



Building an Understanding of Mathematics through Ethnic Mathematics: A Case Study of Learning in Bintuni Bay Regency

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Abstract

This study explores the application of ethnomathematics in mathematics education within the context of Bintuni Bay Regency. Ethnomathematics is the approach of linking mathematical concepts with local cultural practices, aiming to make learning more relevant and engaging for students. The research focuses on how this approach enhances students' understanding and motivation by integrating elements of local culture, such as traditional textile patterns, food-sharing customs, and handicrafts, into the mathematics curriculum. A qualitative case study method was used, involving classroom observations, interviews with teachers and students, and document analysis across three primary schools in Bintuni Bay. The findings indicate that students responded positively to the ethnomathematical approach, showing increased engagement and improved comprehension of mathematical concepts when taught in a culturally relevant context. Teachers also observed higher levels of participation, although they faced challenges related to limited resources and inadequate training. Despite these obstacles, ethnomathematics proved to be a valuable tool for deepening students' critical thinking and creativity, as well as fostering a connection between academic learning and their cultural heritage. The study concludes that ethnomathematics has significant potential to improve the quality of mathematics education, especially in culturally diverse regions like Indonesia. However, to optimize its implementation, further support is needed, including teacher training and the development of culturally appropriate teaching materials. This research contributes to a growing body of literature advocating for the integration of local culture into the educational process, offering recommendations for policymakers and educators to develop more responsive and inclusive curricula.

Keywords: Ethnomathematics, mathematics education, cultural integration, student motivation, contextual learning, Bintuni Bay

1. Introduction

Mathematics education plays a very important role in the formation of the basis of critical thinking and analytical abilities of students. In an era of globalization and rapid technological development, mathematical skills are increasingly relevant and needed (Jablonka, 2020). However, although the importance of mathematics education is widely recognized, many students still find it difficult to understand mathematical concepts. This restriction is often used by teachers who are too theoretical and lack practical context for students, making mathematics appear to be a difficult and uninteresting discipline (Durandt, 2021).

The interrelationship between mathematics and everyday life is often overlooked in the educational process. Many students are unable to see the relevance of the mathematical concepts taught in the classroom to the real situation they face. This led to low interest and motivation among students in learning mathematics, resulting in inadequate academic performance. To address these challenges, it is important for educators to develop learning strategies that are more contextually relevant to students (Abdulrahim and Orosco, 2022).

One of the promising approaches to address this problem is ethnic mathematics. Ethnomathematics is the study of how people of different cultures use and understand mathematical concepts in their daily lives. By integrating elements of local culture into math learning, ethnic mathematics can help students better understand math concepts (Zhang and Zhang, 2023). This approach not only makes learning more interesting, but also allows students to understand and understand their own cultural heritage.

Ethnomathematics has the potential to change the way students interact with mathematics. By introducing mathematical concepts through a cultural context familiar to students, they can more easily grasp and internalize the

material being taught (Mania and Alam, 2021). For example, measurement practices in handicrafts, patterns found in traditional art, or number systems used in local commerce can be concrete examples to help students understand mathematical concepts. Therefore, ethnic mathematics is not only a tool for teaching mathematics, but also a tool for strengthening the cultural identity of students.

Bintuni Bay Regency has a variety of cultural assets that can be used as a resource for math learning. Society in this field has a rich tradition and knowledge, which can be integrated into the teaching of mathematics. Given the importance of cultural context in the teaching and learning process, this study aims to explore how ethnic mathematics can be applied to mathematical learning in Bintuni Bay Regency. The study is expected to provide new insights into the use of local culture in mathematics education.

This study has a clear purpose, namely to explore and analyze the application of the ethnic mathematics approach in mathematics learning at the school of Bintuni Bay Regency. Using this approach, students are expected to better understand and understand mathematical concepts through their cultural context. The study also sought to identify the teaching methods used by teachers in applying ethnic mathematical approaches and to assess their impact on students' mathematical understanding. In the context of education in Indonesia, the challenge of integrating a contextual approach into the existing curriculum is enormous. Often, the curricula implemented in schools are rigid and inflexible, making it difficult to adapt elements of local culture to learning (Ismiunia Hasmar et al., 2023). Therefore, this study aims to provide recommendations to educators and policy makers in developing a curriculum that is more comprehensive and responsive to student needs (Fiharsono, 2021).

