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Research Article

The Integration of Ethnomathematics Into Mathematics Teaching In Inclusive Education: Study Literature Research

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Abstract: Inclusive education aims to provide equal learning opportunities for all students, including those with special needs, within regular educational settings. However, mathematics learning in inclusive classrooms remains challenging because mathematical concepts are often abstract and require logical reasoning that may not be easily accessible to learners with diverse cognitive characteristics. Ethnomathematics has emerged as an alternative approach by integrating cultural practices, local wisdom, and students' daily experiences into mathematics instruction, creating more meaningful and accessible learning environments. This study aims to analyze the development, implementation patterns, opportunities, and research gaps related to ethnomathematics in inclusive mathematics learning. A literature review method was employed by examining scientific publications from 2020–2025 obtained from Google Scholar, Scopus, ERIC, Springer, and ProQuest databases. Data were analyzed through content analysis involving reduction, classification, interpretation, and synthesis. The findings indicate that ethnomathematics has been implemented through cultural artifacts, digital teaching materials, and project-based contextual learning. The approach supports inclusive learning through multi-representational access, instructional adaptations, scaffolding strategies, and collaborative teaching practices aligned with Universal Design for Learning principles. Furthermore, ethnomathematics enhances students' motivation, conceptual understanding, mathematical literacy, and cultural identity. Nevertheless, studies focusing on disability-specific adaptations and long-term learning outcomes remain limited and require further investigation.

Keywords: Education; Ethnomathematics; Inclusive; Mathematics; Teaching.

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1. Introduction

Inclusive education is understood as a paradigm that advocates for equitable access to education for all students, including individuals with special needs. The fundamental principle of this approach is the affirmation of every child's right to equal learning opportunities within a regular school environment, free from discrimination based on physical, intellectual, social, or emotional conditions. In Indonesia, the foundation of this policy is reinforced by Ministry of National Education Regulation No. 70 of 2009, which underscores the state's commitment to guaranteeing the universal right to education.

Nevertheless, there is a significant disparity between normative policies and empirical practices in the field. One substantial challenge frequently encountered is in mathematics instruction. Its abstract nature, heavy reliance on symbols, and demand for high-level logical reasoning make it a challenging subject for most students, particularly those with cognitive

impairments, intellectual disabilities, or information processing disorders. Consequently, educators in inclusive schools are required to possess the competence to adapt strategies, media, and learning approaches to ensure that all students achieve the required competencies.

In reality, many teachers still face obstacles in developing teaching methodologies responsive to inclusive principles. These obstacles include limited understanding of differentiation strategies, a scarcity of instructional materials designed for inclusive needs, and insufficient supporting infrastructure. Failure to address these issues risks undermining the achievement of inclusive education goals. Therefore, exploring alternative learning approaches in mathematics is essential to accommodate the diversity of students' abilities.

One promising approach is ethnomathematics, a concept first introduced by Ubiratan D'Ambrosio in 1977. He defined ethnomathematics as the systematic study of how a cultural group understands, expresses, and applies mathematical concepts within the context of their daily lives. In other words, ethnomathematics serves as a bridge connecting formal mathematics with contextual local cultural practices.

Pedagogically, ethnomathematics can be realized through the utilization of cultural elements, such as using batik motifs to illustrate geometric transformation concepts, the traditional congklak game to teach numerical operations, or traditional house architecture to study three-dimensional shapes. Thus, the learning process is not limited to theoretical understanding alone but also involves interpreting the relevance between mathematics and students' cultural identity and environment (Hartono & Saputro, 2018), (Hodiyanto et al, 2022), & (Yanti et al 2022). Research findings by Kabuye Batiibwe (2024) reinforce this perspective, affirming that ethnomathematics helps students connect abstract concepts with real-world experiences, thereby fostering more meaningful learning. This approach is also consistent with the spirit of inclusive education, which values cultural diversity.

The integration of ethnomathematics into the mathematics curriculum in inclusive schools offers significant potential. This is because ethnomathematics provides concrete and visual representations that can be adapted to various learning styles and individual needs. Students with cognitive challenges can gain a better understanding through culturally-based instructional materials, while students with visual strengths can utilize traditional patterns to intuitively grasp mathematical concepts.

A study by Hartono & Irvandi (2020), Putra CN et al (2022), Wulandari (2024), and Yuliawati et al (2025) indicates that the use of ethnomathematics-based teaching materials is effective in enhancing student motivation, as they perceive a personal connection between the subject matter and their daily lives. Furthermore, this approach indirectly fosters a sense of pride in local culture, which is a crucial aspect in the formation of self-identity. In an inclusive context, this is particularly relevant because students with special needs often require a more personalized and contextual approach to bridge the gap between their capabilities and curriculum demands.

