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Integrating ethnomathematics in secondary mathematics curriculum: Approaches, practices, and teacher experiences

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A R T I C L E I N F O

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A B S T R A C T

This study examined how ethnomathematics is integrated into the secondary mathematics curriculum, with particular attention to its current representation and teachers' experiences of its implementation in practice. It also identified the essential components for its successful integration. The study regards mathematics as a socially established subject influenced by cultural practices and indigenous knowledge systems. It is anchored on ethnomathematics theory, constructivist learning theory, and culturally responsive pedagogy. The Most Essential Learning Competencies (MELCs), the MATATAG Curriculum Guide, and instructional materials were among the 82 curriculum-related documents that were analyzed using a qualitative exploratory design with 130 junior high school math teachers. The data were gathered through semi-structured interviews and document analysis, then subjected to thematic and matrix-based analyses. The findings suggest that while ethnomathematics is present in the curriculum, it often appears implicitly and in dispersed form, and its implementation largely depends on teacher initiative. Although culturally grounded instruction improves identity development, conceptual understanding, and learner engagement, its implementation has been limited by resource constraints, inadequate professional training, and misalignment with assessment methods. The study emphasizes that intentional alignment among curricular design, teaching, and evaluation is necessary for meaningful integration. These results support further initiatives to advance inclusive, culturally sensitive, and contextually relevant mathematics education.

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Introduction

In formal education, mathematics is often taught as a universal, context-independent subject, which can create a gap between learners' real experiences and the abstract ideas taught. Despite this, mathematics is deeply embedded in daily community activities, including resource management, trading,

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construction, and measurement. Despite being fundamentally mathematical, such knowledge is rarely accepted as an appropriate component of formal education (Iskandar et al., 2022).

Ethnomathematics challenges this traditional approach by recognizing that mathematical understanding develops within cultural and social practices, rather than existing independently of them (D'Ambrosio, 2016). This strategy aligns with culturally responsive pedagogy, which encourages relating instruction to students' cultural backgrounds to increase engagement and comprehension (Ladson-Billings, 2021). Contextualizing mathematics within well-known cultural encounters enhances engagement, conceptual clarity, and appreciation of the subject, according to numerous studies (Bravo et al., 2023; Prahmana & Istiandaru, 2021).

Ethnomathematics remains under-integrated into formal education systems, despite these benefits. Policies in the Philippines encourage contextualization and inclusivity, but cultural knowledge is commonly used superficially, emphasizing generic real-life examples over genuine indigenous traditions (Valdez & Pueblos, 2022). Implementation is nevertheless restricted by structural constraints, such as insufficient teaching materials, limited teacher preparation, and evaluation methods that prioritize procedural knowledge (Tupas & Dela Cruz, 2023).

These gaps further highlight the need for a more systematic academic investigation into how ethnomathematics can be effectively integrated into the secondary mathematics curriculum. To identify the essential components for successful integration, this study examines curriculum representations and teachers' experiences.

Literature review

This chapter summarizes pertinent studies and literature that provide theoretical and empirical support for the current study. It covers ethnomathematics, integration challenges and opportunities, and ethnomathematics in the curriculum.

Ethnomathematics

Ethnomathematics is generally understood as the study of the relationship between mathematics and culture, challenging the notion of mathematics as purely abstract and universal. Grounded in D'Ambrosio's (2016) work, it recognizes that mathematical knowledge is socially and historically constructed within cultural practices.

Several studies have shown that mathematical ideas are embedded in everyday activities such as counting, measuring, designing, and trading (Arda-Cimen, 2014). From an educational viewpoint, ethnomathematics promotes culturally responsive and transformative pedagogy by validating learners' identities and enhancing engagement and conceptual understanding, particularly among marginalized groups (Rosa & Orey, 2019; Gayagay, 2021). Consequently, it repositions local knowledge systems as legitimate sources of mathematical understanding and learning rather than as supplementary examples.

