

Ethnomathematics-Inspired Mathematics Learning in Indonesia: A Systematic Literature Review

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Abstract

Studies on ethnomathematics have developed massively over at least the last decade, especially in its use in teaching mathematics in schools. However, there is still limited research that comprehensively examines the research trends in the use of ethnomathematics in mathematics learning in Indonesia. Therefore, research from 2015 to 2024 was analyzed comprehensively through a systematic literature review (SLR) study based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) standards. The analysis results found 26 articles from the Scholar and Eric databases. There are at least six findings in this study: (1) the most publications were found in 2020 and 2021; (2) it shows that there are three forms of culture, namely ideas, artifacts, and activities; (3) in addition, the RME model is the most commonly used approach in ethnomathematics-based or inspired mathematics learning; (4) problem-solving ability is the most frequently related variable; (5) lastly, the most commonly used mathematics material is geometry.

Keywords: Ethnomathematics; Mathematics Learning; Systematics Literature Review

Introduction

As a large country, Indonesia has a rich diversity of cultures, including languages, food, dance, traditional houses, and more. However, mathematics is often taught in ways that are far removed from the socio-cultural context of Indonesian society. As a result, students do not fully understand mathematics and perceive learning it as irrelevant, leading to an inability to apply mathematical knowledge to solve everyday problems. This backdrop has led many researchers to utilize the concept of ethnomathematics in mathematics education. They believe that implementing an ethnomathematics approach can enhance the quality of mathematics learning in classrooms (Mania & Alam, 2021). The application of ethnomathematics, enhance creativity, improve conceptual understanding, and boost learning outcomes through the culture around them (Risdayanti & Prahmana, 2021; Sarwoedi et al., 2018; Sulistyowati et al., 2024). Therefore, the application of real socio-cultural contexts surrounding students is very important in mathematics learning. Thus, mathematics education should be able to contextualize mathematics with the culture that exists around the students.

The trivium curriculum, consisting of literacy, matheracy, and technocracy developed by D'Ambrosio (1999), marks the beginning of ethnomathematics as an approach to mathematics in schools. From the perspective of ethnomathematics, literacy is the ability of students to read, communicate, understand, and perform calculations using media; matheracy is the ability of students to make hypotheses and draw conclusions from calculations related to everyday problems; and technocracy is the ability of students to use and connect various technologies to assist them in their daily activities (D'Ambrosio, 1999).

The use of ethnomathematics context in mathematics learning can make students interested, motivated, and easily understand concepts comprehensively (Sunzuma et al., 2021), However, using this approach has the potential to create different learning environments in each region and may lead to social gaps due to cultural differences. Larvor & François (2018) explain that in a mathematics class, some students might feel happy and proud because their culture is highlighted, while others with different cultural backgrounds might feel uncomfortable and forced to follow the lesson. However, this does not necessarily weaken the ethnomathematics approach in its application in the classroom. The introduction of ethnomathematics in schools can be important, as students will continue to learn mathematics and be able to compete internationally. It is hoped that students' experiences will create meaningful learning processes without involving individual student cultures. If learning mathematics is perceived as meaningless, difficult to understand, and not a popular subject, the fault may lie with the teacher. The success of Japan and China in mathematics is attributed to their use of local culture as a basis for mathematics education (Uloko & Imoko, 2007).

This systematic literature review (SLR) study analysis the forms of culture used, the treatments employed in learning, the cognitive or affective variables that emerge, and the school mathematics materials in mathematics learning integrated with the ethnomathematics approach in Indonesia. Other SLR studies mostly focus only on the exploration of ethnomathematics within specific cultures (Lidinillah et al., 2022; Nurfauziah & Putra, 2022; Okti Yolanda & Putra, 2022; Permana, 2023; Puspitasari & Putra, 2022; Turmuzi et al., 2022; Wahed et al., 2022) without considering its urgency in the cognitive and pedagogical studies of mathematics learning. Therefore, this SLR study aims to identify which Indonesian cultures are used as contexts in the application of the ethnomathematics approach.

