

IMPLEMENTING NIAS CULTURE-BASED LEARNING TO IMPROVE STUDENTS' SCIENTIFIC ATTITUDES AND NUMERACY LITERACY

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Abstract

The purpose of this study was to examine the effect of implementing Nias culture-based learning on students' scientific attitudes and numeracy literacy at SMA Negeri 1 Teluk Dalam. This research employed a quasi-experimental design with a non-equivalent control group. The population consisted of tenth-grade students, and two classes were selected as the experimental and control groups using purposive sampling. The experimental group received mathematics instruction integrated with Nias cultural elements, while the control group received conventional mathematics instruction. Data were collected through a scientific attitude questionnaire, numeracy literacy tests, and classroom observations. Descriptive and inferential statistics, including independent sample t-tests and normalized gain (N-gain) analysis, were used to analyze the data. The results indicate that students in the experimental group showed significant improvement in both scientific attitudes and numeracy literacy compared to the control group. Students demonstrated greater curiosity, critical thinking, and engagement in learning, and they were more able to apply mathematical concepts to real-life contexts. This study highlights the importance of integrating local cultural elements into mathematics education to create meaningful, contextualized learning experiences that simultaneously enhance cognitive and affective outcomes.

Keywords: *Nias Culture-Based Learning; Scientific Attitudes, Numeracy Literacy; Ethnomathematics; Mathematics Education.*

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh implementasi pembelajaran berbasis budaya Nias terhadap sikap ilmiah dan literasi numerasi siswa di SMA Negeri 1 Teluk Dalam. Penelitian ini menggunakan desain quasi-eksperimen dengan kelompok kontrol yang tidak setara. Populasi penelitian adalah siswa kelas X, dengan dua kelas yang dipilih sebagai kelompok eksperimen dan kontrol menggunakan teknik purposive sampling. Kelompok eksperimen menerima pembelajaran matematika yang terintegrasi dengan unsur budaya Nias, sedangkan kelompok kontrol menerima pembelajaran matematika konvensional. Data dikumpulkan melalui angket sikap ilmiah, tes literasi numerasi, dan



observasi kelas. Analisis data dilakukan menggunakan statistik deskriptif dan inferensial, termasuk uji t dan analisis normalized gain (N-gain). Hasil penelitian menunjukkan bahwa siswa pada kelompok eksperimen mengalami peningkatan signifikan pada sikap ilmiah dan literasi numerasi dibandingkan kelompok kontrol. Siswa menunjukkan rasa ingin tahu, berpikir kritis, dan keterlibatan yang lebih tinggi dalam pembelajaran, serta kemampuan yang lebih baik dalam menerapkan konsep matematika pada konteks kehidupan nyata. Penelitian ini menekankan pentingnya integrasi unsur budaya lokal dalam pembelajaran matematika untuk menciptakan pengalaman belajar yang bermakna dan kontekstual, sekaligus meningkatkan hasil kognitif dan afektif siswa.

Kata kunci: *Pembelajaran Berbasis Budaya Nias, Sikap Ilmiah; Literasi Numerasi; Etnomatematika; Pendidikan Matematika.*

A. Introduction

Mathematics learning in the 21st century emphasizes not only cognitive achievement but also the development of students' scientific attitudes and numeracy literacy. Scientific attitude refers to students' curiosity, critical thinking, objectivity, and openness to evidence, which are essential in understanding mathematical concepts meaningfully. These attitudes significantly influence how students engage with learning and solve problems in real-life contexts. Meanwhile, numeracy literacy is a crucial competence that enables students to apply mathematical knowledge in everyday situations, particularly in interpreting data and solving contextual problems. However, various studies indicate that students' numeracy literacy in Indonesia remains relatively low and requires innovative learning approaches that integrate meaningful contexts into mathematics instruction. (Munthahana, J., Budiarto, M. T., & Wintarti, A. 2023)

One promising approach to addressing this issue is the integration of culture into mathematics learning through ethnomathematics. Ethnomathematics connects mathematical concepts with cultural practices, making learning more contextual and relevant to students' daily lives. Research shows that incorporating local wisdom into mathematics instruction can enhance students' understanding, engagement, and learning outcomes. Furthermore, ethnomathematics-based learning provides opportunities for students to explore mathematical ideas embedded in cultural artifacts, such as traditional architecture, patterns, and social practices. This contextualization not only improves numeracy skills but also fosters positive attitudes toward mathematics learning (Resi, B. B. F., Nay, F. A., Ellissi, W., & Bria, M. E. 2025)

In addition, the development of numeracy literacy is closely related to scientific-based learning approaches. Learning materials designed with a



scientific approach have been proven to significantly improve students' motivation and higher-order thinking skills. This indicates that integrating scientific attitudes into mathematics learning can positively influence students' ability to analyze, evaluate, and solve problems. Therefore, combining scientific attitudes with contextual learning approaches such as ethnomathematics becomes a strategic effort to improve both affective and cognitive learning outcomes simultaneously (Rangkuti, A. N., et al. 2024).

