reinforces scientific concepts but also bridges science with students' real-life experiences.

Keywords: Contextual science learning; Local wisdom; Science process skills; Heat transfer; Primary education.

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INTRODUCTION

Natural Science (IPA) education at the elementary school level plays a crucial role in equipping students with foundational scientific understanding as well as critical and systematic thinking skills. One of the key components of science education is science process skills, which include the abilities to observe, classify, predict, experiment, and communicate scientific ideas (Biswal & Behera, 2023). According to Ibrahim (2016), science process skills in primary schools need to be developed through contextual learning using a scientific approach that emphasizes observing, questioning, reasoning, concluding, and decision-making, so that students become accustomed to scientific thinking from an early age. However, in practice, science learning in many elementary schools remains theoretical and disconnected from students' real-life contexts, resulting in suboptimal development of science process skills (Nurussaniah et al., 2017).

To promote more meaningful and contextual science learning, the integration of local wisdom has emerged as a strategic solution. Local wisdom reflects community practices and cultural values that have proven to be adaptive to the environment and can serve as relevant, easily understood learning resources for students (Sari & Ernawati, 2025). Several studies have shown that incorporating local wisdom into science education improves conceptual understanding, strengthens

scientific attitudes, and nurtures cultural identity among students (Rapsanjani et al., 2023; Widyaningrum, 2018). This approach aligns with the principles of contextual learning, which emphasize the importance of linking lesson content to students' surrounding environments (Widiastuti, 2020).

Previous studies have reported the successful implementation of this approach in various regions. For instance, Sanjayanti (2022) found that integrating Balinese local wisdom into science learning improved students' character and science literacy. Likewise, Sudirman et al. (2025) demonstrated that incorporating local potential into science education in Lombok significantly enhanced students' scientific attitudes. Studies conducted by Pamungkas et al. (2017) and Arma (2024) in Central Java revealed that science learning based on local wisdom fostered creativity and improved student achievement. Additionally, research by Islamiyati et al. (2024), which involved developing science worksheets using Augmented Reality and local cultural elements, showed improvements in students' science process skills and creative thinking. However, while these studies indicate positive outcomes, most did not specifically measure the development of science process skills at the primary level, especially in the unique cultural context of the Malind community in Merauke.

The local context of the Malind community in Merauke offers a rich source of ethnoscientific knowledge. Traditional practices such as forest management, hunting, food gathering, and seasonal forecasting reflect scientific skills such as observation and environmental classification. Rapsanjani et al. (2024) noted that these practices harbor significant scientific concepts including adaptation, natural cycles, and the utilization of natural energy sources. Unfortunately, this local knowledge has not been fully utilized in formal elementary education. Teachers in remote border regions continue to rely heavily on nationally standardized textbooks that lack relevance to the environmental and cultural context of their students' daily lives.

To date, few studies have specifically developed and tested science learning models based on the local wisdom of the Malind community and their impact on students' science process skills. Most prior research has focused on conceptual understanding or character development, rather than on the indicators of science process skills as emphasized in the *Kurikulum Merdeka* (Day et al., 2025; Rapsanjani et al., 2023). This highlights a critical research gap that must be addressed by designing and assessing science learning that systematically integrates local culture. Such research is also vital in supporting curriculum decolonization and strengthening culturally grounded education in remote and border areas (Supriyadi & Nurvitasari, 2019).

Research Novelty

This study presents a novel contribution to the development of elementary science education through the integration of contextual learning approaches grounded in local wisdom, aiming specifically to enhance students' science process skills. The novelty lies in the utilization of indigenous knowledge such as traditional environmental observations, agricultural techniques, and conservation practices as real-life contexts for science learning, particularly in frontier areas like Merauke. This strategy enables meaningful learning experiences by encouraging students to understand scientific concepts through phenomena familiar to their everyday lives.

Consequently, core skills such as problem formulation, hypothesis construction, variable identification, data analysis, and drawing conclusions can be developed more effectively (Sari et al., 2016; Supriyadi et al., 2020a).

