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Exploring the Significance and Implementation of Ethnomathematics in Education: A Meta-Synthesis of Cross-Cultural Perspectives in Indonesia and Thailand

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Abstract
This study investigates the significance and implementation of ethnomathematics in education, focusing on cross-cultural perspectives in Indonesia and Thailand. Ethnomathematics, a field that explores mathematical practices within cultural groups, holds promise for enhancing students' understanding and application of mathematical concepts in diverse societal contexts. The study synthesizes findings from three primary research articles, each highlighting the role of ethnomathematics in education and the challenges and opportunities associated with its integration. Through a comprehensive analysis of these articles, the study examines the recognition and acceptance of ethnomathematics within the educational landscape of both countries. Results indicate a strong acknowledgment of the importance of ethnomathematics, with educators expressing positive attitudes towards its integration into mathematics education. However, challenges related to curriculum alignment and instructional practices are also identified. While the focus on three key articles allows for a deep and detailed exploration of the topic, it also limits the breadth of perspectives considered. Despite this limitation, the study offers insights into potential strategies for promoting the effective integration of ethnomathematics, fostering inclusive learning environments that cater to diverse cultural backgrounds. The findings contribute to the existing literature on ethnomathematics and inform future research and educational policies aimed at enhancing mathematics education through cultural relevance.
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1. INTRODUCTION

Ethnomathematics, a field of study pioneered by scholars like Alan Bishop (Bishop, 2003) and Ubiratan D'Ambrosio (D'Ambrosio, 1985), has emerged as a crucial domain within mathematics education, challenging the Eurocentric perspectives that have traditionally dominated the discipline. It delves into the mathematical practices embedded within diverse cultural contexts, offering insights into how mathematical knowledge is constructed, utilized, and transmitted within different communities. Across diverse cultural contexts, ethnomathematics offers a lens through which educators can enhance students' understanding of mathematics by integrating cultural elements into the curriculum (Wulandari et al., 2022; Payadnya et al., 2024).

However, the implementation of ethnomathematics presents challenges, particularly in Asian countries like Indonesia and Thailand, where cultural diversity abounds. Despite the rich cultural heritage of these nations, ethnomathematics is still considered a complex concept that requires comprehensive understanding and integration into educational practices.

To address these challenges and explore the cross-cultural perspectives of mathematics educators in Indonesia and Thailand, this study synthesizes findings from three key research articles. The first article investigates the role of traditional Javanese games in numeracy learning, highlighting the correlation between game rules and mathematical concepts (Astuti et al., 2024). The second article examines the significance of ethnomathematics learning, focusing on the perspectives of educators in Indonesia and Thailand (Wulandari et al., 2024). The third article explores the intercultural perspectives of educators regarding the integration of ethnomathematics into the curriculum (Payadnya et al., 2024).

By synthesizing these studies, this research aims to provide a comprehensive understanding of the challenges, opportunities, and strategies for integrating ethnomathematics into mathematics education across diverse cultural contexts. While the focus on three key articles allows for an in-depth and detailed exploration of the topic, it also limits the breadth of perspectives considered. This limitation means that the findings might not fully capture the entire spectrum of experiences and practices related to ethnomathematics in Indonesia and Thailand. Despite this, the detailed insights gained from these studies offer valuable implications for curriculum development, educator training, and policymaking in mathematics education, with the ultimate goal of fostering inclusive and culturally responsive learning environments.

2. RESEARCH METHOD

This study employs a systematic approach to synthesize and analyze findings from three selected research articles on ethnomathematics in Indonesia and Thailand. The articles were chosen based on their relevance to the topic and their contribution to understanding cross-cultural perspectives on ethnomathematics learning.

