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Mathematical Literacy through Local Wisdom: A Literature Review on Ethnomathematics Representations in Textbooks and Teaching Modules

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Abstract

This study aims to examine the role of ethnomathematics integration in enhancing mathematical literacy and numeracy among elementary school students within the framework of the *Merdeka Curriculum*. Employing a qualitative approach through a literature review method, this article analyzes thirteen peer-reviewed research studies and scholarly publications published between 2020 and 2025 that focus on ethnomathematics, mathematical literacy, and numeracy. The findings reveal that the ethnomathematical approach—which leverages local cultural contexts as sources of mathematical learning—offers students more contextualized, meaningful, and engaging learning experiences. The application of ethnomathematics has been shown to strengthen students' conceptual understanding, enhance numeracy competencies, and cultivate positive attitudes toward mathematics. Moreover, its integration aligns with the objectives of the *Merdeka Curriculum*, which emphasizes context-based learning, the inclusion of local wisdom, and differentiated instruction. The study further highlights the crucial role of teachers in designing instructional materials and strategies that meaningfully connect mathematical concepts with students' cultural backgrounds. Accordingly, the development of ethnomathematics-based teaching resources and targeted teacher training is strongly recommended to improve the quality of elementary mathematics education in a more inclusive and transformative manner.

Keywords: mathematical literacy, ethnomathematics, textbooks, teaching modules, local wisdom.

1. Introduction

Mathematical literacy is a fundamental 21st-century competency that is very important in forming individuals who are capable of solving real-life problems. The Organisation for Economic Co-operation and Development (OECD) in the Program for International Student Assessment (PISA) defines mathematical literacy as an individual's ability to formulate, use, and interpret mathematics in various contexts, including the ability to reason mathematically and use mathematical concepts, procedures, facts, and tools to explain and predict phenomena (OECD, 2023).

In Indonesia, the results of the 2022 National Assessment reported by the Center for Education Assessment (Pusat Asesmen Pendidikan, 2022) show that students' literacy and numeracy skills are still below the minimum standard. Many students have difficulty understanding contextual mathematics problems, especially those that require application in everyday life. This shows a gap between mathematics learning in schools and its application in the cultural and social context of students.

One approach that is believed to be able to bridge this gap is the ethnomathematics approach. Ethnomathematics, first introduced by Ubiratan D'Ambrosio, refers to the mathematical methods used by certain cultural groups to solve problems related to their lives (D'Ambrosio, 2006). This approach integrates local culture into the mathematics learning process, making the learning material more contextual and meaningful for students (Nay, 2018).

The implementation of ethnomathematics in learning not only strengthens students' cultural identity but also increases students' engagement and understanding of abstract mathematical concepts. Research by Puspadewi (Puspadewi et al., 2025) shows that the use of culturally-inspired ethnomathematics problems based on Balinese traditions can significantly improve middle school students' numeracy and engagement. Similarly, Sudrajat (Sudrajat et al., 2023) revealed that Kalimantan batik motifs contain geometric elements such as symmetry, lines, and transformations that can be effectively integrated into elementary school mathematics learning to enhance students' understanding of geometric concepts.

However, problems arise when the representation of ethnomathematics in textbooks and teaching modules widely used in schools is still very limited. A study by Nuryani (Nuryani Suwarno, 2020) revealed that most mathematics textbooks in Indonesia have not optimally integrated local cultural contexts. Cultural representations are often symbolic or decorative without substantive links to mathematical processes.

This condition is exacerbated by the lack of teacher training in designing ethnomathematics-based teaching materials. Ardiana (Ardiana et al., 2023) found that most teachers still have difficulty in compiling contextual mathematical literacy questions or modules, especially those that highlight local cultural richness. In fact, the Merdeka Curriculum encourages strengthening the profile of Pancasila students which includes dimensions of critical reasoning and global diversity, which are ideally integrated into mathematics learning through a cultural context.

2. Methods

This study uses a qualitative approach with a literature review type (library research). Literature review was chosen because it allows researchers to evaluate, examine, and synthesize various relevant research results and publications in order to gain a deep and theoretical understanding of the issues being studied (Zed, 2008). The main focus of this study is to examine the representation of ethnomathematics in mathematics teaching materials and its relationship to improving student literacy and numeracy.

