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Exploring the Misalignment between Ethnomathematics and Cultural Artifact-Based Research

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ABSTRACT

Ethnomathematics emerged as a movement that rejected the hegemony of formal European mathematics and recognized local mathematical systems as socio-cultural practices. This study aims to explore the misalignment between the philosophical vision of ethnomathematics and contemporary mathematics research practices based on cultural artifacts. This study uses a qualitative approach with a literature review. Data were collected from books, articles, and proceedings, which were analyzed through thematic content analysis. The results show that many studies claim to be "ethnomathematics" simply because they find mathematical forms in artifacts. Many studies do not investigate whether the communities that own the culture have mathematical awareness, terminology, or procedures related to these objects. This practice results in epistemological reduction, distortion of cultural values, and blurring of boundaries with contextual approaches such as RME, CTL, or ethnomodeling. This study contributes to reaffirming the validity of ethnomathematics, which demands ethnographic involvement, an emic perspective, and respect for cultural epistemic autonomy.

Keywords: Ethnomathematics; Misalignment; Philosophy of mathematics education; Emic perspecttive

INTRODUCTION

Ethnomathematics was born not merely as a learning approach, but as a philosophical movement that rejects the hegemony of formal mathematics originating in European tradition (Alghar & Radjak, 2024; D'Ambrosio, 1985). Ethnomathematics exists to acknowledge that each cultural group has its own way of understanding, calculating, measuring, and designing the world around it (Bishop, 1988; Rosa et al., 2016). In this vision, mathematics becomes a universal entity that is integrated into the lives and social practices of society (Herrera Jr. & Palomo, 2022; Umbara et al., 2025). Ethnomathematics needs to involve

mathematical modeling, social anthropology, and mathematics education, see Figure 1 (Alghar & Radjak, 2024; Desai et al., 2022; Rosa et al., 2016). Therefore, ethnomathematics is not only about "finding mathematics in culture," but about understanding how mathematics is created, used, and transmitted by the community itself.

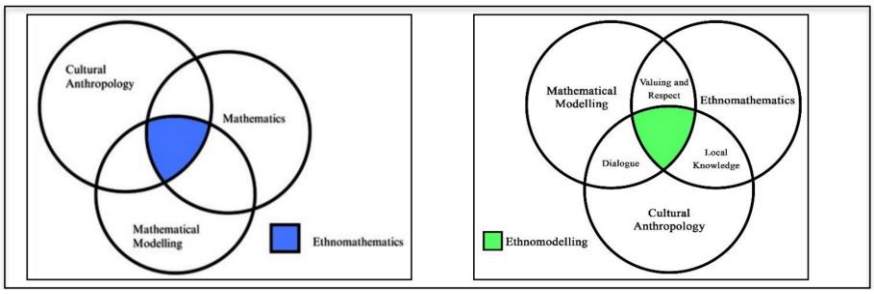

Figure 1. The scope of ethnomathematics (left) and ethnomodelling (right) research (Alghar & Radjak, 2024; Desai et al., 2022)

Ethnomathematics has now grown into a research program that encompasses historical, philosophical, and pedagogical dimensions (Alghar & Lubis, 2025; D'Ambrosio, 1999). Ethnomathematics emphasizes the importance of the emic perspective, which is the view from within the culture (Santos & Madruga, 2021). This means that ethnomathematics does not aim to observe from the outside and project formal mathematical concepts onto cultural objects (Rosa et al., 2016). This approach requires researchers to engage in an ethnographic process that includes listening, observing, and comprehensively understanding the logic of the indigenous community (Spradley, 2016). Thus, losing the emic (internal) perspective will turn culture into a mere decoration for school mathematics, rather than a source of pure mathematical knowledge (Pais, 2011).