This study aims to gather various research related to the use of ethnomathematics in mathematics learning in Indonesia by using a systematic literature review of scientific journals published between 2015 and 2024. The objectives of this research are to explore (1) the trends in the number of studies on ethnomathematics-inspired learning; (2) the trends in research subjects used; (3) the forms of culture (ideas, activities, artifacts) in Indonesia that are utilized; (4) the trends in learning approaches integrated with ethnomathematics; (5) the trends in variables resulting from research using ethnomathematics; and (6) the trends in mathematics used.

Methods

Research Design

This systematic literature review (SLR) study followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Page et al., 2021). This review aimed to describe learning approaches integrated with the ethnomathematics approach and to answer predetermined research questions by collecting and summarizing all empirical evidence that met the predefined eligibility criteria. SLR is a technique used to obtain relevant information about a subject that meets established eligibility requirements (Mengist et al., 2020). The article screening process followed the four PRISMA stages: (1) identifying relevant articles; (2) manually screening titles and abstracts; (3) assessing eligibility to determine if there is a complete explanation; and (4) applying inclusion and

exclusion criteria to select appropriate articles. The search for articles used keywords including ethnomathematics, Indonesian ethnomathematics, mathematics education, mathematics learning, learning model, and mathematics teaching.

Data Sources

The data used in this study were collected based on keywords and content from the Google Scholar and Eric databases. Additionally, inclusion and exclusion criteria were applied in this research, as follows:

Table 1. Inclusion and Exclusion Criteria

Inclusion	Exclusion
Published in scientific journals indexed by SINTA (1-4) or in national and international conference proceedings between 2015 and 2024	Documents, books, magazines, brief surveys, bulletins, and others
Discusses ethnomathematics in mathematics learning in Indonesia	
Mentions the forms of culture and mathematics materials used	
Listed in the Google Scholar and Eric databases	
Written in Indonesian or English	

Data Analysis

The data analysis in this study employed a systematic review and meta-analysis based on PRISMA. The process began by identifying relevant articles for analysis using keywords (n=173), followed by screening based on duplicates and inclusion and exclusion criteria (n=79), and then assessing the eligibility or content of the articles (n=29). As a result, a total of 47 articles were selected for review.

Results and Discussion

Number of Studies per Year

Based on the data on the number of publications per year, the frequency of research related to ethnomathematics-inspired learning in Indonesia can be observed. This data covers the publication period from August 2015 to March 2024 and comes from journals indexed in SINTA 1-4 and national conference proceedings. The number of publications indicates a significant interest among researchers in ethnomathematics within the context of education, as well as its relevance to the curriculum and teaching methods in Indonesia. The increasing frequency of such studies reflects the importance of integrating local culture into mathematics learning to enhance students' understanding and engagement. The data on the number of publications is displayed in Figure 1.



Figure 1. Number of articles publications

Based on Figure 1, it can be seen that the number of research publications related to ethnomathematics-inspired learning in Indonesia, based on scientific journals indexed by SINTA 1-4 or national proceedings, was still limited in 2015, 2016, and 2017, with only 1 article each year. The number then increased in 2018 and 2019, with 3 articles found each year. The trend further increased in 2020 and 2021, with 7 articles each year, making these two years the periods with the highest number of articles found in at least the last decade. The following year, 2022, saw a decrease, with only 1 article found, while 2023 had 2 articles. In 2024, there was an increase again, with 3 articles found by March 2024. The results of this study indicate that research related to ethnomathematics-inspired mathematics learning primarily explores cultural objects in various regions and the development of ethnomathematics-inspired teaching materials.

Research Subjects

The analysis results indicate that research related to ethnomathematics-inspired mathematics learning in Indonesia has been conducted on subjects ranging from elementary school to higher education levels. This data can be seen in Figure 2.