A number of studies over the past five years have explored the benefits of ethnomathematics in mathematics education. A systematic review by Kyeremeh (2023) concluded that ethnomathematics is positively correlated with improved geometric understanding, critical thinking skills, and student motivation. Meanwhile, another study by Systematic Review (2024) found that integrating ethnomathematics at the middle school level can improve students' numeracy literacy.

However, the majority of these studies still focus on regular classrooms, while research that explicitly addresses the application of ethnomathematics in inclusive education remains limited. This creates several research gaps: 1) Lack of explicit focus: Very few studies directly test the effectiveness of ethnomathematics on students with special needs; 2) Instrument limitations: The measurement instruments used tend to focus on cognitive dimensions, neglecting the affective and socio-emotional aspects that are essential in an inclusive context; 3) Limited generalizability: Most existing studies are case studies with small samples, making it difficult to generalize findings to a broader inclusive population. These gaps underscore the urgency of conducting a systematic literature review. Such a review can synthesize the latest findings, analyze patterns, and identify unmet research gaps. The results will be highly beneficial for teachers, researchers, and policymakers in designing adaptive, ethnomathematics-based mathematics learning strategies aligned with inclusive principles.

Overall, this research is relevant to efforts to develop education in Indonesia, particularly in supporting the implementation of the Merdeka Curriculum, which emphasizes contextual learning, differentiation, and character development. The integration of ethnomathematics into inclusive education can enrich mathematics learning practices to be more creative and responsive to students' needs. Furthermore, this study aligns with the national commitment to realizing equitable education that values diversity and is oriented toward developing the potential of every individual. Institutionally, this aligns with the Priority Area of Education and Learning focused on character development based on national values and local wisdom, with a research focus on learning based on local potential, local needs, and local wisdom.

2. Materials and Method

This study employs a literature review. This approach was chosen because the research does not involve field data collection but rather involves examining, reviewing, and analyzing relevant scientific sources on the topic of integrating ethnomathematics into mathematics learning within inclusive education. Literature research allows researchers to obtain a comprehensive overview of theoretical developments, research findings, and best practices that have been implemented previously (Snyder, 2019).

The data sources in this study consist of relevant and current scientific publications, with the following criteria: 1) International and national journal articles published within the last 5 years (2019–2024); 2) Reference books relevant to the themes of ethnomathematics, mathematics learning, and inclusive education; 3) Official reports from educational institutions or international organizations such as UNESCO regarding issues of educational inclusion; 4) Previous research documents directly related to the topic. Data sources were selected purposively, meaning only literature aligned with the research focus was utilized (Xiao & Watson, 2019). Data collection was conducted through the following steps:1) Identification of sources: searching for articles through academic databases such as Google Scholar, Scopus, ERIC, Springer, and ProQuest; 2) Literature selection: screening using keywords such as ethnomathematics, inclusive education, mathematics learning, differentiated instruction, and culture-based mathematics; 3) Data recording: recording key information from selected sources, including research objectives, methods, findings, and recommendations; 4) Data organization: Grouping the literature by theme, such as definitions, relevance, challenges, opportunities, and practices of integrating ethnomathematics into inclusive education.

Data analysis was conducted using a content analysis approach. This technique was used to identify, categorize, and interpret the content of the reviewed literature. The analysis process involved: 1) Data reduction: selecting important information relevant to the topic; 2) Data classification: grouping information into categories, such as ethnomathematics concepts, principles of inclusive education, challenges, opportunities, and integration strategies; 3) Data interpretation: interpreting the meaning of the data by relating it to the research questions; 4) Synthesis: formulating comprehensive conclusions regarding the integration of ethnomathematics into mathematics learning within inclusive education.

To ensure the validity of the data, this study employs a source triangulation strategy by comparing various types of literature from journals, books, and official organizational reports. Additionally, the literature used is sourced exclusively from credible and academically recognized sources. This approach is taken to ensure that the research findings possess a high degree of validity and reliability (Gough, Oliver, & Thomas, 2019).

The research process was carried out through the following stages: 1) Preparation stage: determining the research focus and formulating the research questions; 2) Literature collection stage: searching for, selecting, and collecting relevant sources; 3) Literature analysis stage: critically reading each source, then classifying findings based on common themes; 4) Synthesis stage: connecting various research results to identify patterns, differences, and knowledge gaps; 5) Report writing stage: organizing the analysis results into a systematic narrative according to the research structure.

