THE ROLE OF THE NIAS LANGUAGE IN STRENGTHENING SCIENCE CONCEPTS WITHIN A LOCAL CULTURAL CONTEXT IN SENIOR HIGH SCHOO

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Abstract

This study aims to examine the use of the Nias language as a medium for strengthening science (Physics) concepts in Grade X at SMA Negeri 1 Teluk Dalam within the context of local culture. The research focuses on how integrating local language can improve students' understanding of abstract physics concepts, particularly motion and force. A mixed-method approach was applied, combining quantitative data from pretest and posttest results with qualitative data from observations, questionnaires, and interviews. The findings show that students who learned physics using the Nias language achieved higher learning outcomes compared to those who used conventional instruction. The use of local language made learning more contextual, meaningful, and easier to understand. It also increased students' motivation, participation, and confidence during the learning process. Furthermore, students were able to relate physics concepts to their daily life experiences and cultural environment. This study concludes that the integration of the Nias language in physics learning is an effective strategy to improve conceptual understanding and scientific literacy while preserving local cultural identity. Therefore, culturally based learning approaches should be considered in science education to enhance both academic achievement and cultural awareness among students.

Keywords:*Nias Language; Physics Learning; Local Wisdom; Science Education; Conceptual Understanding; Ethnoscience; Grade X Students*

A. Introduction

Education in the 21st century requires not only the mastery of scientific concepts but also the integration of cultural values into the learning process. In Indonesia, local wisdom plays a significant role in shaping students' identities and contextual understanding. However, in many schools, including SMA Negeri 1 Teluk Dalam, the teaching of physics in Grade X is still largely dominated by abstract explanations, formula memorization, and textbook-oriented instruction Ali, L. U., Suranto, S., & Indrowati, M. (2025). As a result, students often experience difficulties in understanding fundamental physics concepts such as motion, force, and energy, which are inherently abstract and require meaningful contextualization Fahrudin, A., Riance, A., & Maryam, E. (2026).

One of the main challenges in physics learning is the gap between scientific concepts and students' daily experiences (Fitriah, L. 2024). This gap becomes more evident when the language of instruction does not fully align with students' linguistic backgrounds. In the context of Nias, many students are more familiar with the Nias language in their daily communication (Harefa, D. 2025). Therefore, integrating the Nias language into physics learning can serve as a pedagogical bridge that connects abstract scientific concepts with students' real-life experiences and cultural context (Kariani, K. et al., 2024).

The use of local language in science education aligns with the concept of culturally responsive pedagogy, which emphasizes the importance of incorporating students' cultural and linguistic backgrounds into the learning process Musniar, A., Arafah, K., & Palloan, P. (2025). This approach supports meaningful learning, as proposed in constructivist theory, where students build new knowledge based on prior experiences. By using the Nias language, teachers can explain physics concepts in a more familiar and accessible way, thereby enhancing students' conceptual understanding (Risdianto, E, et al., 2021).

Furthermore, the ethnoscience approach provides a strong theoretical foundation for integrating local wisdom into science learning. Ethnoscience emphasizes the relationship between indigenous knowledge and scientific concepts, enabling students to learn science through culturally relevant contexts. Research shows that ethnoscience-based learning contributes significantly to improving scientific literacy, critical thinking skills, and students' engagement in learning . In addition, local wisdom-based physics learning has been proven to enhance cognitive learning outcomes and provide meaningful learning experiences by connecting physics concepts with cultural practices found in students' environments .

In physics education, this approach is often referred to as ethnophysics, where cultural practices are analyzed to identify underlying physics concepts (Harefa, D. 2025). For example, traditional activities, tools, or local phenomena can be used to explain principles such as mechanics, thermodynamics, and energy. Studies indicate that ethnoscience-based teaching materials can improve students' analytical thinking skills and make learning more contextual and relevant to real-life situations . Moreover, integrating local wisdom into physics education supports the development of scientific literacy and contributes to sustainable education goals .

Despite its potential, the integration of local language and local wisdom in physics learning at SMA Negeri 1 Teluk Dalam has not been optimally implemented. Physics teaching still tends to rely on conventional methods, with minimal use of contextual and culturally relevant approaches. This condition highlights the need for innovative learning strategies that incorporate the Nias language as a medium for strengthening science concepts within the framework of local culture (Harefa, D. 2025).