Furthermore, contextual and culture-based learning is highly relevant for senior high school students, as they require deeper conceptual understanding and the ability to apply knowledge in complex situations. Studies reveal that students' numeracy literacy is still at a basic level and requires more meaningful and contextual learning strategies to reach higher levels of understanding. This highlights the need for innovative teaching approaches that connect mathematical concepts with students' real-life experiences and cultural backgrounds (Pratiwi, D., Sudarmin, S., & Yamtinah, S. 2025).

Based on these considerations, implementing Nias culture-based learning in mathematics classrooms is expected to be an effective solution to enhance students' scientific attitudes and numeracy literacy. Nias culture, with its rich local wisdom such as traditional houses, cultural

practices, and social systems, provides authentic contexts for learning mathematical concepts. By integrating these cultural elements into mathematics instruction, students can experience more meaningful learning while simultaneously preserving local culture. Therefore, this study aims to investigate the implementation of Nias culture-based learning to improve students' scientific attitudes and numeracy literacy at SMA Negeri 1 Teluk Dalam.

B. Research Method

This study employed a quasi-experimental research design using a non-equivalent control group design to examine the effectiveness of implementing Nias culture-based learning in improving students' scientific attitudes and numeracy literacy. This design was selected because it allows researchers to compare the outcomes of an experimental group receiving a specific treatment with those of a control group without random assignment. The quasi-experimental approach is widely used in educational research where full randomization is not feasible due to existing classroom structures. It enables the researcher to measure the causal impact of an intervention in a natural classroom setting while maintaining practical feasibility (Salkind, N. J. 2010).

The research was conducted at SMA Negeri 1 Teluk Dalam, located in South Nias, Indonesia. The population of this study consisted of all tenth-grade students



enrolled in the academic year. Two classes were selected as samples using a purposive sampling technique: one class as the experimental group and another as the control group. The experimental group received mathematics instruction based on Nias culture, while the control group was taught using conventional learning methods. Purposive sampling is appropriate when selecting participants based on specific criteria relevant to the research objectives, ensuring that the sample reflects the characteristics needed for the study Palinkas, L. A., et al. (2015)..

The independent variable in this study was the implementation of Nias culture-based learning, while the dependent variables were students' scientific attitudes and numeracy literacy. Scientific attitudes were defined as students' curiosity, critical thinking, objectivity, and openness to new ideas, while numeracy literacy referred to students' ability to apply mathematical concepts in real-life contexts. The integration of cultural elements into mathematics learning aligns with the ethnomathematics approach, which emphasizes contextual and meaningful learning experiences. This approach has been shown to improve both affective and cognitive domains of students (D'Ambrosio, U. 2006).

Data were collected using multiple instruments, including a scientific attitude questionnaire, a numeracy literacy test, and observation sheets. The questionnaire was

designed using a Likert scale to measure students' attitudes toward scientific inquiry and learning processes. The numeracy literacy test consisted of contextual mathematical problems reflecting real-life situations, particularly those related to Nias culture. Observation sheets were used to record students' engagement and participation during the learning process. The use of multiple instruments enhances the validity and reliability of the data through triangulation (Creswell, J. W. 2015).