In addition to contributing to the improvement of science process skills, this approach strengthens students' cultural identity and sense of ownership of their environment. This aligns with the goals of curriculum decolonization and the development of character based on local values (Rapsanjani et al., 2024; Safitri et al., 2023; Widiarni et al., 2025). Furthermore, the integration of local wisdom into science education offers an adaptive solution to the challenges faced by schools in 3T regions (frontier, remote, and underdeveloped areas) by providing learning models that accommodate the geographical, social, and cultural conditions of the students. As such, this research not only enriches the repertoire of science education innovations but also serves as a strategic step toward realizing science education that is contextual, relevant, and sustainable (Demircioğlu et al., 2018).

Therefore, the main objective of this study is to examine and analyze the influence of contextual science learning based on local wisdom and to evaluate its impact on elementary students' science process skills. It is hoped that the findings will provide both theoretical and practical contributions to the development of contextual education in Indonesia, particularly in culturally diverse and geographically remote regions.

METHODS

This study employed an experimental research method with a *Pre-Experimental Design* approach. Specifically, it utilized a *One-Group Pretest–Posttest Design*, which involved a single group of participants observed before and after treatment to assess the effect of the intervention. The research design is illustrated as follows:

O_1	X	O_2

Figure 1. Research design

Where:
O_1 = Observation before treatment (pre-test)
X = Treatment or intervention
O_2 = Observation after treatment (post-test)

The research was conducted during the odd semester of the 2024/2025 academic year at SD YPK Tanas, targeting a single class of fifth-grade students consisting of 20 participants. The study involved two variables: the independent variable was contextual science learning based on local wisdom, while the dependent variable was students' science process skills.

The intervention introduced students to contextual science learning by integrating local cultural knowledge—in this case, the traditional *bakar batu* (stone-burning) technique used in sago (*sagu sep*) preparation by the Malind community, which relates to the topic of heat transfer in science. This culturally relevant context was embedded into classroom instruction to make science concepts more meaningful and relatable to students.

To measure science process skills, the researchers used a descriptive essay test that encompassed five key indicators: (1) formulating problems, (2) developing hypotheses, (3) identifying variables, (4) analyzing data, and (5) drawing conclusions. These indicators reflect essential components of scientific reasoning and are aligned with the expected competencies outlined in national science curricula.

The students' test scores were categorized according to the achievement levels shown in Table 1.

Table 1. Science process skills score categories

No	Score Range	Category
1	81 % – 100 %	Very Good
2	61 % – 80 %	Good
3	41 % – 60 %	Fair
4	21 % – 40 %	Poor
5	0 % – 20 %	Very Poor

To determine the effectiveness of the contextual science learning model based on local wisdom, the normalized gain (*N-Gain*) was calculated using the following formula:

$$<g> = (\%post\text{-}test\ score - \%pre\text{-}test\ score) / (100 - \%pre\text{-}test\ score)$$

This formula evaluates the relative improvement in students' performance following the intervention. The interpretation of the N-Gain scores was based on the criteria shown in Table 2.

Table 2. N-gain interpretation criteria

N-gain score	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

The N-Gain analysis was conducted to assess the degree of improvement in each of the five indicators of science process skills after implementing the local-wisdom-based instructional strategy. This quantitative approach allowed for a systematic and objective evaluation of the instructional model's effectiveness in enhancing scientific reasoning among primary school students.

RESULTS AND DISCUSSION

The implementation of contextual science learning based on local wisdom, through the practice of *sagu sep* preparation using the *bakar batu* (stone-burning) technique, demonstrated a positive impact on enhancing elementary students' science process skills. This improvement was evident through the comparative analysis of pre-test and post-test scores, which assessed five core indicators of science process skills: formulating problems, developing hypotheses, identifying variables, analyzing data, and drawing conclusions.

Prior to the intervention, students were administered a pre-test to establish their baseline science process skills. Following the contextual instructional intervention, in which the topic of heat transfer was integrated with the local cultural

practice of preparing *sagu sep*, a post-test was conducted to measure the instructional model's effect on students' skill development.

The results indicated a significant increase in students' science process skills after the application of local wisdom-based science learning. Table 3 presents a detailed comparison of pre-test and post-test results along with N-Gain values for each indicator.