Ethnomathematics in the curricula

The integration of ethnomathematics into curricula responds to the limitations of decontextualized mathematics instruction. Scholars argue that mathematics education should be grounded in learners' socio-cultural contexts to enhance relevance and understanding (Nst & Batubara, 2024). Studies indicate that contextualized instruction improves conceptual understanding, participation, and the application of mathematics to real-life situations (Prahmana & Istiandaru, 2021; Mania & Alam, 2021). However, effective integration requires alignment among policy, teacher preparation, community engagement, and instructional resources, though implementation varies across contexts (Hunter & Hunter, 2023). In the Philippine context, despite rich cultural resources, integration remains largely exploratory and lacks systematic implementation (Valdez & Pueblos, 2022).

Challenges in integration

Despite its potential, the integration of ethnomathematics continues to face several structural and pedagogical challenges. Standardized curricula often limit opportunities for contextualization, as they tend to emphasize procedural competencies over culturally grounded understanding (Valdez & Pueblos, 2022). Additionally, the dominance of Western mathematical frameworks often overshadows indigenous knowledge systems, reducing cultural content to superficial representations rather than treating it as a meaningful source of knowledge (Pascua & Gumangan, 2021).

Teachers also encounter practical difficulties, including limited preparation in ethnomathematics, insufficient instructional resources, and a lack of institutional support (Tupas & Dela Cruz, 2023; Bishop et al., 2020). Taken together, these challenges suggest that meaningful integration requires more than teacher effort; it calls for broader systemic and institutional support.

Statement of the problems

This study explored the integration of ethnomathematics in the secondary mathematics curriculum. It specifically aimed to answer the following questions:

1. How should ethnomathematics be best integrated into any curricula?

2. How is ethnomathematics currently presented in the secondary mathematics curriculum?

3. What are the personal accounts of teachers in integrating ethnomathematics in the classroom?

4. What essential components should be included to integrate ethnomathematics into the secondary mathematics curriculum effectively?

Methodology

This chapter presented the research design, sources of data, including the study locale, population, and sampling; data-gathering instrument; and data analysis, including its ethical standards.

Research design

This study employed a qualitative exploratory approach to investigate the conceptualization, representation, and integration of ethnomathematics within the secondary mathematics curriculum. The approach was appropriate for capturing contextual meanings and personal experiences that cannot be adequately explained through quantitative methods.

Locale of the study

The study was conducted in public secondary schools in the Schools Division of Ilocos Norte, Philippines. The division encompasses 61 public secondary schools, distributed across four geographic zones: North, Central, East, and South. The geographic distribution of schools enabled the study to capture a diverse range of educational contexts across the province, thereby strengthening the representativeness of teachers' perspectives and curriculum implementation experiences.

Population and sampling

Junior high school math teachers from public secondary schools in the Schools Division of Ilocos Norte participated in this study. The study initially targeted a total enumeration of the teacher population; however, participation was obtained from 130 of 193 teachers, corresponding to a response rate of approximately 67 percent. Non-participation was primarily attributed to scheduling conflicts, workload demands, and other professional obligations commonly encountered in school-based research settings.
In addition to teacher participants, the study also analyzed curriculum-related documents to examine how ethnomathematics is currently represented in the secondary mathematics curriculum. A total of 82 documents were included in the document analysis. These consisted of the Most Essential Learning Competencies (MELCs) document, MATATAG Curriculum Guide, and instructional materials, specifically lesson plans, lesson exemplars, and daily lesson logs (DLLs) used in Mathematics Grades 7–10 during the first and second quarters. These instructional documents were obtained from the participating teacher respondents and reflect the actual materials used in classroom instruction.

Data gathering instrument

The study employed two research instruments: a Document Analysis Matrix Tool and a Semi-Structured Interview Guide. These instruments were designed to gather complementary data to inform the identification and articulation of the essential components required for effectively integrating ethnomathematics into the curriculum.

The Document Analysis Matrix Tool served as the primary instrument for examining curriculum documents. The matrix captured both descriptive information and analytical indicators related to the presence of ethnomathematics across three key curricular dimensions: content, pedagogy, and assessment. By organizing documentary evidence into systematic categories, the matrix facilitated the identification of patterns, gaps, and opportunities for cultural integration within existing mathematics curriculum frameworks.