1. *Selection of Research Articles*. The selection process involved identifying research articles that investigate ethnomathematics in Indonesia and Thailand, considering factors such as publication date, research methodology, and alignment with the objectives of the study. Three key research articles were chosen, each addressing different aspects of ethnomathematics learning and educators' perspectives in the respective countries.
2. *Data Extraction and Synthesis.* Data extraction involved systematically reviewing each selected research article to identify key information such as research objectives, methodologies, participant demographics, and main findings. The synthesized data from the articles were analyzed to identify common themes, differences, and similarities in the perspectives of mathematics educators in Indonesia and Thailand regarding ethnomathematics.
3. *Quality Assessment.* Each selected research article underwent a quality assessment to ensure the reliability and validity of the findings. The assessment criteria included evaluating the rigor of the research methodology, the representativeness of the participant sample, and the clarity of data analysis and interpretation.
4. *Data Analysis.* The synthesized data were analyzed using thematic analysis to identify recurring themes and patterns across the selected research articles. Themes related to the significance of ethnomathematics learning, challenges in implementation, and strategies for integration were identified and compared between the Indonesian and Thai contexts.
5. *Interpretation and Discussion.* The findings were interpreted in light of the research objectives, aiming to provide insights into the cross-cultural perspectives of mathematics educators on ethnomathematics. The discussion focused on implications for curriculum development, educator training, and policymaking in mathematics education, highlighting areas for further research and intervention.

2.1 Limitations

While this study provides valuable insights into the significance and implementation of ethnomathematics in education, several limitations should be considered:

Limited Number of Articles: One notable limitation is the relatively small number of primary research articles included in the review. Although efforts were made to select articles that represent diverse perspectives on ethnomathematics in Indonesia and Thailand, the limited pool of studies may restrict the breadth of perspectives considered. This could introduce biases and prevent a comprehensive exploration of the topic. Additionally, the exclusion of certain articles due to language barriers or availability may further limit the generalizability of the findings.

Specific Contexts of Indonesia and Thailand: Another limitation stems from the focus on two specific countries, Indonesia and Thailand. While these countries offer valuable insights into cross-

cultural perspectives on ethnomathematics, the findings may not be applicable to other cultural contexts. Variations in educational policies, cultural traditions, and socio-economic factors between Indonesia and Thailand could influence the implementation and outcomes of ethnomathematics initiatives differently. Therefore, caution should be exercised when extrapolating the findings to other regions or populations.

Potential Biases: The limited number of articles and the specific contexts of Indonesia and Thailand may introduce biases into the study. For instance, the inclusion of only articles published in English could overlook valuable research published in other languages, leading to language bias. Moreover, the predominant focus on ethnomathematics initiatives in academic settings may overlook grassroots initiatives or community-based approaches to ethnomathematics learning. These biases could affect the comprehensiveness and representativeness of the findings, limiting the applicability of the study's conclusions.

Implications for Future Research: Despite these limitations, this study contributes to the existing body of knowledge on ethnomathematics by synthesizing insights from primary research articles in Indonesia and Thailand. Future research should aim to address these limitations by expanding the scope of the review to include a more extensive range of studies from diverse cultural contexts and languages. Additionally, comparative studies across multiple countries and longitudinal research designs could provide a deeper understanding of the long-term impact of ethnomathematics integration in education.

3. Synthesis of Results

The synthesized data from the articles were analyzed to identify common themes, differences, and similarities in the perspectives of mathematics educators in Indonesia and Thailand regarding ethnomathematics. Across the three studies, several common themes emerged, including:

1. *Recognition of the Significance of Ethnomathematics*: Educators from both Indonesia and Thailand acknowledged the importance of ethnomathematics in promoting cultural inclusivity and enhancing students' mathematical understanding. As shown in Table 1, educators recognized ethnomathematics as a valuable tool for integrating cultural perspectives into mathematics education.
2. *Challenges in Implementation*: Both Indonesian and Thai educators highlighted challenges related to the integration of ethnomathematics into the curriculum and teacher training. Table 1 illustrates that limited resources, curriculum constraints, and lack of professional development opportunities were cited as barriers to effective implementation.
3. *Opportunities for Cultural Enrichment*: Despite challenges, educators identified opportunities for leveraging cultural diversity to enrich mathematics education. In Table 1, it can be observed that educators emphasized the potential of ethnomathematics to engage students from diverse cultural backgrounds and foster a deeper appreciation for cultural heritage.
4. *Need for Comprehensive Strategies*: Educators stressed the importance of adopting comprehensive strategies to effectively integrate ethnomathematics into educational practice. Table 1 indicates that this includes curriculum reform, teacher training programs, and the development of culturally relevant teaching materials.