Before being administered, all instruments were validated by experts and tested for reliability. Content validity was assessed through expert judgment, while construct validity was analyzed using factor analysis. Reliability was measured using Cronbach's alpha coefficient to ensure consistency of the instruments. A reliable and valid instrument is essential to obtain accurate and trustworthy data, especially in educational research involving psychological and cognitive constructs. (Cronbach, L. J. to Harefa 2025)

The data analysis technique involved both descriptive and inferential statistics. Descriptive statistics were used to summarize the data, including mean, standard deviation, and percentage scores. Inferential statistics, such as independent sample t-tests, were conducted to determine whether there were significant differences between the experimental and control groups. Additionally, normalized gain (N-gain) analysis was used to measure



the improvement in students' numeracy literacy and scientific attitudes. These statistical methods are commonly applied in quasi-experimental studies to evaluate the effectiveness of educational interventions (Wasserstein, R. L., & Lazar, N. A. 2016)

Furthermore, prerequisite tests such as normality and homogeneity tests were conducted before hypothesis testing. The normality test aimed to determine whether the data were normally distributed, while the homogeneity test was used to assess the equality of variances between groups. These tests are important to ensure that the assumptions required for parametric statistical analysis are met. If the assumptions were violated, non-parametric alternatives would be used. This step ensures the robustness and accuracy of the statistical conclusions drawn from the study Branch, R. M. (2015)

Finally, the implementation procedure of Nias culture-based learning was carried out in several stages: planning, implementation, and evaluation. During the planning stage, lesson plans and teaching materials integrating Nias cultural elements were developed. In the implementation stage, students engaged in contextual learning activities involving cultural artifacts, such as traditional houses and local practices. In the evaluation stage, students' scientific attitudes and numeracy literacy were assessed using the prepared instruments. This systematic procedure

ensures that the intervention is conducted consistently and effectively throughout the research process (Harefa, D. 2025).

C. Research Results and Discussion

Results

The results of this study indicate that the implementation of Nias culture-based learning had a positive impact on students' scientific attitudes and numeracy literacy at SMA Negeri 1 Teluk Dalam. Based on the descriptive statistical analysis, the experimental group showed a significant increase in both variables compared to the control group. The mean score of students' scientific attitudes in the experimental class increased from the pre-test to the post-test, indicating improved curiosity, critical thinking, and openness to evidence. Similarly, students' numeracy literacy scores improved substantially, particularly in solving contextual mathematical problems related to real-life situations. These findings are consistent with previous studies highlighting the effectiveness of contextual learning in enhancing students' engagement and understanding Yilmaz, R. M. (2014).

Furthermore, the results of the independent sample t-test revealed a statistically significant difference between the experimental and control groups. The p-value obtained was less than 0.05, indicating that the implementation of Nias culture-based learning significantly influenced students' scientific attitudes and numeracy literacy. The experimental group



outperformed the control group in both variables, demonstrating that integrating cultural elements into mathematics learning provides a more meaningful learning experience. This finding supports the argument that culturally responsive teaching enhances student achievement and engagement in mathematics education Gay, G. (2013).

In addition, the normalized gain (N-gain) analysis showed that the improvement in students' numeracy literacy in the experimental group was categorized as moderate to high, while the control group showed only a low to moderate improvement. This indicates that students who learned through Nias culture-based learning experienced greater progress in applying mathematical concepts to real-life contexts. The integration of cultural contexts allowed students to better understand abstract mathematical ideas by relating them to familiar situations. This result aligns with studies emphasizing the importance of contextual and realistic mathematics education in improving numeracy skills Van den Heuvel-Panhuizen, M. (2014).

The improvement in students' scientific attitudes was also evident from the questionnaire results and classroom observations. Students in the experimental group demonstrated higher levels of curiosity, active participation, and critical questioning during the learning process. They were more engaged in discussions

and showed greater willingness to explore mathematical concepts through cultural contexts. Observation data revealed that students became more confident in expressing their ideas and evaluating different problem-solving strategies. This finding is in line with research showing that inquiry-based and contextual learning approaches foster positive scientific attitudes among students Kind, P., & Osborne, J. (2017).

Moreover, the integration of Nias cultural elements, such as traditional houses, local practices, and social structures, contributed significantly to students' understanding of mathematical concepts. These cultural contexts provided concrete examples that helped students visualize and interpret abstract mathematical ideas. As a result, students were able to solve problems more effectively and demonstrate better reasoning skills. This supports the concept of ethnomathematics, which emphasizes the role of culture in shaping mathematical understanding and learning processes .

Another important finding of this study is that students expressed positive responses toward the implementation of Nias culture-based learning. Based on student feedback, the learning process was more interesting, relevant, and meaningful compared to conventional teaching methods. Students reported that learning mathematics through cultural contexts made it easier to understand concepts and



increased their motivation to learn. This indicates that culturally relevant pedagogy not only improves academic performance but also enhances students' attitudes toward learning Ladson-Billings, G. (2014).