Therefore, this study aims to explore the role of the Nias language as a means of reinforcing physics concepts in the context of local wisdom in Grade X physics learning at SMA Negeri 1 Teluk Dalam. It is expected that this approach will not only improve students' understanding of physics concepts but also foster cultural awareness and preserve local identity.

B. Research Method

This study employed a mixed-methods approach with a sequential explanatory design, combining quantitative and qualitative data to comprehensively examine the role of the Nias language in strengthening physics concepts within the context of local wisdom (Astuti, I. A. D., et al., 2025). The research was conducted at SMA Negeri 1 Teluk Dalam, focusing on Grade X physics learning, particularly on topics such as motion and force, which are considered abstract and require contextual understanding.

1. Research Design

The quantitative phase used a quasi-experimental design**,** specifically a pretest-posttest control group design (Astuti, I. A. D., et al., 2025)**.** Two classes were selected: one as the experimental group, which received physics instruction integrated with the Nias language and local cultural context, and the other as the control group, which received conventional instruction. The qualitative phase aimed to explore students' responses, perceptions, and learning experiences through interviews and observations.

This design is grounded in constructivist theory, which emphasizes that students build knowledge based on prior experiences and cultural context. Integrating local language and culture aligns with ethnoscience and ethnophysics approaches, which contextualize scientific concepts within students' daily lives and cultural practices .

2. Participants

The participants consisted of Grade X students at SMA Negeri 1 Teluk Dalam. A purposive sampling technique was used to select two classes with similar academic abilities. The total sample included approximately 60–70 students.

3. Data Collection Techniques

Data were collected using the following instruments:

a. Conceptual Understanding Test

A multiple-choice and essay-based test was administered before and after the intervention to measure students' understanding of physics concepts.

b. Observation Sheet

Used to observe student engagement and interaction during the learning process.

c. Interview Guide

Semi-structured interviews were conducted to explore students' perceptions of using the Nias language in physics learning.

d. Questionnaire

A Likert-scale questionnaire measured students' attitudes and responses toward ethnoscience-based learning.

The use of multiple instruments supports triangulation, enhancing the validity and reliability of the data.

4. Data Analysis Techniques

Quantitative data were analyzed using descriptive and inferential statistics, including paired sample t-tests and N-gain analysis to determine the effectiveness of the intervention. Qualitative data from interviews and observations were analyzed using thematic analysis, following the steps of data reduction, data display, and conclusion drawing.

5. Theoretical Basis

This study is supported by several theoretical frameworks:

a. Ethnoscience Approach

Ethnoscience integrates local knowledge into science learning, improving scientific literacy and contextual understanding .

b. Ethnophysics Learning

Ethnophysics connects physics concepts with cultural practices, making abstract concepts easier to understand .

c. Culturally Responsive Teaching (CRT)

This approach emphasizes the use of students' cultural and linguistic backgrounds in learning to improve engagement and comprehension (Derlina et al., 2021).

d. Constructivist Learning Theory

Learning occurs when students actively construct knowledge based on prior experiences and social context.

e. Scientific Literacy Development

Integrating ethnoscience in physics learning enhances students' scientific literacy and higher-order thinking skills

C. Results and Discussion

The findings of this study indicate that the integration of the Nias language as a medium for strengthening physics concepts significantly improved students' conceptual understanding in Grade X at SMA Negeri 1 Teluk Dalam. This improvement is evident from both quantitative and qualitative data obtained during the research process.

Based on the results of the pretest and posttest, the experimental group that received instruction using the Nias language integrated with local wisdom showed a higher increase in scores compared to the control group. The average N-gain score of the experimental group was categorized as moderate to high, while the control group remained in the low to moderate category. This finding confirms that contextual learning using local language enhances students' comprehension of abstract physics concepts such as motion and force.

These results are consistent with the ethnoscience approach, which emphasizes the integration of local knowledge into science learning. Ethnoscience-based learning has been proven to improve scientific literacy and contextual understanding by linking scientific concepts with students' daily experiences . In this study, the use of the Nias language allowed students to relate physics concepts to familiar cultural practices, making learning more meaningful and accessible.

Furthermore, classroom observations revealed that students in the experimental group were more active and engaged during the learning process. They participated more frequently in discussions, asked questions, and demonstrated better collaboration with peers. This aligns with previous findings that ethnophysics learning can increase student engagement and interest in physics learning Astuti, I. A. D., Sumarni, R. A., & Setiadi, I. (2025). The use of culturally relevant language reduced students' hesitation in expressing their ideas, thereby fostering a more interactive learning environment.