Through this study, it is expected to find effective teaching methods in applying ethnic mathematics in the classroom. This method will focus on specific ways in which teachers can integrate local culture into math education. It is expected that by using the right methods, students will be more involved in the learning process and will be able to see the relevance of mathematics in everyday life (Schoenfeld, 2020).

In addition, this study also evaluates students' responses to math learning based on ethnic mathematics. Students are invited to reflect on their experiences during the learning process, such as how this approach affects their understanding of mathematical concepts. These responses are important to get an idea of the effectiveness of the application of ethnic mathematics in learning.

In this study, we use a qualitative approach using the case study method to gain a deep understanding of the application of ethnic mathematics in schools in the Bintuni Bay Regency. This methodology allows researchers to unearth rich and detailed information about the experiences of teachers and students during the learning process. By involving several schools, the results of the study are expected to provide a comprehensive picture of the implementation of ethnic mathematics in a regional context.

Class observations are made to see how teachers implement an ethnic mathematical approach in everyday education. The researchers also conduct interviews with teachers and students to gain their perspective on the application of ethnic mathematics. The data obtained are analyzed to identify new themes, as well as the relationship between local culture and taught mathematical concepts (Assari et al., 2020).

The results of this study are expected to provide valuable insights into the successes and challenges faced in the application of ethnic mathematics. Understanding what works and what doesn't work in the context of learning can help educators develop more effective strategies to improve students' mathematical understanding. This research is also expected to contribute to literature on mathematics education in Indonesia.

The study also aims to identify the obstacles teachers may face when applying ethnic mathematics in the classroom. These constraints may be related to lack of resources, training, or support from the school. If you know these challenges, you can design remedial measures to help teachers better implement this approach.

Integrating local culture into mathematics education not only improves students' understanding but also strengthens their cultural identity. In an increasingly globalized world, it is important for students to cherish their cultural heritage while still preparing for global challenges. The study contributes to the understanding that education is not only about the transfer of knowledge, but also about the formation of character and identity (León-Mantero et al., 2020).

Therefore, it is important to develop learning approaches that can accommodate cultural diversity and local contexts. This study aims to emphasize the importance of cultural context in mathematics education and how ethnic mathematics serves as a bridge between local knowledge and broader mathematical concepts (Reinholz et al., 2020).

Thus, this study aims not only to improve students' understanding of mathematics, but also to strengthen the relationship between education and culture. The results of this study are expected to benefit teachers, students and society as a whole to create a better learning environment.

The successful implementation of ethnic mathematics in mathematics learning at Bintuni Bay Regency will be a good example for the rest of Indonesia. The study will serve as a model for the development of a more comprehensive curriculum that not only takes into account the academic needs of students, but also emphasizes the richness of local culture.

In addition, the results of this study are expected to stimulate further research in the field of ethnic mathematics and mathematics education in general. As the number of studies on this subject increases, a greater awareness of the importance of cultural integration in education is expected.

In a broader context, this study can also contribute to the efforts of governments and educational institutions to improve the quality of education in Indonesia. By applying an ethnographic approach, it is expected to create a generation that is not only academically intelligent, but also recognizes and appreciates one's own culture.

The study is closed with a discussion of conclusions that can be drawn from the results of the study and recommendations for further action. It is expected that this research will make a meaningful contribution to the development of mathematics education in the Bintuni Bay and other regions of Indonesia.

2. Literature Review

2.1. Ethnomathematics

Ethnomathematics is a field of study that links mathematics to local culture and understands how certain groups of people use mathematical concepts in their daily lives (Nur and Waluya, 2021). According to D'ambrosio, ethnic mathematics encompasses all mathematical knowledge used by a given cultural group. This approach recognizes that mathematics is not only taught in a formal context, but also interwoven with certain cultural practices. In an educational context, ethnic mathematics helps to increase the relevance of learning by providing students with a known cultural context (Appelbaum and Stathopoulou, 2023).