However, some challenges were also identified during the implementation of the learning model. Teachers required additional time and effort to design culturally integrated learning materials and activities. In addition, not all students were initially familiar with connecting cultural contexts to mathematical concepts, requiring guidance and adaptation during the learning process. Despite these challenges, the overall results demonstrate that the benefits of implementing Nias culture-based learning outweigh its limitations. This finding is consistent with previous studies highlighting both the opportunities and challenges of implementing culturally responsive teaching in classrooms Sleeter, C. E. (2012)..

Overall, the findings of this study confirm that the implementation of Nias culture-based learning is effective in improving students' scientific attitudes and numeracy literacy. The integration of cultural elements into mathematics learning provides a meaningful and engaging learning experience that enhances both cognitive and affective outcomes. Therefore, this approach can be considered a viable alternative for improving mathematics education, particularly in contexts where local culture can be utilized

as a valuable learning resource Schukajlow, S., & Rakoczy, K. (2019).

Discussion

The findings of this study demonstrate that the implementation of Nias culture-based learning significantly contributes to improving students' scientific attitudes and numeracy literacy at SMA Negeri 1 Teluk Dalam. This result confirms that integrating cultural contexts into mathematics instruction enhances both affective and cognitive domains of learning. The observed improvement in students' scientific attitudes, such as curiosity, critical thinking, and openness to evidence, indicates that culturally contextualized learning environments can foster deeper engagement and meaningful learning experiences. These findings are consistent with previous research emphasizing that contextual learning supports students in constructing knowledge actively.

The significant difference between the experimental and control groups further highlights the effectiveness of Nias culture-based learning. Students who were exposed to culturally integrated instruction performed better in numeracy literacy tasks compared to those who experienced conventional teaching methods. This suggests that embedding local cultural elements into mathematical problems helps students better understand abstract concepts by linking them to familiar real-life situations. This finding aligns with the principles of culturally relevant pedagogy,



which advocate for the inclusion of students' cultural backgrounds in the learning process to enhance academic achievement.

Moreover, the improvement in numeracy literacy can be explained through the lens of realistic mathematics education (RME), which emphasizes the use of real-world contexts in learning mathematics. The integration of Nias cultural elements, such as traditional architecture and local practices, provided meaningful contexts that allowed students to explore mathematical ideas more concretely. As a result, students were able to develop better problem-solving skills and apply mathematical concepts more effectively. This supports previous studies indicating that contextual and realistic approaches significantly improve students' mathematical understanding and literacy.

In terms of scientific attitudes, the findings reveal that students in the experimental group demonstrated higher levels of inquiry, participation, and critical reflection. This can be attributed to the interactive and student-centered nature of culture-based learning, which encourages students to actively engage in the learning process. By exploring mathematical concepts through cultural contexts, students are motivated to ask questions, investigate patterns, and evaluate solutions. This finding is supported by research suggesting that inquiry-based learning

fosters the development of scientific attitudes and critical thinking skills.

The use of ethnomathematics as a framework in this study also plays a crucial role in bridging the gap between formal mathematics and students' everyday experiences. Ethnomathematics allows students to recognize that mathematical concepts are embedded in their own culture, thereby increasing their appreciation and understanding of mathematics. In the context of Nias culture, elements such as traditional houses, patterns, and social systems serve as rich sources of mathematical exploration. This approach not only enhances students' learning outcomes but also contributes to the preservation of local culture. These findings are consistent with D'Ambrosio's perspective on the importance of cultural relevance in mathematics education.

Furthermore, students' positive responses toward the implementation of Nias culture-based learning indicate that this approach increases motivation and interest in learning mathematics. Students reported that learning through cultural contexts made mathematics more meaningful and enjoyable. This suggests that culturally responsive teaching not only improves academic performance but also enhances students' attitudes toward learning. Increased motivation is an important factor that contributes to better learning outcomes and long-term engagement in education. This finding is



supported by studies highlighting the impact of culturally relevant pedagogy on student motivation and achievement.

Despite the positive outcomes, this study also identified several challenges in implementing culture-based learning. One of the main challenges is the need for teachers to have sufficient knowledge and skills in integrating cultural elements into mathematics instruction. Designing culturally relevant learning materials requires time, creativity, and a deep understanding of both mathematical concepts and local culture. Additionally, some students initially faced difficulties in connecting cultural contexts with abstract mathematical ideas. However, these challenges can be addressed through proper teacher training and continuous practice. This finding is in line with previous research on the challenges of implementing culturally responsive teaching Sleeter, C. E. (2012).