To complement documentary analysis, a semi-structured interview guide was used to gather insights from mathematics teachers, curriculum designers, and cultural experts. The interview questions explored

participants' experiences with culturally responsive teaching, perceived challenges in integrating ethnomathematics, and recommendations for components for systematic integration of ethnomathematics. The semi-structured interview allowed participants to elaborate on their professional experiences while ensuring consistency across interviews.

Data gathering procedure

Data collection followed a structured, sequential procedure aligned with the study's developmental nature. Initially, relevant curriculum documents—including national curriculum guides and instructional materials—were gathered from authorized sources and analyzed using the Document Analysis Matrix Tool. This stage generated documentary evidence regarding how ethnomathematics is currently represented within official mathematics curriculum frameworks.

Subsequently, semi-structured interviews were conducted with selected participants. Interviews were conducted either face-to-face or via virtual platforms, depending on participant availability and logistical constraints. With informed consent, the interviews were audio-recorded and later transcribed verbatim to preserve the authenticity of participant responses.

Data analysis tool

The data analysis involved both qualitative document analysis and thematic analysis. Curriculum documents were examined using matrix coding across the dimensions of content, pedagogy, and assessment. This approach enabled the systematic identification of ethnomathematical elements, patterns of representation, and areas where cultural knowledge could be more effectively integrated within the mathematics curriculum.

Both deductive and inductive coding techniques were used in the thematic analysis of interview data. Deductive codes were derived from the study's research questions and conceptual framework, while inductive coding allowed new insights to emerge from participants' narratives. Through iterative comparison and categorization, codes were organized into broader themes reflecting pedagogical practices, implementation challenges, institutional supports, and culturally responsive assessment strategies.

Ethical considerations

The study complied with accepted ethical standards for educational research, particularly those regarding responsible data management, informed consent, and confidentiality. Every participant was made aware of the study's goal, the methods used, and their freedom to leave at any time without incurring any fees. Before data collection, informed consent was acquired, and participation was entirely voluntary.

To safeguard confidentiality, identifying information was removed from transcripts and datasets, and pseudonyms or coded identifiers were used in reporting research findings. Digital files were stored in password-protected devices accessible only to the researcher. These measures ensured the protection of participant privacy and the secure handling of research data.

Data presentation and analysis

This section presents the collected data and corresponding analyses in response to the study's research questions.

Problem 1: How should ethnomathematics be best integrated into any curricula?

Table 1: Ethnomathematics integration across curricula

Theme	Focus	Key Scholarly Support	Implications
Culturally responsive curriculum design	Embeds culture as a foundational source of mathematical knowledge; aligns content with learners' lived experiences and local practices.	"Culturally responsive pedagogy improves student performance…" (Dilor, 2025)	Integrate cultural mapping and align local knowledge systems with formal competencies to enhance relevance, validate identity, and deepen conceptual understanding.
		"helps students become aware of how people mathematize…" (Rosa & Orey, 2016)	
		"Education must impart respect of culture…" (Fouze, 2017)	
		"explores mathematical practices embedded within diverse cultural contexts…" (Luga et al., 2024)	
Transformative and scaffolded pedagogy	Employs experiential, inquiry-based, and scaffolded instruction progressing from cultural context to abstraction	"enhanced… problem-solving strategies…" (Ndeot et al., 2025)	Apply structured progression (cultural immersion → abstraction → generalization) to bridge informal knowledge and formal mathematics while improving engagement
		"gives them the freedom to think… apply… in everyday life" (Fendrik et al., 2020)	
		"teachers must recognize its relevance…"(Supriyadi et al., 2024)	
		"higher motivation and satisfaction…" (Wulandri et al., 2024)	
Contextualized and culturally aligned assessment	Uses authentic, culturally grounded tasks to assess meaningful mathematical understanding	"scored significantly higher…" (Ntumi et al., 2026)	Develop performance-based, context-driven assessments reflecting community practices to improve validity, engagement, and alignment with curriculum and pedagogy
		"higher motivation and satisfaction…" (Wulandri et al., 2024)	
		"promoting shared accountability…" (DepEd, 2011)	
		"shall be contextualized…" (DepEd, 2024)	
		"ethnomathematical concepts present…" (Sulatra, 2023)	