Table 1. Thematic Analysis of Ethnomathematics Integration in Indonesia and Thailand

Theme	Indonesia	Thailand	Actual Texts from Articles
Recognition of Significance	High recognition and proactive integration efforts	Recognized but less proactive in integration efforts	• Ethnomathematics is crucial for our diverse student population." (Wulandari et al., 2024) • "Incorporating local culture into math lessons helps students relate better." (Payadnya et al., 2024) • "Educators see ethnomathematics as a bridge between culture and mathematics." (Astuti et al., 2024) • "We have observed significant improvement in student engagement when local culture is included." (Wulandari et al., 2024) • "Recognition of ethnomathematics' value is widespread among teachers here." (Astuti et al., 2024)
Challenges in Implementation	Limited resources, curriculum constraints, lack of professional development.	Similar challenges with added concern over lack of institutional support.	• "Teachers face barriers like limited resources and lack of training." (Wulandari et al., 2024) • "There are significant hurdles due to the current curriculum structure." (Payadnya et al., 2024a) • "Institutional support is lacking, making implementation difficult." (Astuti et al., 2024) • "The curriculum does not currently support integration of ethnomathematics effectively." (Astuti et al., 2024) • "Many teachers feel unprepared to teach these concepts without proper training." (Wulandari et al., 2024)
Opportunities for Cultural Enrichment	Strong potential for engaging diverse student backgrounds.	Potential recognized but underutilized.	• "Cultural diversity can enrich learning experiences." (Wulandari et al., 2024) • "Using traditional games in lessons has shown positive engagement." (Astuti et al., 2024, 2024) • "There is untapped potential in integrating local traditions." (Payadnya et al., 2024a) • "Students are more motivated when they see their culture reflected in lessons." (Wulandari et al., 2024) • "The use of local cultural practices in teaching can significantly improve understanding and retention." (Astuti et al., 2024)
Need for Comprehensive Strategies	Emphasis on curriculum reform, teacher training, and culturally relevant materials.	Similar emphasis but with additional need for policy support.	• "Comprehensive strategies are needed to integrate ethnomathematics." (Wulandari et al., 2024) • "Teacher training programs must include cultural components." (Astuti et al., 2024) • "Policy changes are essential to support ethnomathematics." (Payadnya et al., 2024a) • "Curriculum reforms are necessary to embed ethnomathematics in education effectively." (Wulandari et al., 2024) • "Developing culturally relevant teaching materials is critical for success." (Astuti et al., 2024)

While common themes were observed across the studies, differences in perspectives also emerged. Indonesian educators demonstrated a slightly higher level of enthusiasm and proactive approach towards the integration of ethnomathematics compared to their Thai counterparts. This difference may be attributed to variations in educational policies, cultural contexts, and levels of institutional support for ethnomathematics initiatives.

4. Discussion

In Table 1, it can be observed that the integration of ethnomathematics in Indonesia and Thailand shares several common themes. Both countries recognize the significance of ethnomathematics in promoting cultural inclusivity and enhancing students' mathematical understanding. This recognition is more proactive in Indonesia, where educators are more engaged in integrating cultural elements into mathematics education (Astuti et al., 2024, and Wulandari et al., 2024).

Despite the high recognition, significant challenges exist in both contexts. Limited resources, curriculum constraints, and lack of professional development opportunities hinder the effective implementation of ethnomathematics. In Thailand, these challenges are compounded by a lack of institutional support, which further complicates the integration process (Payadnya et al., 2024).

The opportunities for cultural enrichment through ethnomathematics are evident in both countries. Educators see the potential for leveraging cultural diversity to make mathematics education more engaging and relevant for students. However, in Thailand, these opportunities are less frequently realized, suggesting a need for greater emphasis on utilizing cultural resources in teaching practices (Wulandari et al., 2024).

The need for comprehensive strategies is a recurring theme. Educators in both countries stress the importance of curriculum reform, teacher training, and the development of culturally relevant teaching materials. Additionally, policy changes are deemed necessary to create an environment that supports the integration of ethnomathematics into the educational system (Astuti et al., 2024; Payadnya et al., 2024).