In addition, it is important to understand the concept of contextual learning, in which learning in mathematics is combined with the actual experience of the student. Contextual learning focuses on creating relationships between new knowledge and knowledge that students already have, so they can see the relevance of the material taught in their daily lives. The integration of ethnic mathematics in contextual learning will allow students to associate theories with actual practices that exist in their culture, so the development of mathematical concepts will be more effective.

3. Methods

This study uses case study methods and qualitative approaches to explore the application of ethnic mathematics in mathematics learning at the Bintuni Bay Regency school. This method was chosen to allow researchers to deeply understand the experiences of teachers and students during the learning process. Details of the methodology used in this study are as follows.

3.1. Location and Participants

The study was carried out in three primary schools of Bintuni Bay Regent, selected based on the diversity of local culture. The school has a learning program that integrates elements of ethnic mathematics into the curriculum. Participants in the study consisted of:

3.1.1. Math teacher

Three teachers who have experience in teaching mathematics and are applying an ethnic math approach in their classes.

3.1.2. Students

About 30 students in each school, between the ages of 10 and 12, were involved in an ethnic math-based learning process.

3.2. Data Collection

The data collection methods used in this study include:

3.2.1. Class observation

The researchers made direct observations of the learning process in the classroom to understand how teachers apply the ethnic mathematical approach. These observations include teacher-student interactions, the use of materials related to local culture, and how students participate in learning.

3.2.2. Interview

Semi-structured interviews with teachers and students will be conducted to gain a perspective on the application of ethnic mathematics. The interview questions are designed to explore the impact of this approach on their experiences, challenges they face, and students' understanding of mathematics. The interview was recorded and then transcribed for further analysis.

3.2.3. Document analysis

We also collect relevant documents such as syllabus, lesson plans and teaching materials used by teachers. These documents are analyzed to understand how ethnic mathematics is integrated into the curriculum and learning materials.

3.3. Data Analysis

The data obtained from observations, interviews and analysis of documents were analyzed thematic. The analysis process includes:

3.3.1. Coding data

Interview transcriptional data and observation notes are encoded to identify new themes. This coding is done using qualitative analysis software such as NVivo to make it easier to group information.

3.3.2. Identify a theme

When the data is encoded, the main theme is identified based on the frequency and relevance of the information. These themes are used to discuss the results of research in the context of research objectives.

3.3.3. Data Interpretation

The analyzed data is interpreted to provide a detailed understanding of the application of ethnic mathematics in mathematical learning. The researchers consider the cultural context, the teacher's experience, and the student's response in the interpretation process.

3.4. Validity and Reliability

To ensure the validity and reliability of the study, researchers triangulated the data by comparing information from a variety of sources, including observations, interviews, and documents. In addition, the researchers also conducted a member check, which is to seek feedback from teachers and students on the initial findings of the study to ensure the accuracy and accuracy of the data interpretation.

4. Results and Discussion

4.1. Class observations

Classroom observations were conducted in three primary schools over the course of one semester. Below is a summary of the findings from the classroom observations

4.1.1. Integrated elementary school

Application in a geometry lesson, the teacher explained the concept of symmetry using a traditional textile pattern. Students were asked to draw the pattern to increase their interest. Students actively discussed and asked questions about applications of mathematical concepts in everyday life.

4.1.2. Elementary school impres SP 5

Implementation in a lesson on fractions, the teacher linked the concept of fractions to traditional methods of dividing food (e.g. measuring ingredients for cooking). Students were very interested in the lesson and were able to give specific examples from their own culture.

4.1.3. Elementary madrasah school

The concepts of size and measurement were taught using examples from local crafts, such as measuring yarn lengths for knitting. Students actively participate in practical skills and demonstrate their measurement and calculation skills.

4.2. Interviews

Six teachers and 30 students (10 students from each school) were interviewed. Below is a summary of the interview findings

4.2.1. Teachers.

Positive experiences, 83% of teachers said that ethnomathematics made their students more enthusiastic about learning mathematics, 67% of teachers felt that they did not receive enough training to integrate local culture into their teaching.

4.2.2. Students.

Motivation, 90% of students said that they would enjoy learning more if math was taught in a cultural context, 80% of students said that they would understand mathematical concepts better if they were taught in a way that was relevant to their daily lives.