Source: Ballesteros (2026)

Table 1 presents how ethnomathematics can be effectively integrated into curricula, highlighting the convergence of culturally responsive curriculum design, transformative and scaffolded pedagogy, and contextualized assessment systems as key dimensions of a systemic and culturally grounded approach to mathematics education. The integration of ethnomathematics is most effectively framed as a culturally grounded approach that positions culture as a foundational source of mathematical knowledge. This requires curriculum design anchored in learners' lived experiences, community practices, and indigenous knowledge systems. Empirical literature affirms that "culturally responsive pedagogy improves student performance, engagement, and conceptual comprehension when mathematics instruction incorporates students' cultural contexts" (Dilor, 2025). Similarly, Rosa and Orey (2016) argue that "ethnomathematical curriculum helps students become aware of how people mathematize and think mathematically in their own cultures and to use this awareness to learn about formal mathematics." These perspectives, supported by Fouze's (2017) assertion that "education must impart respect for culture and take into account cultural values," and Luga et al. (2024), highlight the necessity of cultural mapping and the recognition of local epistemologies in curriculum development.

Effective integration further requires transformative and scaffolded pedagogical practices that situate learning within sociocultural contexts. Ethnomathematics-informed instruction emphasizes meaningful engagement with real-world cultural practices rather than abstract teaching. As noted by Kyeremeh (2023), "the educational activities designed in accordance with culturally relevant pedagogy principles concentrate on the function of mathematics in a sociocultural framework," while Jacob and Dike (2023) assert that "ethnomathematical techniques aim to make classroom mathematics more applicable and meaningful to learners." Empirical findings demonstrate that culturally grounded tasks lead to "enhanced children's problem-solving strategies, persistence, and conceptual understanding" (Ndeot et al., 2025) and that ethnomathematics "helps students understand and learn mathematics because it gives them the freedom to think and apply mathematical concepts in everyday life" (Fendrik et al., 2020). Instructional sequencing is critical, with approaches that "begin with cultural realities and move on to formal abstraction" (Kyeremeh, 2023), and this approach is further supported by improved higher-order thinking outcomes (Balacuit & Oledan, 2024).

Aligning assessment practices with cultural contexts is equally essential. Traditional assessments often fail to capture authentic understanding when detached from learners' lived experiences; in contrast, culturally relevant assessments provide more valid measures of learning. Evidence indicates that students "scored significantly higher in mathematics performance" when assessed through familiar cultural contexts (Ntumi et al., 2026) and that "students exhibit higher motivation and satisfaction with mathematics learning when connected to their local culture" (Wulandri et al., 2024). Furthermore, teachers must "recognize its relevance and make room for it" in curriculum implementation (Supriyadi et al., 2024). Policy frameworks reinforce this direction, emphasizing contextualization, community engagement, and culturally responsive practices (DepEd, 2011; DepEd, 2024), while empirical cases, such as integrating mathematical concepts into fishing practices, demonstrate the authenticity of cultural assessment contexts (Sulatra, 2023).

Ethnomathematics integration is most effective when curriculum design, pedagogy, and assessment operate as an interconnected system grounded in cultural relevance. This systemic approach ensures that

cultural practices function as integral components of mathematical understanding rather than peripheral illustrations. By embedding ethnomathematics through intentional design, experiential pedagogy, and contextualized assessment, mathematics education becomes more meaningful, inclusive, and equitable, fostering both conceptual understanding and cultural identity.

Problem 2: How is ethnomathematics currently presented in the secondary mathematics curriculum?

Table 2. Representations of ethnomathematics in the secondary mathematics curriculum.