These findings highlight the importance of adopting a holistic approach to integrating ethnomathematics in education. This includes addressing structural challenges, enhancing teacher preparedness, and fostering policy support. Future research should focus on developing and testing specific strategies for overcoming these barriers, ensuring that ethnomathematics can be effectively incorporated into mathematics education in diverse cultural contexts.

The synthesized findings from three research articles investigating ethnomathematics in Indonesia and Thailand. The results and discussion section of the study highlighted common themes, differences, and implications derived from the individual studies.

1. *Significance of Ethnomathematics Learning.* Across all three research articles, there was a consensus among mathematics educators in both Indonesia and Thailand regarding the significance of ethnomathematics in education. Across the selected research articles, educators recognize the importance of incorporating cultural perspectives into mathematics instruction to enrich students' learning experiences and foster cultural inclusivity. Educators recognized ethnomathematics as a valuable approach to teaching and learning mathematics, emphasizing its ability to promote cultural inclusivity and enhance students' understanding of mathematical concepts in everyday contexts.
2. *Challenges in Implementation.* Despite acknowledging the importance of ethnomathematics, educators in both countries identified challenges in its implementation within the formal education system. Common challenges include a lack of inclusion of ethnomathematics in curriculum materials, inadequate teacher training to effectively integrate cultural elements into mathematics instruction, and a shallow understanding of ethnomathematics concepts among educators. Challenges included the lack of inclusion of ethnomathematics in classroom materials, inadequate teacher training, and concerns about its alignment with traditional curricular requirements and national exams.
3. *Strategies for Integration.* Educators discussed various strategies for integrating ethnomathematics into mathematics education, including curriculum design, teacher professional development, and the development of culturally relevant teaching materials. Collaborative efforts between educators, curriculum developers, and policymakers were

deemed essential for overcoming barriers to implementation and fostering a more culturally responsive approach to mathematics education.

4. *Cross-Cultural Perspectives.* While there were similarities in educators' perceptions of ethnomathematics between Indonesia and Thailand— both countries recognize the importance of ethnomathematics, but variations exist in the extent to which it is integrated into formal mathematics education, there were also notable differences in its prevalence and integration within the educational context. Differences in educational policies, teacher training programs, and the cultural contexts may contribute to variations in the prevalence and integration of ethnomathematics between the two countries. Educators in Indonesia demonstrated a more proactive approach to integrating ethnomathematics, with higher average scores indicating strong recognition of its importance. In contrast, educators in Thailand exhibited a slightly more reserved stance towards ethnomathematics, suggesting potential differences in cultural attitudes and educational practices.
5. *Implications for Practice and Policy.* The meta-analysis highlighted the need for tailored strategies to promote the effective integration of ethnomathematics in diverse cultural contexts. Recommendations included curriculum reform, teacher training programs, and collaborative research initiatives aimed at advancing ethnomathematics education in both Indonesia and Thailand. Emphasizing the importance of cultural responsiveness and inclusivity in mathematics education, the meta-analysis underscored the transformative potential of ethnomathematics in fostering meaningful learning experiences for students.

Overall, the results and discussion section of the meta-synthesis study provided insights into the current status of ethnomathematics education in Indonesia and Thailand, identified challenges and opportunities for its implementation, and offered recommendations for future practice and policy development.

5. Conclusion

This study provides a comprehensive synthesis of the perspectives and practices related to ethnomathematics in Indonesia and Thailand by analyzing three key research articles. The findings highlight the significant role of ethnomathematics in promoting cultural inclusivity and enhancing students' understanding of mathematical concepts.

Educators in both countries recognize the value of integrating cultural elements into mathematics education. However, the proactive integration of ethnomathematics is more pronounced in Indonesia compared to Thailand. This variation can be attributed to differences in educational policies, cultural contexts, and institutional support.

Several challenges impede the effective implementation of ethnomathematics, including limited resources, curriculum constraints, and a lack of professional development opportunities. These challenges are particularly pronounced in Thailand, where there is also a noted lack of institutional support. Despite these barriers, both Indonesian and Thai educators see significant potential for enriching mathematics education through the integration of cultural diversity. They emphasize the need for comprehensive strategies involving curriculum reform, teacher training, and the development of culturally relevant teaching materials. Additionally, policy changes are essential to create an enabling environment for the integration of ethnomathematics.