Figure 2. Research Subject

Based on Figure 2, it is evident that research related to ethnomathematics-inspired mathematics learning has been conducted most frequently with middle school students, with 17 articles found. The trend of conducting ethnomathematics-inspired mathematics learning research at the middle school level

is likely because middle school students are at a phase where they are well-acquainted with a significant amount of local culture and have the capability to study it. This aligns with Sariningsih (2016), who stated that learning in schools is the beginning of student formation, and teachers should not present abstract symbols and confusing theorems to some students. Research related to ethnomathematics-inspired mathematics learning at the elementary school level is also quite common, with 6 articles discussing it. At this stage, elementary school students need concrete objects that can be perceived by their senses during the learning process (Witha et al., 2021).

At the high school level, as seen in Figure 2, there are fewer studies conducted, likely due to school policies aimed at minimizing activities outside or in the school environment to ensure students focus on graduation exams. Research involving university students or at the higher education level found only two articles, specifically at the undergraduate (S1) level, and no studies were found that used subjects at the master's (S2), doctoral (S3), or teacher levels. Therefore, there are significant opportunities for other researchers who wish to conduct studies in this area.

Forms of Culture

The first research question relates to the forms of culture. Ideas represent cultural forms such as concepts, values, norms, and regulations existing in the minds of the community. Activities are cultural forms that manifest as patterned actions of humans. Artifacts encompass all physical results of activities, actions, and creations of all individuals in society. The analysis results indicate that research related to cultural forms in Indonesia has been conducted on the forms of cultural activities and artifacts. This data is illustrated in Figure 3.



Figure 3. Cultural Form

Based on Figure 3, it was found that research related to cultural forms in Indonesia most frequently uses artifacts, with a total of 23 articles. For cultural forms as activities, there is 1 related article. There are 5 related articles that use both activities and artifacts as cultural forms. As seen in Figure 3, there are no articles using ideas or concepts as cultural forms. It appears that artifacts dominate in the use of cultural forms in mathematics education in schools. However, essentially, ideas and artifacts are products of human activities. Artifacts are understood as objects created by the culture of a specific group or community that help define its culture. Artifacts can include clothing, houses, tools, ornaments, paintings, designs, and more. All these artifacts provide information about the culture of their creators and the ideas related to those objects. Rosa & Gavarrete (2017) believe that not only should mathematical knowledge and teaching approaches be considered in the curriculum, but also the mathematical ideas from cultural groups within society. Furthermore, they argue that efforts to create and integrate mathematical materials related to culture and referring to students' own experiences in the mathematics curriculum, are very feasible to implement.

Treatments Used

The next research question is about the treatments used during mathematics learning with an ethnomathematics approach. Various types of treatments have been applied in related studies. One of the purposes of using treatments is to test the researchers' hypotheses. The list of treatments found is shown in Table 2.

Table 2.7	Γypes of	Treatments	Used
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No	Treatment	Total
1	Problem-Based Learning	5
2	Realistic Mathematics Education	7
3	Contextual Teaching and Learning	4
4	Probing prompting	4
5	Model Eliciting Activities (MEAs)	2
6	Assurance, Relevance, Interest, Assessment, Satisfaction (ARIAS)	2

Based on the research findings, the most frequently used ethnomathematics-themed treatment is Realistic Mathematics Education (RME) with 7 articles found. Meanwhile, the least used ethnomathematics-themed treatments are Connected Mathematics Project Learning (CMP), Inquiry Learning Model, Discovery Learning, Open-Ended Learning, and Project-Based Learning (PjBL), each found in 1 related article.

RME is an instructional approach with the same principles. RME is learning based on the real world (Van den Heuvel-Panhuizen & Drijvers, 2020). This model uses the environment as a learning resource (Atikah et al., 2020). One of the learning resources in students' environments is local culture, or the use of ethnomathematics. This aligns with Fajriyah (2018), who states that ethnomathematics provides an enjoyable learning atmosphere, which increases students' interest in learning mathematics. This encourages other researchers to conduct studies using RME treatments with an ethnomathematics theme. An example of such research is a quasi-experiment on students' mathematical concept understanding abilities (Melati & Umbara, 2023)

Resulting Variables

Based on research on the use of ethnomathematics in mathematics learning along with other variables, this study discusses the trends or tendencies of which variables are frequently associated with ethnomathematics-themed learning. The relationship between these variables provides opportunities to enhance students' mathematical abilities. Below are the variables that are often associated with ethnomathematics-themed learning, as shown in Table 3.