Table 3. Average Pre-test, post-test scores, and n-gain of science process skills

Science Process Indicator	Average percentage		N-gain score	Category
	Pre-test	Post-test		
Formulating problems	7,69	82,51	0,81	High
Developing hypotheses	0	76,92	0,77	High
Identifying variables	0	84,62	0,85	High
Analyzing data	0	87,56	0,88	High
Drawing conclusions	0	78,64	0,79	High

The average results show that prior to the intervention, most students had very limited science process skills, with a total average score of only 1.54%, classified as "very poor." However, after the contextual learning was implemented, students' performance improved markedly, with the average post-test score reaching 82.05%, which falls under the "very good" category.

These findings suggest that contextual science instruction embedded in culturally relevant practices can effectively enhance students' mastery of scientific processes. The use of local wisdom provided concrete, familiar experiences that helped students to understand abstract scientific concepts, in this case, heat transfer. The structured integration of cultural knowledge with scientific content enabled students to not only engage more deeply in the learning process but also to develop their scientific reasoning in a meaningful way.

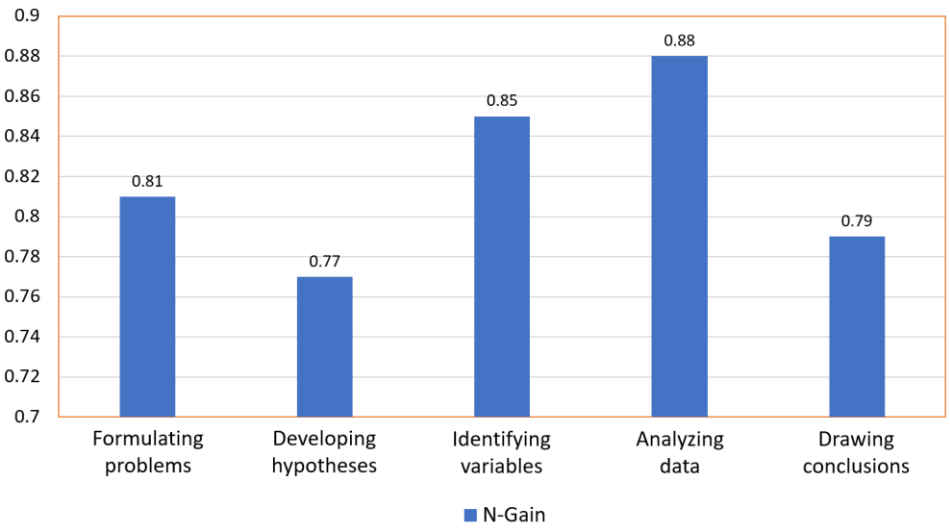

Figure 2. The n-gain results of science process skills

Based on the results of the pre-test and post-test, all indicators of science process skills showed a significant improvement, with N-Gain values falling into the "high" category. This indicates that the contextual science learning approach

incorporating local wisdom had a strong positive influence on students' ability to engage in scientific thinking and inquiry.

The first indicator, *formulating problems*, showed an increase from an initial score of 7.69% to 82.51%, yielding an N-Gain of 0.81. This substantial growth suggests that students became capable of generating scientific questions based on their observations of the *bakar batu* process. During the learning activity, students directly observed how heated stones were used to cook sago dough wrapped in leaves. These concrete experiences enabled them to pose questions such as, "Why can hot stones cook the sago?" or "What type of heat transfer occurs when the stone touches the sago?" Activities like this enhanced students' observational skills and critical thinking abilities. According to Dewi et al. (2018), such concrete experiences serve as a strong foundation for developing science process skills, particularly in the early stages of scientific learning.

The second indicator, *developing hypotheses*, also demonstrated a notable improvement, rising from 0% to 76.92%, with an N-Gain of 0.77. After making observations, students began constructing hypotheses such as: "If the stones used in the *bakar batu* are not hot enough, then the sago will not cook properly." This type of hypothesis shows that students began to understand causal relationships—in this case, between temperature and the degree of doneness of the food. As Ibrahim (2016) suggests, hypothesis development is an essential component of early scientific reasoning and must be nurtured from the primary school level to foster an inquiry-based mindset.

The third indicator, *identifying variables*, showed a significant rise from 0% to 84.62%, with an N-Gain value of 0.85. In the context of the *sagu sep* preparation, students were able to identify the temperature of the stones as the independent variable, the degree of sago doneness as the dependent variable, and the heating time as the control variable. This achievement highlights students' ability not only to understand basic experimental concepts but also to relate them to firsthand experiences. As stated by Astutik (2023), Carin and Sund (1989), and Hamadi et al. (2018), understanding variables is a crucial component in building logical and systematic scientific reasoning.