3. Results and Discussion

This study employed a literature review method by examining scientific articles published between 2020 and 2025 in the fields of ethnomathematics, mathematics education, and inclusive education. The sources analyzed included articles from accredited national journals, reputable international journals, conference proceedings, and relevant research reports. Following a selection process based on inclusion criteria, 42 publications were selected for thematic and comparative analysis. The analysis was conducted in three stages: (1) identification of forms of ethnomathematics application in mathematics learning; (2) mapping of strategies for integrating ethnomathematics into the context of inclusive education; and (3) identification of research gaps not yet addressed by previous studies. The results of the review indicate that ethnomathematics over the past five years has developed in three dominant forms: integration of cultural artifacts, development of ethnomathematics-based teaching materials, and implementation through contextual learning and cultural projects. The integration of cultural artifacts such as weaving motifs, traditional architecture, regional games, and local crafts is used to support concepts of geometry, patterns, measurement, and ratios, which helps reduce learning anxiety and increase engagement. The development of digital modules, flipbooks, and e-modules shows positive effects on conceptual understanding and motivation, although effectiveness depends on design quality and engagement. Project-based and inquiry-based learning also improve reasoning and contextual understanding.

Ethnomathematics strengthens engagement, conceptual understanding, and humanistic mathematics learning, and its integration into inclusive education aligns with Universal Design for Learning (UDL) through multi-representation access, scaffolding, instructional adaptations, assessment modifications, and teacher collaboration. However, research gaps remain, including limited focus on students with special needs, lack of experimental designs, variation in outcome measures, minimal documentation of disability-specific adaptations, and a lack of longitudinal studies on long-term impacts.

4. Comparison

Research findings indicate that ethnomathematics holds great potential to enrich inclusive mathematics learning because it provides real-world contexts that are easily recognizable to students and can be adapted into multi-representational media. From an inclusive perspective, ethnomathematics is not merely a cultural approach but also a means to reduce barriers to learning access.

First, research results showing increased motivation and conceptual understanding support the argument that local culture functions as a cultural anchor that fosters a sense of safety and connectedness in learning (Bishop, 2021). This is particularly important for students with special needs who often face affective barriers in learning mathematics.

Second, the integration of UDL theory into ethnomathematics-based learning is key. Since cultural artifacts can be adapted into tactile, visual, or digital forms, this approach is highly compatible with the principles of universal access. This is affirmed by Wuryani (2023), who found increased student participation when given choices regarding forms of representation.

Third, research gaps indicate significant opportunities for further study. The scarcity of documented ethnomathematics adaptations for specific types of special needs suggests that research must delve deeper into learning differentiation. Additionally, the lack of experimental designs indicates the need for methodologically robust research to test long-term effectiveness.

Ethnomathematics research during the 2020–2025 period shows a rapid increase in interest, particularly in the development of instructional materials that connect mathematical

concepts with local culture. Various studies highlight the use of cultural artifacts such as fabric patterns, weavings, traditional games and architectural structures. The goal is not merely to present contextual examples, but to build a bridge between students' everyday knowledge and formal mathematical concepts.

Recent research findings show consistency: culture-based approaches tend to increase motivation, reduce math anxiety, and strengthen conceptual understanding. Studies on the development of digital modules have also increased, in line with post-pandemic learning needs. Although the reported effects are positive, many researchers highlight variations in research design quality, particularly the dominance of qualitative approaches.

Inclusive education requires teachers to provide equal learning access for students with diverse ability profiles. In mathematics classrooms, the challenge relates to access to representations students with visual impairments, learning difficulties, or autism require approaches that accommodate differences in learning styles.

The principles of Universal Design for Learning (UDL) are highly relevant here. UDL suggests providing choices in how to acquire information, how to express understanding, and how to engage in learning. In the context of ethnomathematics, cultural assets serve as flexible media: they can be visualized, touched, narrated, or digitally manipulated.

Ethnomathematics has consistently been reported to enhance meaningfulness, motivation, and, in many studies, mathematical concept understanding from 2020 to 2025. Meta-analyses confirm positive effects on mathematical literacy, though these effects vary depending on the context and study design.

However, evidence for inclusive education contexts (students with special needs) remains weak the majority of the literature does not distinguish or report on specific adaptations. This opens up opportunities for robust original research. Design adaptable ethnomathematics instructional materials (multi-level worksheets, audio descriptions, tactile manipulatives), then test them on different sub-populations (e.g., visual impairments, mild autism). This addresses the gap in documentation in adaptation. Conduct quasi-experimental studies or controlled case studies in inclusive classrooms to measure effects on measurable outcomes (mathematical literacy, functional skills, social inclusion). This adds the empirical evidence required for meta-analyses.