No	Variable	Total
1	Problem-Solving Ability	12
2	Creative Thinking	1
3	Learning Motivation	2
4	Conceptual Understanding	4
5	Mathematical Communication	4
6	Learning Outcomes	2
7	Mathematical Literacy	3
8	Mathematical Reasoning	1

Table 3. Relationship of Variables with Ethnomathematics-themed Learning

Based on Table 3 above, the variables frequently associated with ethnomathematics-themed learning are generally related to students' cognitive aspects. Problem-solving ability is the most commonly linked variable, with 12 articles. This is because ethnomathematics-themed learning facilitates students in constructing mathematical concepts using their prior knowledge, as it connects with their environment (Richardo, 2016). Research types related to the use of ethnomathematics-themed learning often link problem-solving ability variables with various treatments such as RME, PBL, and CTL in quasi-experimental studies (Hidayati & Abdullah, 2021; Lubis & Widada, 2020; Nurliastuti et al., 2018).

Several other variables that are still rarely studied concerning ethnomathematics-themed learning in Indonesia provide opportunities for other researchers to conduct such studies. Variables such as creative thinking, mathematical reasoning, self-efficacy, learning motivation, and other affective abilities.

Mathematics Material

The final question in this research is about the trends in the materials used in ethnomathematicsthemed mathematics learning in Indonesia. Based on the analysis conducted, geometry is the most frequently found topic compared to other mathematics topics. Below are the results of the analysis related to the mathematics materials/topics used, shown in Table 4.

No	Торіс	Subtopic	Number Articles	of
1	Geometry	Flat Shapes	15	
		Transformations	2	24
		Solid Shapes	6	24
		Sphere	1	
2	Arithmetic	Social Arithmetic	2	2
3	Numbers	Linear Programming	1	1
4	Algebra	Linear Equations and Inequalities in One Variable	2	2

Table 4. The Math Material Used

Based on Table 4 above, it is evident that in addition to geometry being the most frequently used mathematics topic, the subtopic of flat shapes is the most discussed. This is because the cultural forms used are mostly artifacts, which are closely related to the subtopic of flat shapes. Topics such as arithmetic, numbers, and algebra have been used in fewer studies so far. As stated by (Hendriyanto et al., 2023), Based on Table 4 above, it is evident that in addition to geometry being the most frequently used mathematics topic, the subtopic of flat shapes is the most discussed. This is because the cultural forms used are mostly artifacts, which are closely related to the subtopic of flat shapes. Topics such as arithmetic, numbers, and algebra have been used in fewer studies so far. As stated by (Acharya et al., 2021; Laurens et al., 2020; Supiyati et al., 2019; Utami et al., 2019). Therefore, it poses a challenge for researchers to uncover mathematical concepts within local cultures in Indonesia that can be used in school learning with a more diverse range of mathematical materials.

Conclusion

The main findings from this literature review are that the use of ethnomathematics to study mathematics in Indonesia from 2015 to 2024 has shown a positive trend in creating meaningful learning experiences for students. There are at least six main topics from this research: (1) the research trend in 2020 and 2021 shows a significant number of studies related to ethnomathematics-themed mathematics learning; (2) the most frequently used subjects in ethnomathematics-themed mathematics learning research were students at the junior high school level; (3) the trend shows that cultural artifacts dominate

ethnomathematics studies compared to ideas and artifacts; (4) the Realistic Mathematics Education (RME) approach is widely used in ethnomathematics-themed mathematics learning compared to other models or approaches; (5) the variable most frequently associated with ethnomathematics-themed mathematics learning is problem-solving ability; and (6) geometry is the most frequently found topic compared to other mathematics topics in ethnomathematics-themed learning.

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