Philosophically, ethnomathematics is based on fallibilism, which rejects an absolute view of mathematical truth (Ernest, 1991; Glas, 1998). Mathematics is seen as knowledge that is changeable, contextual, and shaped by human experience (Pais, 2011; Rowlands & Carson, 2002). This view is in line with social constructivism, which sees mathematics as the result of social interaction within a culture (Eglash, 1997; Knijnik, 2012). Within this framework, the validity of mathematics is not determined by its conformity to mathematical axioms, but by its relevance in solving real problems in the community (Ernest, 1991).

However, current research trends often deviate from this philosophical foundation. Many studies claim to be "ethnomathematics" simply because they discover mathematical concepts, such as geometric shapes, in cultural artifacts such as carvings, architecture, or textiles (Alghar & Lubis, 2025; Pais, 2011; Xu & Ball, 2024). In fact, the existence of these visual forms does not necessarily reflect the mathematical awareness or cognitive activities of cultural actors. Without verification through in-depth interviews or participatory observation, such claims risk replacing local mathematical systems with external interpretations that seem forced (Flick, 2013; Rowlands & Carson, 2002; Xu & Ball, 2024).

Such an approach, which merely finds mathematical concepts in artifacts, often ignores fundamental questions. For example, did the society that owned the culture actually use these mathematical concepts? Did they have specific terms, procedures, or meanings related to these forms? (Bishop, 1988; Pais, 2011). If the answers are unknown, then what is being done is not ethnomathematics. Such activities are merely contextual illustrations that use culture "as decoration" (Alghar & Lubis, 2025; Rowlands & Carson, 2002). This is not only methodologically misleading, but it can also distort cultural values that should be respected and considered sacred (Pais, 2011; Žižek, 1997).

A deeper danger lies in the epistemological reduction that occurs when artifacts are used as substitutes for ethnomathematics practices. By focusing on the form of artifacts, researchers ignore the social dynamics, rituals, and practical knowledge that gave birth to these artifacts (McCurdy et al., 2004; Xu & Ball, 2024). As a result, ethnomathematics loses its critical spirit as a form of defense against scientific colonialism (D'Ambrosio, 2016). Instead, it becomes a new tool that "dragging" formal mathematical logic into a cultural space that should be autonomous.

This tendency will exacerbate the blurring of boundaries between ethnomathematics and other approaches such as Realistic Mathematics Education (RME) or Contextual Teaching and Learning (CTL). While RME and CTL use real-world contexts, including culture, as a means of teaching school mathematics, ethnomathematics aims to uncover the mathematical systems that already exist within that culture (Desai et al., 2022; Prahmana, 2022). This difference is fundamental: RME and CTL are more instructional in nature, while ethnomathematics is exploratory-epistemological (Desai et al., 2022; Fernández-Oliveras et al., 2021; Lidinillah et al., 2022; Prahmana, 2022). However, in practice, some studies often mix the two without a clear philosophical purpose.

Although criticism of the misuse of ethnomathematics has been raised for a long time (Alghar & Lubis, 2025; Netto et al., 2025; Pais, 2011; Rowlands & Carson, 2002; Xu & Ball, 2024), there have been few attempts to distinguish between authentic ethnomathematics and culture-based mathematics research from a philosophical and methodological perspective. In particular, there has been no in-depth analysis of how this misalignment has eroded the integrity of research on the topic of ethnomathematics. This gap needs to be filled immediately so that ethnomathematics does not lose its original meaning as a "knowledge independence movement."

Therefore, this article aims to explore the misalignment between ethnomathematics as a philosophical research program and contemporary research practices based on cultural artifacts. This paper seeks to clarify the epistemological boundaries between "mathematics from culture" and "mathematics in culture." Hopefully, this discussion can return ethnomathematics to its path as a way to respect the diversity of ways humans understand the world through mathematics.

METHOD

This study uses a qualitative approach with a literature review. This approach was chosen to critically reflect on the epistemological and methodological foundations of current ethnomathematics research. The main data sources are relevant international literature, including books, journal articles, and documents discussing ethnomathematics, the philosophy of mathematics education, and critiques of cultural reductionism. References to recent empirical studies that claim to be "ethnomathematics" but are based on cultural artifacts are also used in this study as comparative material.