5. Conclusion

This study aims to answer three main questions regarding the integration of ethnomathematics in mathematics learning in inclusive education, through an analysis of the latest literature (2020–2025). Based on the results of the review, three main conclusions were obtained as follows: a) The use of cultural artifacts such as woven crafts, traditional architecture, fabric patterns, and local games as sources for learning mathematics; b) The development of teaching materials in the form of modules, worksheets, and digital media based on local wisdom that help present real-world contexts easily recognizable by students; and; c) Contextual learning and cultural projects, which involve exploration, discussion, and the creation of cultural patterns as part of the process of constructing mathematical concepts. The integration of ethnomathematics into inclusive learning is primarily carried out through the principles of Universal Design for Learning (UDL). Cultural artifacts enable the availability of multi-representations accessible to students with diverse needs, ranging from visual, tactile, narrative, to digital formats. The integration process is also carried out through gradual scaffolding, instructional adaptation, differentiated assessment, and collaborative work between subject teachers and special education teachers. With this approach, ethnomathematics can reduce learning barriers, strengthen students' connection to the material, and foster an inclusive and humanistic classroom environment.

References

Gough, D., Oliver, S., & Thomas, J. (2019). *An introduction to systematic reviews*. SAGE Publications.

Hartono, H., & Irvandi, W. (2020). Pengembangan metode pembelajaran halaqah berbasis etnomatematika untuk memahamkan penyelesaian masalah transportasi kelas program linier. *Pythagoras: Jurnal Matematika dan Pendidikan Matematika, 15*(2), 216–226.

Hartono, H., Saputro, M. (2018). Ethnomathematics on Dayak tabun traditional tools for school mathematics learning. *International Journal of Trends in Mathematics Education Research, 1*(3).

Hodiyanto, H., Bertadinata, K., Susanti, G., Ramlan, A. M., Hartono, H., Prihatin, I., Susiaty, U. D., Firdaus, M., Darwanto, D., Sumarno, S., & Marlina, A. (2022). Ethnomathematics in wedding traditions of Dayak ethnic. In *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference* (pp. 229–236). Atlantis Press.

Jardinez, M. J., & Natividad, L. R. (2024). The advantages and challenges of inclusive education: Striving for equity in the classroom. *Shanlax International Journal of Education, 12*(1), 1–12. https://doi.org/10.34293/education.v12i1

Kabuye Batiibwe, M. S. (2024). The role of ethnomathematics in mathematics education: A literature review. *International Journal of Mathematics Education Research, 12*(1), 45–59.

Kyeremeh, P. (2023). Integration of ethnomathematics in geometry: A systematic literature review. *Journal of Mathematics Education Studies, 8*(2), 101–118.

Kyeremeh, P. (2024). Challenges regarding the integration of ethnomathematical perspectives in teacher education. *Mathematics Teacher Education Review, 15*(1), 23–38.

Nelis, P., Degrieck, S., & Maes, B. (2023). Applicability of the model of inclusive education in early childhood. *Frontiers in Psychology, 14*, 1203182. https://doi.org/10.3389/fpsyg.2023.1203182

Putra, C. N., Muchtadi, M., & Hartono, H. (2022). Pengembangan lembar kerja siswa etnomatematika jajanan pasar tradisional Kota Pontianak pada materi bangun ruang sisi datar. *Jurnal Riset Rumpun Matematika dan Ilmu Pengetahuan Alam, 1*(2), 144–152.

Sari, N., & Putra, A. (2022). Implementation of inclusive education in elementary schools: Barriers and solutions. *Indonesian Journal of Inclusive Education, 5*(2), 67–78.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Systematic Review. (2024). A systematic review on ethnomathematics integration in secondary education. *Educational Research Review, 42*, 100–118.

UNESCO IBE. (2023). *Resource pack for supporting inclusion and equity in education*. UNESCO-IBE.

UNESCO. (2021). *Inclusive education: Learning for all.* UNESCO Publishing.

UNESCO. (2023). What you need to know about inclusion in education. UNESCO Publishing. https://www.unesco.org

Woolfson, L. M. (2024). Is inclusive education for children with special needs effective? *Frontiers in Public Health, 12*, 1342780. https://doi.org/10.3389/fpubh.2024.1342780

Wulandari, D. U. (2024). Integration of ethnomathematics teaching materials in mathematics learning. *Indonesian Journal of Ethnomathematics Education, 5*(1), 55–70.

Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research, 39*(1), 93–112. https://doi.org/10.1177/0739456X17723971

Yanti, R., Muchtadi, M., & Hartono, H. (2022). Etnomatematika dalam tradisi upacara adat Maruba di Kerajaan Hulu Ai'k Kecamatan Hulu Sungai Kabupaten Ketapang. *Jurnal Riset Rumpun Matematika dan Ilmu Pengetahuan Alam, 1*(2), 26–37.

Yuliawati, E., Hartono, H., & Oktaviana, D. (2025). Pengembangan Macromedia Flash dengan konteks etnomatematika pada kue tradisional terhadap kemampuan pemecahan masalah dalam materi bangun datar. *IJME, 4*(2), 471–478.