According to Zed (Zed, 2008), a literature review is a systematic technique for extracting information from various valid and relevant written sources, both primary and secondary. In this study, data sources were collected from journal articles, reference books, curriculum documents, and mathematics teaching modules published within the last five years (2020–2025). The selection focused on publications from journals indexed by SINTA (Science and Technology Index), with a minimum rating of SINTA 4, to ensure the credibility and relevance of the materials reviewed. A total of 13 peer-reviewed articles were identified and analyzed. The selection process was guided by the following criteria: (1) the article explicitly addressed themes related to ethnomathematics, mathematical literacy, or numeracy; (2) the study population or context involved primary or secondary education in Indonesia; and (3) the publication presented empirical findings or conceptual insights that contributed to understanding the integration of local culture into mathematics education. These criteria ensured that the reviewed literature was directly aligned with the purpose of this study.

Data were collected through systematic searches in several online databases, including Google Scholar, Garuda Ristekbrin, and DOAJ. All retrieved documents were then examined using content analysis techniques, which involved identifying key concepts, thematic categories, and recurring patterns related to the representation of ethnomathematics and literacy-numeracy approaches in instructional materials. The findings were subsequently organized into several main themes, such as: the representation of local culture in textbooks; the relationship between cultural elements and mathematical concepts; and the alignment of teaching materials with the numeracy goals of the Merdeka Curriculum.

To enhance the validity of the study, source triangulation was applied by comparing findings across various types of documents research articles, textbooks, curriculum frameworks, and teacher

training modules. This approach was intended to ensure that the study's conclusions were comprehensive, critical, and relevant to current practices in mathematics education in Indonesia.

3. Result and Discussion

The results of the literature review on ethnomathematics representation in textbooks and teaching modules in Indonesia show the following findings:

1). Minimal and Decorative Representation

Most of the content in textbooks and teaching modules that claim to be based on local culture only insert elements such as pictures of motifs or names of cultural objects without clear mathematical meaning. This finding supports the research results of (Sumartono, 2022) which state that local cultural elements are often used symbolically and decoratively, not as part of conceptual learning.

2). Potential of Local Cultural Objects

Local cultural objects such as woven motifs, traditional house ornaments, traditional games, and even traditional number systems actually contain mathematical principles. For example, the motif of ikat woven cloth from East Flores contains symmetrical patterns and geometric transformations (Sumartono, 2022), while the congklak and spinning top games can be used in learning numeracy and number patterns (Fitriatunnisa et al., 2024).

3). Positive Impact on Learning

A study by Maulina et al. (Maulina et al., 2024) described that integrating Acehnese cultural elements into ethnomathematics-based learning significantly enhanced mathematical literacy among rural and suburban high school students. In addition, a quantitative study by Wibowo et al. (Wibowo et al., 2023) showed that the “Mathematics Ethnic Learning” program utilizing traditional games improved elementary students’ understanding of mathematical concepts and cultivated cultural appreciation.

4). Barriers to Pedagogical Aspects

Teachers often lack adequate training to design learning based on local cultural contexts. A qualitative study by Maulina, Junaidi, & Maulida (Maulina et al., 2024) found that mathematics teachers in Indonesian secondary schools have limited understanding of ethnomathematics and require specialized training to implement it effectively.

5). The Role of Ethnomathematics in Character Education and Inclusion

A cross-cultural study by educators in Indonesia and Thailand conducted by Wulandari, Payadnya, & Puspadewi (Payadnya et al., 2024) shows that ethnomathematics-based learning strongly supports character education and inclusion. This approach enhances student engagement in underdeveloped regions and reflects global diversity as part of the Pancasila Student Profile. In line with this, a study by Moses Feninlambir (Moses Feninlambir et al., 2024) on the ethnomathematical practices in the Manglusi Village Community, Tanimbar Islands Regency, revealed that local cultural activities—such as patterned sasi (traditional seasonal prohibitions), construction of traditional houses, and ancestral measurement systems—not only convey mathematical concepts but also embed cultural values such as discipline, solidarity, and

respect for customary law. These findings highlight the role of ethnomathematics in fostering both cognitive and moral development, particularly in indigenous and rural settings.