Data analysis was conducted using thematic content analysis (Flick, 2013). The focus of the study was to identify inconsistencies in theoretical claims and methodological practices in ethnomathematics research. The research procedure was carried out in four stages: (1) literature collection through systematic searches in databases such as Scopus, Google Scholar, and DOAJ using the keywords ethnomathematics, cultural artifact, misuse, and philosophy of mathematics education; (2) literature selection based on conceptual relevance and source credibility; (3) thematic coding to distinguish between authentic ethnomathematics research and research based solely on artifacts; and (4) philosophical interpretation to reconstruct the epistemological boundaries between ethnomathematics and culturally based contextual approaches. The validity of the analysis was maintained through triangulation of the references used and discussion with the theoretical framework in the philosophy of mathematics education.

RESULTS AND DISCUSSION

The dominant dualism in ethnomathematics research

Contemporary ethnomathematics research shows a striking dualism in its philosophical foundations and methodological practices in the field. On the one hand, many researchers cite D'Ambrosio (1985) and Bishop (1988) to affirm their commitment to and recognition of authentic local mathematical systems. On the other hand, however, the approaches used tend to be "descriptive-visual," analyzing only mathematical patterns, such as geometric shapes, in artifacts without investigating whether the communities that own the culture actually understand or use these mathematical concepts. As a result, the claim of "ethnomathematics" becomes ambiguous and often inconsistent with the original spirit of this research program (Pais, 2011).

The first pattern, which is authentic ethnomathematics, involves direct engagement with cultural communities through participatory observation and in-depth interviews. Researchers in this pattern not only look at mathematical forms, but also ask about the meaning, procedures, and social functions of these practices (Akbar et al., 2023; Alghar & Marhayati, 2023; Spradley, 2016; Umbara et al., 2021; Zaslavsky, 1999). For example, Zaslavsky (1999) research in Figure 2. They respect culture as an epistemic subject, not just an object to be illustrated. This approach is in line with D'Ambrosio (2016) vision of ethnomathematics as a form of resistance to epistemic colonialism.

1	otu	30	ohu na iri (20 and 10)
2	abuo	31	ohu na iri na otu (20 + 10 + 1)
3	ato	40	ohu abuo (20 × 2)
4	ano	50	ohu abuo na iri [(20 × 2) + 10]
5	iso	60	ohu ato (20 × 3)
6	isii	100	ohu iso (20 × 5)
7	asaa	200	ohu iri (20 × 10)
8	asato	300	ohu iri noohu ise [(20 × 10) + (20 × 5)]
9	toolu	400	nnu
10	iri		
11	iri na otu (10 and 1)		
12	iri na abuo (10 and 2)		
20	ohu		
21	ohu na otu (20 and 1)		

Figure 2. Igbo Number Word (Zaslavsky, 1999)

Conversely, the second pattern is more dominant in recent ethnomathematics research. This pattern relies solely on visual documentation and formal analysis of cultural artifacts such as carvings, architecture, or textiles (Arwanto, 2017; Rahman et al., 2022; Soebagyo & Luthfiyyah, 2023). For example, in the study by Rahman et al. (2022), which explores the concept of reflection in gate artifacts (see Figure 3). The researchers feel that the study by Rahman et al. (2022) is not in line with the epistemology of ethnomathematics because there is no validation from traditional leaders or local cultural actors. Without validation from cultural practitioners, mathematical interpretations in this pattern are projective and often ignore the actual symbolic or spiritual layers of meaning (Rowlands & Carson, 2002; Xu & Ball, 2024). Artifacts are treated as a "blank sheet of paper" on which researchers write "Euclidean concepts," rather than as a living expression of a knowledge system.