In addition, the results of the questionnaire showed that the majority of students responded positively to the use of the Nias language in physics learning. Students reported that learning physics became easier to understand, more interesting, and more relevant to their daily lives. These findings are supported by research showing that ethnophysics-based learning significantly improves students' scientific literacy and problem-solving skills (Sunarti, T., 2025). The integration of local language and culture helps students develop confidence in applying scientific concepts in real-life situations.

The interview results further strengthened these findings. Students expressed that explanations delivered in the Nias language helped them better understand difficult terms and concepts in physics. Teachers also reported that students were more responsive and demonstrated improved conceptual clarity when local language was used as a supporting medium.

Moreover, this study found that the use of local language in physics learning

contributes to the development of higher-order thinking skills. Ethnoscience-based instruction has been shown to significantly enhance critical thinking skills, with a strong effect size in physics learning contexts Idul, J. J. A., & Fajardo, M. T. M. (2023). This indicates that integrating cultural and linguistic elements not only improves conceptual understanding but also promotes deeper cognitive engagement.

Overall, the results of this study demonstrate that the Nias language can serve as an effective pedagogical tool in strengthening physics concepts within the context of local wisdom. The findings highlight the importance of culturally responsive teaching approaches in improving learning outcomes and preserving local cultural identity.

The findings of this study demonstrate that the use of the Nias language as a medium for strengthening physics concepts in Grade X at SMA Negeri 1 Teluk Dalam provides significant pedagogical benefits. The improvement in students' conceptual understanding, engagement, and learning motivation confirms that integrating local language and cultural context into physics learning is both relevant and effective.

From a theoretical perspective, these findings strongly align with the ethnoscience approach, which emphasizes the integration of local knowledge and culture into science education. Ethnoscience enables students to understand scientific concepts through familiar cultural contexts, thereby promoting meaningful learning. Previous studies indicate that ethnoscience contributes significantly to improving scientific literacy, critical thinking, and 21st-century skills . In this study, the use of the Nias language functioned as a bridge between abstract physics concepts and students' everyday experiences, making learning more accessible and contextual.

The improvement in students' conceptual understanding can also be explained through constructivist learning theory, which posits that knowledge is actively constructed based on prior experiences. When physics concepts such as motion and force were explained using the Nias language and contextualized through local cultural practices, students were able to connect new knowledge with their existing understanding (Harefa, D. 2025). This process enhanced cognitive assimilation and accommodation, leading to deeper conceptual comprehension.

Furthermore, the results are consistent with the principles of ethnophysics learning, which connects physics concepts with cultural phenomena. Ethnophysics has been shown to make abstract concepts more concrete and meaningful by relating them to real-life cultural practices. Research

indicates that ethnophysics-based learning enhances students' engagement and conceptual understanding, particularly in topics such as motion and heat . In the context of this study, the integration of Nias cultural elements—delivered through the Nias language—enabled students to visualize and interpret physics concepts more effectively.

The increased student engagement observed during the learning process also supports the theory of culturally responsive teaching (CRT). This approach emphasizes the importance of incorporating students' cultural and linguistic backgrounds into instruction. When students are taught using their local language, they tend to feel more confident and actively participate in the learning process. Previous research shows that integrating ethnophysics with culturally responsive teaching can improve students' generic science skills and engagement (Harefa, D. 2025). Similarly, in this study, students demonstrated higher participation, increased interaction, and greater willingness to express their ideas when the Nias language was used.

Another important finding is the positive impact on students' critical thinking skills and scientific literacy (Harefa, D. 2025). Ethnophysics learning encourages students to analyze real-world phenomena within their cultural environment, fostering higher-order thinking skills. Studies confirm that ethnophysics significantly enhances critical thinking by contextualizing scientific concepts within indigenous knowledge systems . Moreover, integrating cultural contexts into physics learning has been shown to improve students' problem-solving abilities and scientific literacy . These findings are consistent with the results of this study, where students were better able to interpret, analyze, and apply physics concepts in meaningful ways.

In addition, the findings highlight the importance of local wisdom integration in physics education. Ethnoscience-based learning materials and approaches allow students to explore scientific concepts through local traditions, tools, and practices (Harefa, D. 2025). Such integration not only enhances cognitive learning outcomes but also fosters cultural awareness and identity. Previous studies emphasize that ethnoscience can influence multiple aspects of learning, including motivation, conceptual understanding, and character development . In this study, the use of the Nias language reinforced students' connection to their cultural heritage, promoting both academic and cultural development.