6). Development of High-Order Thinking Skills

An experimental study by Suprojo et al. (Suprojo et al., 2025) demonstrated that the integration of STEM into project-based ethnomathematics learning significantly improves students' higher-order thinking skills (HOTS), including analysis, evaluation, and creativity (C4–C6), compared to conventional teaching methods. Similarly, Suryonegoro & Hidayah (Suryonegoro & Hidayah, 2023) found that Problem-Based Learning (PBL) using ethnomathematics based on Gedongsongo Temple objects effectively enhances junior high school students' creative thinking abilities and self-confidence.

Table 1.

Summary of Results of Literature Review of Ethnomathematics Representation

No	Study Aspects	Main Findings	References
1	Representation in Books and Modules	Ethnomathematics is mostly displayed only decoratively (pictures, cultural names), without explicit mathematical meaning.	(Nuryani Suwarno, 2020)
2	Potential of Local Cultural Objects	Objects such as woven motifs, traditional houses, traditional games contain mathematical concepts (symmetry, number patterns, geometry).	(Sumartono, 2022); (Fitriatunnisa et al., 2024)
3	Impact on Conceptual Understanding	Local cultural context helps understanding basic mathematical concepts and encourages active student participation.	(Maulina et al., 2024);(Wibowo et al., 2023) (Gravemeijer, 2020)
4	Teacher Limitations	Teachers are not yet trained to design contextual learning based on local culture.	(Maulina & Maulida, 2023)
5	Increasing Literacy and Cultural Love	Ethnomathematics-based modules improve mathematical literacy and appreciation of regional culture.	(Arisetyawan & Yuda, 2019)(Rahayu et al., 2020)
6	Character Education & Inclusion	Ethnomathematics supports character learning (mutual cooperation, independence) and inclusion in the 3T region.	(Moses Feninlambir et al., 2024; Payadnya et al., 2024)
7	Higher Order Thinking Skills	Project-based ethnomathematics integrated with STEM improves students' HOTS (C4–C6) more effectively than conventional methods.	(Suprojo et al., 2025; Suryonegoro & Hidayah, 2023)

Table 1 summarizes the findings from 13 selected studies examining the representation of ethnomathematics in educational materials. The review reveals that ethnomathematics is often portrayed superficially, limited to decorative images or cultural references that lack clear

mathematical connections. However, many scholars emphasize that cultural artifacts such as woven fabrics, traditional houses, and indigenous games naturally embody mathematical ideas like symmetry, geometric patterns, and counting systems. Meaningful integration of these elements into learning materials enhances students' conceptual understanding and engagement, especially when grounded in real-life, culturally relevant contexts.

Despite the potential benefits, a major barrier to implementing ethnomathematics-based education is the lack of teacher readiness. Many educators have not received sufficient training to design or facilitate contextualized lessons that incorporate local cultural elements. Nonetheless, the literature indicates broader advantages, including fostering mathematical literacy, promoting cultural appreciation, and supporting inclusive education particularly in remote and underserved (3T) areas. Ethnomathematics-based learning also nurtures higher-order thinking by encouraging students to engage in critical, logical, and creative reasoning.

Across Indonesia’s diverse cultural landscape, ethnomathematics can be linked to various mathematics topics. For instance, geometry is visible in traditional architecture and textile patterns, while arithmetic appears in traditional counting and trade practices. Algebraic thinking can be found in woven motifs and cultural songs, and measurement concepts emerge from indigenous systems used in agriculture and ceremonies. Additionally, traditional games illustrate logic and strategy, supporting skills in problem-solving. These culturally rooted mathematical practices align with the Merdeka Curriculum's emphasis on contextual, student-centered learning that respects diversity and builds character.