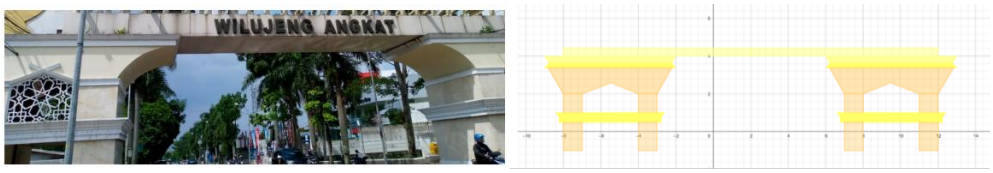

Figure 3. The concept of reflection in gate artifacts (Rahman et al., 2022)

This difference is not merely technical, but reflects two conflicting views on the nature of mathematics. The first views mathematics as a dynamic social practice (D'Ambrosio, 2016; Rosa et al., 2016), while the second treats it as a universal and context-free abstract system (Netto et al., 2025; Pais, 2011; Xu & Ball, 2024). This tension erodes the integrity of ethnomathematics as a philosophical movement and turns it into a "rhetorical tool" to embellish research reports.

To overcome this ambiguity, researchers need to explicitly state their epistemological position from the outset. If the goal is to uncover local mathematical systems, then ethnographic methods are mandatory (Spradley, 2016). If the goal is to develop contextual learning, then it is more honest to call it a "cultural approach to mathematics learning" rather than "ethnomathematics" (Desai et al., 2022; Tandas & Cerveza, 2025). This transparency clarifies the contribution of each study and prevents conceptual confusion that undermines the integrity of ethnomathematics research programs.

Epistemological inconsistency between claims and practice

Many researchers claim to be based on the philosophy of fallibilism (Ernest, 1991; Glas, 1998), but the methodology used actually contradicts this basic principle. They state that mathematics is contextual and revisable, but in practice they impose formal definitions (Pais, 2011). For example, "a square must have four sides of equal length" is a cultural artifact (Lisnani et al., 2020). They do not consider the internal logic of the society that owns it. This creates a serious epistemological dissonance: pluralism on the surface, reductionism in substance.

This dissonance is evident when researchers refer to an ornament, such as reflective symmetry, without asking whether the local community has that concept (Arwanto, 2017; Rahman et al., 2022). Without verification through interviews or observation, such interpretations only reflect the researcher's point of view, not that of the community being studied (Spradley, 2016; Umbara et al., 2022). Ini Wittgenstein (2009) framework, this means ignoring the original "language game" and replacing it with foreign external rules.

This has resulted in ethnomathematics losing its critical dimension as a form of resistance to the hegemony of formal mathematics (D'Ambrosio, 2016). Instead of empowering local knowledge, this type of research actually reproduces scientific hierarchies, with school mathematics at the top and culture at the bottom as "raw material." As criticized by Pais (2011) and Xu & Ball (2024), this is not the decolonization of knowledge, but symbolic exploitation that claims to respect culture, when in fact it empties it of meaning.

The main solution lies in epistemological consistency at every stage of research. If researchers claim to be grounded in fallibilism, then they must be open to the possibility that the "square" on the historic door is not a square in the mathematical sense. It needs to have meaning, spiritual symbolism, ritual structure, or even technical coincidence (Alghar et al., 2022; Desai et al., 2022; Hayati et al., 2025; Zaslavsky, 1999). Validation must come from within the culture, not from Euclid's theorems (Pais, 2011). Only then can ethnomathematics return to being a space for dialogue, rather than merely an academic monologue in reports devoid of cultural meaning.

Distortion of cultural values due to the absence of an emic approach

One of the most serious impacts of the artifact-based approach is the distortion of cultural values that should be respected (Pais, 2011; Rowlands & Carson, 2002). When researchers do not involve key informants, the symbolic meaning of an artifact is often simplified into mere geometric shapes (Netto et al., 2025). Sacred motifs are transformed into examples of "equilateral triangles," and carvings that have local cultural value are reduced to "symmetrical patterns" (Pais, 2011; Xu & Ball, 2024). This is not only a methodological error, but also an intellectual ethical violation against the culture being studied (Dingwall, 1980).