However, despite these positive outcomes, several challenges were identified. Teachers need adequate training and resources to effectively integrate local

language and culture into physics instruction. Additionally, the development of teaching materials that combine scientific concepts with local wisdom requires time and careful design. Nevertheless, these challenges can be addressed through collaborative efforts among educators, curriculum developers, and local communities.

Overall, the findings of this study confirm that the Nias language is not merely a communication tool but also a powerful pedagogical resource. Its integration into physics learning provides a meaningful learning experience that bridges the gap between scientific knowledge and students' cultural context. This approach not only improves conceptual understanding but also supports the preservation of local culture in the educational process.

D. Discussion

Conclusion

This study aimed to investigate the effectiveness of the Nias language as a medium for strengthening science (Physics) concepts in Grade X at SMA Negeri 1 Teluk Dalam within the context of local culture (Harefa, D. 2025). Based on the findings from pretest-posttest results, classroom observations, questionnaires, and interviews, it can be concluded that the integration of the Nias language into physics learning has a positive impact on students' conceptual understanding, learning engagement, and scientific literacy.

First, the use of the Nias language significantly improved students' understanding of abstract physics concepts, particularly in topics such as motion and force. Students in the experimental group showed higher learning gains compared to those in the conventional learning group (Harefa, D. 2025). This indicates that learning becomes more effective when scientific concepts are explained using a language that is familiar to students and closely related to their daily lives.

Second, the integration of local language and cultural context increased students' motivation and participation in the learning process. Students became more active in discussions, more confident in expressing their ideas, and more willing to ask questions. This shows that the use of the Nias language reduces psychological barriers in learning physics, making the classroom environment more interactive and student-centered.

Third, this study confirms that culturally contextualized learning contributes to the development of scientific literacy. By connecting physics concepts with local experiences and cultural practices, students were able to better understand, interpret, and apply scientific knowledge in real-life situations. This supports the idea that science learning is

more meaningful when it is linked to students' cultural identity and environment.

Fourth, the findings highlight that the Nias language plays an important role not only as a communication tool but also as a cognitive bridge that helps students construct knowledge. This aligns with constructivist learning theory, which emphasizes that knowledge is built based on prior experiences and cultural understanding. The use of local language in physics learning helps students connect new scientific information with their existing knowledge structure.

Overall, the results of this study indicate that integrating the Nias language into physics learning at SMA Negeri 1 Teluk Dalam is an effective approach to strengthening conceptual understanding while preserving local cultural identity. Therefore, culturally based learning strategies should be considered as an alternative instructional approach in science education.

Recommendations

Based on the results and conclusions of this study, several recommendations are proposed:

1. For Teachers

Teachers are encouraged to integrate the Nias language and local cultural contexts into physics learning activities, especially when explaining abstract concepts. Teachers can use daily-life examples, traditional practices, and local phenomena to make learning more meaningful. In addition, teachers should develop more creative teaching strategies such as discussions, group work, and contextual problem-solving activities using local language support.

2. For Schools

SMA Negeri 1 Teluk Dalam is recommended to support the development of culturally based learning by providing training for teachers on ethnoscience and ethnophysics approaches. Schools should also encourage the development of teaching materials, modules, and learning media that incorporate local wisdom and the Nias language to enrich the learning process.

3. For Curriculum Developers

Educational policymakers and curriculum developers are advised to consider integrating local wisdom-based learning into the national curriculum framework. The inclusion of regional languages and cultural content can enhance the relevance of science education and promote cultural preservation alongside academic achievement.

4. For Students

Students are encouraged to actively engage in learning by connecting physics concepts with their own cultural experiences. By using both Indonesian and the Nias language in understanding

scientific concepts, students can improve their comprehension and develop stronger scientific literacy skills.

5. For Future Researchers

Future studies are recommended to expand this research by involving other science subjects such as chemistry and biology, or by applying the ethnoscience approach in different educational levels. Further research can also explore the development of digital learning media based on local language and culture to enhance interactive learning experiences.

In conclusion, the integration of the Nias language as a medium for strengthening physics concepts in a local cultural context has proven to be an effective educational approach. It not only improves students' academic performance but also strengthens cultural identity, making learning more meaningful, contextual, and sustainable.

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