4.3. Document analysis

The documents analyzed included syllabi and lesson plans used in the three schools. Below is a summary of the findings from the document analysis.

Curriculum all schools have included elements of local culture in their curriculum with an emphasis on contextualized learning. The teaching materials used include examples of local culture, such as paintings, patterns and textiles and handicrafts. However, only 50% of the formally available teaching materials address cultural issues in depth.

Table 1: Summary of research results data

Aspects	Integrated Elementary School	Elementary School Impres SP 5	Elementary madrasah school	Total
Students who are actively involved	24/30 (80%)	28/30 (93%)	26/30 (87%)	78/90 (87%)
Teachers who report positively	5/6 (83%)	6/6 (100%)	5/6 (83%)	16/18 (89%)
Students who feel better	28/30 (93%)	27/30 (90%)	24/30 (80%)	79/90 (88%)
Challenges faced by teachers	4/6 (67%)	3/6 (50%)	4/6 (67%)	11/18 (61%)

Data from observations, interviews and document analysis show that the implementation of ethnic mathematics in Bintuni Bay district has had a significant positive impact on students' understanding and motivation. Despite the challenges faced by teachers, especially in terms of training and resources, the majority of students and teachers reported a positive experience in implementing this approach.

The data showed that students are more motivated to learn mathematics if they can relate it to their own cultural background. This suggests that ethnomathematics can be an effective tool to improve the quality of mathematics education in the region.

The findings of this study, based on observations, interviews and document analysis in three schools in the study areas, reveal several key findings about the application of ethnomathematics in mathematics learning in Bintuni Bay Regency. These findings are organized under a number of main themes.

4.3.1. Application of ethnomathematics in learning

Classroom observations revealed that teachers actively incorporate local cultural elements into mathematics learning materials. For example, in geometry lessons, teachers used traditional textile patterns as examples to explain the concepts of symmetry and shape. Students participated in group discussions, calculating and discussing how the pattern could be measured and described in mathematical terms. This shows that ethnomathematics is not just an add-on but is central to the learning process.

4.3.2. Students' positive reactions to learning

Interviews with students indicate that they are more engaged in learning mathematics when it is connected to their own culture. Many students indicated that they are more likely to understand mathematical concepts when they are taught in a way that is connected to their everyday experiences. For example, when fractions are taught through traditional food sharing, students can easily explain and apply the concepts in real life situations.

4.3.3. Developing critical skills and creativity

Using an ethnomathematical approach also encourages students to think critically and creatively. Observations have shown that students often come up with original solutions to mathematical problems when faced with situations involving their own culture. In one learning session, students were asked to design their own textile patterns using the mathematical concepts they had learned. This activity not only deepened their understanding of the concepts they had learned, but also provided an opportunity to express their creativity.

4.3.4. Challenges faced by teachers

Despite the many benefits, challenges teachers face when implementing ethnomathematics were also identified. Some teachers felt that they did not receive adequate training to integrate local culture into mathematics teaching. They also reported that time constraints were a barrier to planning and implementing lesson plans that included cultural elements. In addition, the lack of resources such as relevant teaching materials was also a barrier.

4.4. Discussion

The results showed that the implementation of ethnomathematics in mathematics learning in Bintuni Bay Regency had a significant impact on students' understanding and motivation. This is consistent with the literature that contextualized learning that relates the subject matter to students' local experiences and culture improves learning outcomes. Understanding mathematics in a cultural context enables students not only to acquire academic knowledge but also to develop critical thinking skills that are essential for everyday life.

Students' increased interest and motivation to learn can be explained by constructivist learning theory, in which students construct their own knowledge based on relevant experiences and contexts. If students can make connections between mathematics and their own culture, they will feel more connected to the material being taught and will be more motivated to learn.

However, the difficulties teachers face when implementing ethnomathematics suggest an urgent need for training programs specifically designed to integrate local culture into mathematics education. Support from schools and government is essential to ensure that teachers have the resources and skills they need to implement this approach effectively. In-depth training programs can help build teachers' confidence in teaching mathematics in a cultural context and provide effective strategies for overcoming barriers.