This distortion ignores the basic principle of cultural research, namely that meaning must be understood from the perspective of the actor, not the observer (Spradley, 2016). This is evident in batik artifacts, which are often the focus of ethnomathematics research (Arwanto, 2017; Azzahra et al., 2023; Zayyadi, 2017).

The motifs are often analyzed only as flat shapes, even though for the community they have sacred meanings, are full of love, and have long historical value in the life of the community (Prahmana & D'Ambrosio, 2020; Suhaimi, 2020). Ignoring this meaning is tantamount to emptying culture of its spiritual soul (Alghar & Lubis, 2025). More cruelly, it reduces meaning by replacing it with unfamiliar school mathematics logic (Netto et al., 2025; Pais, 2011).

Furthermore, this distortion violates the spirit of social constructivism in the philosophy of mathematics education. If mathematics is constructed in a social context, then that context must be respected (Eglash, 1997). As Knijnik (2012) said, local mathematics is not a "primitive version" of formal mathematics, but a complete system with its own internal logic. Importing Euclidean definitions into a cultural space without dialogue means ignoring the epistemic autonomy of that community.

Therefore, every ethnomathematics study must involve at least one stage of emic validation through interviews with cultural actors who understand the meaning of the artifacts (McCurdy et al., 2004; Rosa & Orey, 2018; Spradley, 2016). If this is not possible, then researchers must explicitly state these limitations and avoid claims about "local mathematics" (Dingwall, 1980). This methodological transparency is a form of intellectual respect for the culture being studied.

Blurring boundaries with other culture-based approaches (RME, CTL, ethnomodelling)

The tendency to blur ethnomathematics with other approaches such as Realistic Mathematics Education (RME), Contextual Teaching and Learning (CTL), or ethnomodelling further exacerbates the identity crisis of this discipline (Desai et al., 2022; Netto et al., 2025; Rowlands & Carson, 2002). All three do use real contexts such as culture, but with different objectives and philosophical foundations (Desai et al., 2022; Prahmana, 2022). RME and CTL aim to teach school mathematics through context, while ethnomathematics aims to reveal the mathematical systems that already exist in culture (Desai et al., 2022).

On the other hand, ethnomodelling is indeed between the two (Rosa & Orey, 2016). Ethnomodelling formalizes local practices into mathematical models (Alghar & Radjak, 2024; Desai et al., 2022; Stillman et al., 2020). However, the starting point remains practice, not artifacts. Conversely, much of today's "ethnomathematics" research starts from formal concepts and then looks for their correspondence in cultural objects (Netto et al., 2025; Rahman et al., 2022; Xu & Ball, 2024). This is closer to CTL than ethnomathematics, but it is rarely acknowledged honestly by researchers.

The corrective measure is clear terminological differentiation. Researchers must choose appropriate terminology. If the researcher's focus is on local mathematical practices, then use the term ethnomathematics (Rosa et al., 2016). If the researcher's focus is on the use of culture as a learning context, then use the term culture-based contextual approach (Desai et al., 2022; Tambunan, 2025). If the focus is on modeling local practices, then use the term ethnomodeling (Alghar

& Radjak, 2024; Rosa & Orey, 2016). If the focus is on classroom learning, then use the Realistic Mathematics Education (RME) approach (Prahmana, 2022). Thus, each approach can develop along its own path, without blurring each other's philosophical identities.

CONCLUSION

This study reveals a discrepancy between the philosophical foundations of ethnomathematics and contemporary cultural-based mathematics research practices, which tend to be reductive toward cultural artifacts. Many studies claim to be "ethnomathematics" simply because they find mathematical forms in cultural objects, without emic validation or exploration of the mathematical practices that exist within those communities. As a result, ethnomathematics loses its epistemological and ethical dimensions. The difference between "mathematics from culture" (authentic) and "mathematics on culture" (contextual) needs to be emphasized through methodological transparency, respect for culture, and the use of precise terminology such as ethnomathematics, RME, CTL, or ethnomodelling. Further research is expected to empirically examine the comparative pedagogical impact of these various approaches.

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