Themes	Categories	Representative Statements
Presented as localized contexts rather than indigenous knowledge systems	Contextualization through real-life applications	"models real-life situations using quadratic functions." (DepEd, MELCS, 2020)
	Generic application-focused competencies	"solves problems involving quadratic functions." (DepEd, MELCS, 2020)
	Lack of cultural specificity in problem-solving	"solves problems involving quadratic equations and rational algebraic equations." (DepEd, MELCS, 2020)
	Emphasis on everyday situations (not indigenous reasoning)	"Cultural references are restricted to realistic, everyday scenarios like budgeting, jeepney fares, and measurement conversions." (Document Analysis)
	Real-life application without indigenous grounding	"Solve real-life problems involving right triangles through the application of the trigonometric ratios." (DepEd, Matatag Curriculum, 2024)
	Broad contextualization mandate	"Choose and use mathematics effectively in its application to situations that arise in their life at home, at work, and in the community." (DepEd, Matatag Curriculum, 2024)
Philosophical rather than structural representation	Ethnomathematics embedded in curriculum philosophy	"It is more prevalent in philosophical orientation than in requirements for specific material." (Document Analysis)
	DEI-oriented but non-prescriptive curriculum	"diversity, equity, and inclusion need to be continually considered…" (DepEd, Matatag Curriculum, 2024)
	Context-neutral competencies	"Solve problems involving quadratic inequalities in one variable." (DepEd, MELCS, 2020)
	Lack of explicit indigenous knowledge integration	"It does not specify which indigenous knowledge systems should be taught." (Document Analysis)
	Reliance on teacher initiative	"Integration is left to the teachers." (Document Analysis)

Teacher-dependent implementation	Curriculum encourages the use of prior knowledge but lacks structure	"using in tasks situations that are familiar to the learners to draw out the mathematics that they already know…" (DepEd, Matatag Curriculum, 2024)
	Absence of concrete models/frameworks	"Teachers are not given any particular frameworks or models…" (Document Analysis)
		"Solve problems involving quadratic functions." (DepEd, MELCS, 2020)
	Resulting variability in implementation	Ethnomathematics becomes discretionary rather than essential." (Document Analysis)
Subordinate to conventional pedagogy and assessment	Emphasis on procedural and formal mathematics	"Standardized testing, decontextualized problem solving, and procedural mastery remain key components…" (Document Analysis)
	Assessment not culturally grounded.	"Formative and summative assessment tasks… should be developed in conjunction with other learning areas." (DepEd, Matatag Curriculum, 2024)
	Cultural context not required in the evaluation.	"It does not call for assessment criteria that are rooted in the community or culture." (Document Analysis)
	Reinforcement of mathematics as universal and culture-neutral	"Mathematics is still seen as a discipline that transcends all cultures." (Document Analysis)
	Formal competency dominance	"Solve problems involving quadratic inequalities in one variable." (DepEd, Matatag Curriculum, 2024)
Emerging possibility through diversity, equity, inclusivity (DEI) and contextualization mandates	Strong policy support for contextualization	"The curriculum equips learners with the mathematical concepts and skills that may be relevant to social justice, cultural diversity…" (DepEd, Matatag Curriculum, 2024)
	Learner-centered and experience-based pedagogy	"Bring into the fore what learners already know…" (DepEd, Matatag Curriculum, 2024)
	Opportunities for cross-disciplinary integration	"Formative and summative assessment tasks… should be developed in conjunction with other learning areas." (DepEd, Matatag Curriculum, 2024)
	Structural openings for contextual modeling	"Model real-life situations using quadratic functions." (DepEd, MELCS, 2020)
	Encouragement of authentic and contextual tasks	"Use cross-disciplinary performance tasks." (DepEd, Matatag Curriculum, 2024)

	Ethnomathematics as a potential rather than a requirement	"Ethnomathematics is positioned as an emergent option rather than a fully developed curriculum component." (Document Analysis)

Source: Ballesteros (2026)

Table 2 shows the representation of ethnomathematics in the secondary mathematics curriculum. The findings indicate that ethnomathematics in the secondary mathematics curriculum is largely presented implicitly and in fragmented form rather than as a systematically institutionalized component of mathematical knowledge. While curriculum documents such as the MELCs and the MATATAG Curriculum promote contextualization and real-life applications, cultural integration remains superficial and indirect. Ethnomathematics is thus positioned more as a pedagogical possibility than a curricular requirement, with cultural contexts treated as supplementary rather than foundational. This reflects a persistent orientation toward formal, Western-centered mathematical structures despite rhetorical commitments to inclusivity.