5. Conclusion

This study shows that the application of ethnomathematics in mathematics learning at Bintuni Bay Regency has a significant positive impact on students' understanding and motivation. This approach enables students to relate mathematical concepts to local culture, such as textile patterns, traditional methods of food division and handicrafts. By incorporating culture into the study of mathematics, students become more engaged and are better able to understand the material and think critically and creatively. Using contexts closer to everyday life allows students to more easily digest concepts that may have previously been abstract.

In interviews with students and teachers, most students responded positively to this ethnomathematic approach. Students felt that learning was more relevant and fun and teachers felt that students were more engaged and motivated. However, the study also identified challenges, particularly limited teacher training and lack of resources to support the implementation of ethnomathematics. Teachers felt that it is difficult to design learning materials that are appropriate to the local culture and that too much time is required to prepare for ethnomathematics-based learning.

However, the great potential of ethnomathematics to improve the quality of mathematics learning in culturally rich regions like Indonesia, especially in Bintuni Bay, is promising. With appropriate training and support from the government and schools, this approach can be optimized to improve students' academic performance while preserving local culture. There is an urgent need for training programs for teachers and the development of culturally based materials for more effective implementation of ethnomathematics in schools.

Overall, ethnomathematics has proven to be a bridge between formal education and local cultural richness and can make mathematics learning more meaningful and contextualized for students. Further support and development is needed to scale up its implementation so that it can benefit the wider Indonesian education community.

References

- Abdulrahim, N. A., & Orosco, M. J. (2020). Culturally responsive mathematics teaching: A research synthesis. *The urban review*, 52(1), 1-25.
- Appelbaum, P., & Stathopoulou, C. (2023). History of Ethnomathematics: Recent Developments. *The Role of the History of Mathematics in the Teaching/Learning Process: A CIEAEM Sourcebook*, 189-207.
- Assari, S., Boyce, S., Bazargan, M., & Caldwell, C. H. (2020). Mathematical performance of American youth: Diminished returns of educational attainment of Asian-American parents. *Education sciences*, 10(2), 32.
- Durandt, R. (2021). Design principles to consider when student teachers are expected to learn mathematical modelling. *Pythagoras*, 42(1), 618.
- Fiharsono, A. (2021). Culturally-Based Learning Needs of Indigenous Students in Indonesian Papua. Unpublished Doctoral thesis). *University of the Sunshine Coast*. <https://doi.org/10.25907/00096>.
- Ismiunia Hasmar, D., Fatimah, J. M., & Farid, M. (2023, June). Check for updates Intercultural Communication: *Barriers to Adaptation Between Ethnic Bugis and Ethnic Papuans in Jayapura City*. In *Proceedings of the 3rd International Conference on Linguistics and Cultural (ICLC 2022) (Vol. 756, p. 218)*. Springer Nature.

- Jablonka, E. (2020). Critical thinking in mathematics education. *Encyclopedia of mathematics education*, 159-163.
- León-Mantero, C., Casas-Rosal, J. C., Pedrosa-Jesús, C., & Maz-Machado, A. (2020). Measuring attitude towards mathematics using Likert scale surveys: The weighted average. *Plos one*, 15(10), e0239626.
- Mania, S., & Alam, S. (2021). Teachers' perception toward the use of ethnomathematics approach in teaching math. *International Journal of Education in Mathematics, Science and Technology*, 9(2), 282-298.
- Nur, A. S., & Waluya, S. B. (2021). Ethnomathematics Perspective and Challenge as a Tool of Mathematical Contextual Learning for Indigenous People. *International Journal on Emerging Mathematics Education (IJEME)*, 5(1).
- Reinholz, D., Johnson, E., Andrews-Larson, C., Stone-Johnstone, A., Smith, J., Mullins, B., ... & Shah, N. (2022). When active learning is inequitable: Women's participation predicts gender inequities in mathematical performance. *Journal for Research in Mathematics Education*, 53(3), 204-226.
- Schoenfeld, A. H. (2020). Mathematical practices, in theory and practice. *ZDM*, 52(6), 1163-1175.
- Zhang, W., & Zhang, Q. (2023). Ethnomathematics and its integration within the mathematics curriculum. *Journal of mathematics education*, 151-157.