Studies on ethnomathematics in the context of Indonesian education reveal that the representation of local cultural elements in mathematics textbooks and learning modules tends to be superficial. This representation is generally limited to visual illustrations and cultural terminology, without in depth mathematical explanation or exploration (Nuryani Suwarno, 2020). From a constructivist perspective, however, learning that connects formal concepts with students' contextual experiences provides deeper meaning. This presents a challenge in developing instructional materials that are not only visually appealing but also conceptually rich.

Several studies have shown that local cultural objects such as woven motifs, traditional houses, traditional games, and regional musical instruments possess strong mathematical potential. For instance, research by Sumartono (Sumartono, 2022) and Fitriatunnisa et al. (Fitriatunnisa et al., 2024) found that symmetry, number patterns, plane figures, and geometric transformations are implicitly embedded in these cultural forms. This aligns with the ethnomathematics framework proposed by D'Ambrosio, which views mathematics as a cultural construct. Accordingly, utilizing local culture as a source for mathematics instruction can serve as a pedagogical strategy to provide more contextual and relevant learning experiences.

Moreover, several studies indicate that integrating local cultural elements into mathematics lessons enhances students' conceptual understanding and promotes their active classroom participation (Gravemeijer, 2020; Maulina et al., 2024; Wibowo et al., 2023). In such cases, cultural context serves as a bridge between students' informal knowledge and formal mathematical concepts taught in schools. This supports the principles of Realistic Mathematics Education (RME), which emphasizes the importance of meaningful contexts in developing mathematical comprehension. Local contexts also provide students with opportunities to explore real-life experiences and construct meaning independently. However, the effectiveness of the ethnomathematics approach is often limited by teachers' lack of readiness to design culturally grounded, contextual lessons. Research by Maulina and Maulida (Maulina & Maulida, 2023) reveals that many teachers lack adequate understanding or training to systematically integrate local culture into mathematics instruction. As a result, the rich mathematical potential inherent in local cultures remains underutilized. This highlights the need for targeted professional development programs aimed at enhancing teachers' cultural literacy and contextual pedagogical skills across various educational levels.

On the other hand, the development of ethnomathematics-based learning modules has been shown to positively impact students' mathematical literacy while fostering appreciation for regional culture (Arisetyawan & Yuda, 2019; Rahayu et al., 2020). This aligns with the goals of character education in the Merdeka Curriculum, particularly in nurturing the Pancasila Student Profile through values such as collaboration, independence, and respect for diversity. Studies by Moses Feninlambir et al. (Moses Feninlambir et al., 2024) in Manglusi Village, Tanimbar Islands Regency, and Payadnya et al. (Payadnya et al., 2024) in Bali further support these findings, asserting that the ethnomathematics approach strengthens not only academic understanding but also cultural identity and social inclusion especially in disadvantaged, frontier, and outermost (3T) regions.

Furthermore, when the ethnomathematics approach is integrated with project-based learning models and STEM frameworks, its impact becomes even more pronounced in fostering students' higher-order thinking skills (HOTS). Research by Suprojo et al. (Suprojo et al., 2025) and Suryonegoro and Hidayah (Suryonegoro & Hidayah, 2023) shows that such integration effectively enhances students' abilities in analysis, evaluation, and creativity (C4–C6 levels). This suggests that ethnomathematics not only supports basic cognitive achievement but also serves as a strategic tool in cultivating 21st-century competencies. Therefore, integrating ethnomathematics into mathematics education bridges the gap between preserving cultural heritage and sustainably improving the quality of national education.

4. Conclusion

Based on the results of the literature review and discussion, it can be concluded that the integration of ethnomathematics into mathematics learning effectively enhances students' literacy and

numeracy skills. The use of local cultural contexts makes mathematical content more accessible and relevant to students' everyday lives, thereby increasing motivation and engagement in learning. Previous research supports that the ethnomathematics approach not only facilitates the mastery of mathematical concepts but also fosters positive attitudes toward the subject and promotes awareness and appreciation of local culture. Teacher involvement and the development of contextual teaching materials are key factors in the successful implementation of this approach.

Therefore, applying ethnomathematics is an effective instructional strategy to improve mathematics literacy and numeracy while preserving cultural values in education. It is recommended that future efforts focus on providing teacher training and developing local culture-based learning modules to ensure this approach is optimally implemented across all levels of education.

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