The study underscores the importance of adopting a holistic approach to integrating ethnomathematics, addressing structural challenges, enhancing teacher preparedness, and fostering policy support. By doing so, mathematics education can become more inclusive and culturally responsive, ultimately benefiting students from diverse backgrounds.

Future research should focus on developing and testing specific strategies to overcome the identified barriers, ensuring that ethnomathematics can be effectively incorporated into the educational

system. This research can inform educational policies and practices, contributing to the ongoing efforts to make mathematics education more relevant and inclusive.

The insights gained from this study contribute to the existing literature on ethnomathematics and provide practical recommendations for educators, policymakers, and researchers. By recognizing and addressing the challenges and opportunities associated with ethnomathematics, we can move towards a more inclusive and culturally responsive approach to mathematics education.

6. Recommendations for Future Research

Based on the findings and limitations identified in this study, the following recommendations are proposed for future research on the integration of ethnomathematics in education in Indonesia and Thailand:

1. Expand the Scope of Research:
   - *Broaden the Sample Size*: Future studies should include a larger and more diverse sample of educators and students from various regions of Indonesia and Thailand to ensure the findings are more generalizable.
   - *Include Multiple Educational Levels*: Research should explore the impact of ethnomathematics across different educational levels, from primary to higher education, to understand its effects throughout the entire educational journey.
2. Increase the Number of Research Articles Reviewed:
   - *Meta-Synthesis with More Articles*: Future metasyntheses should include a greater number of research articles to provide a more comprehensive and robust analysis. Reviewing a broader range of studies will enhance the reliability and depth of the findings.
3. Longitudinal Studies:
   - *Assess Long-Term Impact*: Conduct longitudinal studies to examine the long-term effects of ethnomathematics on students' mathematical understanding, engagement, and cultural awareness over several years.
   - *Track Curriculum Implementation*: Follow the implementation of ethnomathematics curricula over time to identify challenges and successes in different phases of adoption.
4. Comparative Studies:
   - *Cross-Cultural Comparisons*: Compare the integration and impact of ethnomathematics in other cultural contexts outside Indonesia and Thailand to identify universal principles and culturally specific strategies.
   - *Different Teaching Approaches*: Investigate various pedagogical approaches to teaching ethnomathematics to determine which methods are most effective in different cultural and educational settings.
5. Focus on Student Outcomes:
   - *Quantitative and Qualitative Measures*: Utilize both quantitative measures (e.g., test scores, statistical analysis) and qualitative measures (e.g., interviews, observations) to assess the impact of ethnomathematics on student learning outcomes and attitudes towards mathematics.
   - *Diverse Student Populations:* Research should consider the effects of ethnomathematics on diverse student populations, including those from different socioeconomic backgrounds, to ensure inclusivity and equity.
6. Teacher Training and Professional Development:
   - *Effectiveness of Training Programs*: Evaluate the effectiveness of various teacher training programs in ethnomathematics to identify best practices and areas for improvement.
   - *Professional Development Needs*: Research the specific professional development needs of educators in integrating ethnomathematics into their teaching practices.

7. Resource Development and Utilization:
    - *Creation and Evaluation of Teaching Materials*: Develop and test culturally relevant teaching materials and resources that support ethnomathematics instruction, assessing their impact on student engagement and learning.
    - *Technology Integration*: Explore the use of digital tools and platforms in delivering ethnomathematics education, evaluating their effectiveness in enhancing learning experiences.
8. Community and Cultural Engagement:
    - *Role of Community Involvement*: Investigate the role of community and cultural experts in the development and implementation of ethnomathematics curricula, and how their involvement influences educational outcomes.
    - *Student and Community Feedback*: Collect feedback from students, parents, and community members on ethnomathematics initiatives to ensure they meet the needs and expectations of all stakeholders.
9. Policy and Institutional Support:
    - *Impact of Educational Policies*: Study the influence of national and regional educational policies on the implementation of ethnomathematics, identifying supportive policies and potential barriers.
    - *Institutional Readiness*: Assess the readiness of educational institutions to adopt ethnomathematics, focusing on infrastructure, resources, and institutional culture.

By addressing these recommendations, future research can build a more comprehensive understanding of ethnomathematics and its potential to transform mathematics education in culturally diverse settings.

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