The fourth indicator, *analyzing data*, exhibited the highest improvement, increasing from 0% to 87.56%, with an N-Gain score of 0.88. At this stage, students demonstrated their ability to compare the doneness of sago cooked with varying numbers of stones, and to assess how the quantity of stones influenced heat distribution. They engaged in group comparisons, discussed their findings, and drew preliminary conclusions. This activity not only helped them understand the relationship between data and scientific concepts but also encouraged collaboration and communication skills. According to Sartika and Nuroh (2017), data analysis is a higher-order thinking skill essential in science education.

The final indicator, *drawing conclusions*, improved from 0% to 78.64%, with an N-Gain of 0.79. Students were able to draw conclusions such as, "Heat is transferred from the hot stones to the sago by conduction, which causes the sago to cook." This outcome demonstrated their grasp of heat transfer concepts and their ability to connect theory to experience. In the *bakar batu* practice, heat is transferred through conduction—when hot stones directly contact the sago; convection—when hot steam circulates within the leaf-covered pit; and radiation—from the fire embers to the

surrounding space. This approach aligns well with contextual learning principles, which emphasize linking scientific concepts to students' real-world experiences (Darmayanti, 2024).

Furthermore, this learning model adheres to student-centered pedagogical principles and respects students' cultural backgrounds. According to Rapsanjani et al. (2023), culturally responsive instruction enhances student engagement and renders learning more meaningful. The *sagu sep* preparation using the *bakar batu* technique not only served as a vehicle for understanding heat transfer concepts but also as a medium for preserving cultural practices and shaping student character. Through this approach, students learned science while also gaining appreciation for traditional practices passed down through generations.

As noted by Khoiri (2021), students' science process skills can develop more optimally when they are directly involved in activities that reflect real scientific concepts. This assertion is supported by Wisudawati and Sulistyowati (2022), who state that science skills are more likely to become long-term memory when associated with real-life experiences. This study reinforces that notion, as it shows how the integration of cultural practices into science instruction can deepen conceptual understanding and long-term retention.

This research also supports the findings of Supriyadi et al. (2020b), who emphasized that integrating local wisdom into science learning can be a valuable source of innovation in education. Culturally contextualized materials are not only easier for students to understand but also serve as an inspiration for critical and creative thinking. In this context, the *bakar batu* tradition functioned as more than just a learning medium—it became a cultural preservation tool that strengthened students' local identity.

In summary, the significant improvements observed across all five indicators of science process skills confirm the effectiveness of integrating local cultural knowledge into contextual science instruction. The *bakar batu* method provided a meaningful, real-world context through which students could engage with scientific concepts, fostering not only cognitive development but also cultural appreciation. These findings illustrate the dual function of contextual science learning: enhancing academic outcomes while simultaneously preserving indigenous knowledge systems that are both educational and culturally empowering.

CONCLUSION

Based on the research findings, it can be concluded that contextual science learning based on local wisdom—through the traditional *sagu sep* preparation using the *bakar batu* technique—effectively enhances elementary students' science process skills. All indicators of science process skills showed significant improvement following the implementation of local wisdom-based instruction, with N-Gain values categorized as high. The greatest improvements were observed in the indicators of data analysis and variable identification. The success of this learning approach was supported by students' direct engagement within their cultural context, making the learning process more meaningful and relevant. Science learning grounded in local experiences has proven effective in fostering scientific thinking, strengthening conceptual understanding, and cultivating an appreciation for cultural values.

RECOMMENDATION

Based on the findings of this study, it is recommended that elementary school science teachers integrate local wisdom into the learning process, particularly in subject matter that can be connected to community cultural practices. Cultural contexts such as the *bakar batu* tradition in the preparation of *sagu sep* can serve as powerful instructional tools for developing students' science process skills. Furthermore, the development of learning materials rooted in local wisdom should be enhanced to support adaptive teaching practices that are grounded in students' real-life experiences. Future research is encouraged to explore the development of science learning models or modules based on local wisdom that can be applied more broadly across regions with diverse cultural backgrounds.

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