Overall, this study confirms that Nias culture-based learning is an effective approach to improving students' scientific attitudes and numeracy literacy. The integration of cultural elements provides a meaningful and engaging learning experience that supports both cognitive and affective development. By connecting mathematics to students' cultural backgrounds, this approach helps students develop a deeper understanding of mathematical concepts while also fostering positive attitudes toward learning.

Therefore, Nias culture-based learning can be recommended as an innovative strategy for improving mathematics education, particularly in culturally diverse contexts Schukajlow, S., & Rakoczy, K. (2019).

D. Conclusion

Based on the findings and discussion of this study, it can be concluded that the implementation of Nias culture-based learning has a significant and positive impact on improving students' scientific attitudes and numeracy literacy at SMA Negeri 1 Teluk Dalam. The integration of cultural elements into mathematics learning provides meaningful learning experiences that connect abstract mathematical concepts with students' real-life contexts. This approach not only enhances students' cognitive abilities but also fosters the development of positive attitudes toward learning, particularly in terms of curiosity, critical thinking, and openness to new ideas.

The improvement in students' scientific attitudes observed in this study indicates that culture-based learning encourages active participation and inquiry. Students become more engaged in the learning process as they are given opportunities to explore mathematical concepts through familiar cultural contexts. This engagement leads to the development of essential scientific attitudes, such as questioning, reasoning, and evaluating evidence. As a result, students are better prepared to approach problems



systematically and make informed decisions based on logical thinking.

In terms of numeracy literacy, the findings demonstrate that students who participated in Nias culture-based learning showed greater improvement compared to those who experienced conventional teaching methods. The use of contextual problems derived from Nias culture enables students to better understand and apply mathematical concepts in real-life situations. This contextualization helps bridge the gap between theory and practice, allowing students to develop stronger problem-solving skills and a deeper understanding of mathematics. Consequently, students are more capable of interpreting data, analyzing situations, and making decisions based on numerical information.

Furthermore, the use of ethnomathematics as an underlying approach in this study highlights the importance of cultural relevance in education. By incorporating elements of Nias culture, such as traditional houses, local practices, and community structures, the learning process becomes more relatable and meaningful for students. This not only improves academic outcomes but also contributes to the preservation and appreciation of local culture. Students develop a sense of pride in their cultural heritage while simultaneously gaining a better understanding of mathematical

concepts embedded within their environment.

Another important conclusion is that students responded positively to the implementation of Nias culture-based learning. The learning process was perceived as more interesting, engaging, and relevant compared to traditional methods. This increased interest and motivation play a crucial role in supporting students' learning success. When students are motivated, they are more likely to participate actively, persist in solving problems, and achieve better learning outcomes. Therefore, motivation can be seen as a key factor that mediates the relationship between instructional approaches and student achievement.

Despite the positive outcomes, this study also acknowledges several limitations. One of the main challenges is the need for teachers to design and implement culturally integrated learning materials effectively. This requires a deep understanding of both mathematical concepts and local culture, as well as creativity in developing instructional strategies. Additionally, the study was conducted within a limited sample and specific context, which may affect the generalizability of the findings. Future research is recommended to involve a larger sample size and explore different educational levels to validate and expand the results of this study.



Based on the conclusions drawn from this research, several recommendations can be proposed. First, teachers are encouraged to integrate local cultural elements into mathematics learning to create more meaningful and engaging learning experiences. Second, educational institutions should provide training and support for teachers to develop culturally responsive teaching strategies. Third, curriculum developers should consider incorporating ethnomathematics approaches into the curriculum to promote the integration of culture and education. Finally, future researchers are encouraged to explore the use of technology in supporting culture-based learning, such as digital learning media that incorporate local cultural content.

In conclusion, the implementation of Nias culture-based learning represents an innovative and effective approach to improving students' scientific attitudes and numeracy literacy. By connecting mathematics with students' cultural backgrounds, this approach not only enhances academic achievement but also fosters positive attitudes toward learning and cultural appreciation. Therefore, Nias culture-based learning can serve as a valuable alternative in mathematics education, particularly in regions with rich cultural heritage, and has the potential to contribute to the development of more holistic and meaningful educational practices.

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