The results revealed that ethnomathematics is primarily operationalized through generalized real-life contexts rather than authentic indigenous knowledge systems. Curriculum competencies emphasize application, such as "models real-life situations using quadratic functions" and "solves problems involving quadratic equations" (DepEd MELCs, 2020). However, these contexts are not necessarily grounded in cultural practices. As a result, ethnomathematics is reduced to contextualization, aligning with the critique that it is often treated as merely adding cultural elements rather than engaging with the mathematical logic embedded in cultural systems. As Rosa and Orey (2011) argue, ethnomathematics is frequently misconstrued as superficial contextualization rather than a distinct epistemological framework.

Ethnomathematics is implicitly embedded in the curriculum philosophy rather than explicitly articulated in the content, making its implementation highly dependent on teachers' interpretation. Although the MATATAG Curriculum emphasizes relevance to "social justice, cultural diversity, and sustainable development," it lacks specific directives on integrating indigenous knowledge systems. Similarly, MELCs' competencies remain context-neutral, reinforcing that ethnomathematics is optional rather than mandated. This absence of explicit guidance results in uneven implementation, contingent on teachers' cultural awareness, pedagogical capacity, and available resources.

In addition, ethnomathematics remains subordinate to conventional pedagogy and assessment practices, which continue to emphasize procedural fluency, standardized testing, and decontextualized problem-solving. The marginalization of ethnomathematics is further reinforced by conventional pedagogy and assessment systems that prioritize procedural fluency, standardized testing, and decontextualized problem-solving. Even when cultural contexts are introduced, assessments rarely require culturally grounded reasoning. This sustains the perception of mathematics as universal and culture-neutral, consistent with the critique that "the conventional view of mathematics as culture-free ignores cultural contexts that shape mathematical knowledge" (Rosa & Orey, 2011). Consequently, Western mathematical epistemologies remain dominant within curriculum implementation.

Despite these limitations, the curriculum offers emerging opportunities to integrate ethnomathematics through its emphasis on contextualization and on diversity, equity, and inclusion (DEI). The MATATAG Curriculum promotes learning connected to learners' experiences, creating conceptual space for culturally grounded instruction. However, these provisions remain non-prescriptive, positioning ethnomathematics as a potential rather than a guaranteed component of practice. Overall, the findings suggest that while the curriculum enables ethnomathematics, it does not institutionalize it, underscoring the need for explicit frameworks, structured guidance, and culturally aligned assessment systems to support systematic integration.

Problem 3: What are the personal accounts of teachers in integrating ethnomathematics in the classroom?

Table 3. Teachers' personal accounts on integrating ethnomathematics in the classroom

Themes	Categories	Representative Statements
Grounding mathematics in local culture to make learning meaningful	Use of everyday community practices as mathematical contexts	"We sometimes discuss local practices, like measuring land or crop yields, but I didn't know that could be part of a math approach." (Teacher 36)
	Use of local customs, farming, cooking, trade, and household practices	"One of the most successful and relatable integrations I've done in my math lessons was around non-standard units of measurement that are deeply rooted in Filipino culture." (Teacher 1)
	Cultural artifacts and local structures as teaching resources	"When I asked students to measure the dimensions of their ancestral house and create a floor plan. This helped them understand perimeter, area, and scale drawings while appreciating traditional Ilocano architecture" (Teacher 4)
	Recognition that mathematics already exists in community life	"I didn't know that these everyday practices could be part of ethnomathematics." (Teacher 36)
Enhancement of student engagement and understanding through ethnomathematics	Increased student engagement and participation	"Students become more engaged when they see math reflected in the world they live in" (Teacher 11)
	Greater conceptual understanding through familiar examples	"Ethnomathematics provides a bridge between the students' cultural knowledge and the formal mathematics taught in school. It helps them see the relevance of mathematics in their lives and makes it

		easier for them to understand abstract concepts." (Teacher 41)
	Improved motivation and reduced intimidation in learning mathematics	"It motivates them and makes the subject less intimidating" (Teacher 4)
	Increased confidence and cultural affirmation	"Some students become more confident when they see that math values their culture." (Teacher 13)
	A greater pride in students' ways of life	"Students become proud when they see their way of life reflected in class." (Teacher 12)
Teacher identity transformation and professional reflection	Realization that mathematics is not entirely culture-free	"We always say math is universal, but maybe we have ignored how it shows up differently in different communities" (Teacher 42)
	Reflection on limited familiarity with ethnomathematics	"I am not familiar with ethnomathematics." (Teacher 5)
	Openness to learning and professional growth	"This is actually the first time I have heard of this concept, but I am interested to know how it could be applied in my classroom." (Teacher 22)
	Shift from textbook implementer to reflective teacher	"I have always treated math as abstract and logical. This approach seems to open a different perspective." (Teacher 45)
	Shift from textbook implementer to reflective teacher	"I have never looked at math through a cultural lens, but I am curious now. It might help students who struggle with standard methods." (Teacher 46)
Persistent challenges in implementing ethnomathematics	Lack of culturally relevant teaching materials	"There are no written materials about our local practices, so I have to rely on oral stories from elders." (Teacher 14)
	Limited training and professional support	"The challenge is that there are limited resources and materials available for integrating ethnomathematics in the classroom. Teachers need more training and support to implement this approach effectively." (Teacher 43)
	Difficulty aligning local culture with formal competencies	"Finding examples that match the curriculum is sometimes hard. I also get worried if I am teaching it the right way." (Teacher 20)

	Time constraints and pressure to finish competencies	"We are pressured to finish the MELCs before the quarter ends, so I do not have time to add new activities, and with the school's activities, we lack time to fully integrate culture into the lessons" (Teacher 15)
	Fear of making mistakes without proper guidance	"I am afraid I might make mistakes if I try to include cultural practices without proper guidance" (Teacher 18)
	Resistance or skepticism toward cultural mathematics	"Some teachers might resist it, thinking it is not 'real' math or it is off topic." (Teacher 27)
The need for collaborative and community-anchored integration	Engagement of elders and cultural knowledge holders	"Involving elders and local artisans brings authenticity to lessons, making learning more meaningful and respectful of local heritage." (Teacher 21)
	Reliance on oral knowledge and community consultation	"Most of the knowledge is oral, so I need to talk to elders to get accurate information." (Teacher 7)
	Need for shared teacher strategies and materials.	"There is no official training or materials on this, so we rely on our own ideas." (Teacher 23)
	Community-based tasks as authentic learning opportunities	"I had students interview elders about how they measured rice before weighing scales were common, then we compared it with metric measurements." (Teacher 13)
	Cultural mapping and localization as collective work	"Some of us are not from here, so we need to do some research on the local practices." (Teacher 44)
Curriculum and testing pressures as structural constraints	Exam-oriented teaching reduces room for ethnomathematics	"It limits what we can do—we have to teach to the test" (Teacher 56)
	Standardized tests privilege abstract and procedural mathematics	"The tests do not assess cultural understanding—only computation and problem-solving" (Teacher 28)
	Teachers default to drills, modules, and textbook lessons	"We have to drill students on test formats, not necessarily understanding or application in real life." (Teacher 46)
	Cultural integration is often postponed during exam periods	"We still need to prepare students for standardized tests, so I sometimes have to set aside these lessons during exam periods."(Teacher 19)

	Fixed pacing guides and coverage pressure constrain innovation	"We have to stick closely to the pacing guide, and there is no time for extra content" (Teacher 43)

Source: Ballesteros (2026)

Teachers' personal accounts on integrating ethnomathematics in the classroom are shown in Table 3. They reveal that ethnomathematics enhances the meaningfulness of mathematics by grounding instruction in learners' lived experiences and community practices. Connecting lessons to everyday contexts, such as market transactions, farming, and local crafts, helps students see mathematics as relevant rather than abstract. As reflected in the narratives, "these everyday practices could be part of ethnomathematics" (Teacher 36), and "students become more engaged when they see math reflected in the world they live in" (Teacher 11). These findings affirm that culturally grounded instruction enhances authenticity and aligns with scholarship that emphasizes ethnomathematics as a means of linking mathematical knowledge to cultural identity and lived experience.

A dominant theme across teacher narratives is the improvement of student engagement, confidence, and conceptual understanding. Ethnomathematics functions as a cognitive bridge between learners' prior cultural knowledge and formal mathematical concepts. Teachers observed that "ethnomathematics provides a bridge between the students' cultural knowledge and the formal mathematics taught in school" (Teacher 41) and that "students become more confident when they see that math values their culture" (Teacher 13). These insights support existing studies that culturally responsive practices enhance motivation, reduce anxiety, and deepen conceptual understanding by anchoring abstract concepts in familiar contexts.

The integration of ethnomathematics also fosters shifts in teachers' epistemological perspectives, prompting them to reconceptualize mathematics as culturally situated rather than culture-free. This transformation encourages reflective practice and redefines teachers' roles as facilitators of culturally responsive learning. However, variations in preparedness persist, as some teachers acknowledged knowledge gaps, stating, "I am not familiar with ethnomathematics" (Teacher 5). The findings are consistent with the previous research, which indicates that ethnomathematics requires ongoing professional growth and challenges prevailing paradigms.

Despite its pedagogical potential, teachers identified significant barriers to integration, including limited instructional resources, insufficient training, and systemic constraints. The absence of culturally relevant materials was emphasized, with teachers noting that "there are no written materials about our local practices" (Teacher 14), alongside the need for institutional support, as "teachers need more training and support to implement this approach effectively" (Teacher 43). Time limitations, curriculum demands, and alignment with standardized assessments further complicate implementation, reinforcing the gap between policy aspirations and classroom realities.

Teachers emphasized that sustainable integration of ethnomathematics requires collaboration with colleagues, cultural experts, and community members. Authenticity in instruction is strengthened

through community engagement, as highlighted in the statement, "involving elders and local artisans brings authenticity to lessons" (Teacher 21). These accounts underscore the importance of cultural mapping, shared resource development, and institutional support for the systematic embedding of ethnomathematics. Overall, while ethnomathematics offers significant potential to enhance learning and affirm cultural identity, its success depends on collective efforts and sustained professional and institutional support.

Problem 4: What essential components should be included to integrate ethnomathematics into the secondary mathematics curriculum effectively?

Table 4: Essential components for ethnomathematics integration in the curriculum

Theme	Integration Principles	Curriculum Findings	Teachers Accounts	Implication
Culturally responsive curriculum design (content)	Emphasizes culture as the foundation of mathematical knowledge	Ethnomathematics is implicit and superficial (contextual only)	Teachers integrate culture, but lack structure and materials	Institutionalize cultural mapping and embed indigenous knowledge as curriculum content
Transformative, experiential, and scaffolded pedagogy	Supports experiential and inquiry-based learning	Curriculum lacks explicit pedagogical models	Teachers report improved engagement but need guidance	Implement structured scaffold (immersion → abstraction → generalization)
Culturally aligned assessment systems	Emphasizes authentic and meaningful assessment	Assessment remains standardized and culture-neutral	Teachers experience a mismatch between instruction and assessment	Develop an authentic, performance-based, culturally grounded assessment

Source: Ballesteros (2026)

Table 4 presents the essential components for effective integration of ethnomathematics into the secondary mathematics curriculum. The result reveals that the effective integration of ethnomathematics into the secondary mathematics curriculum is anchored in three interdependent and empirically grounded components: culturally responsive curriculum design, transformative and scaffolded pedagogy, and culturally aligned assessment systems. These components emerged from the synthesis of curriculum analysis, integration principles, and teachers' personal experiences, demonstrating that ethnomathematics integration is not merely theoretical but a necessary response to the systemic gaps identified in current curricular practices. Collectively, the findings indicate that successful integration requires a coherent restructuring of the instructional system in which content, pedagogy, and assessment are aligned to reflect learners' cultural realities and knowledge systems.

Intentional and culturally responsive curriculum design is identified as a foundational component, emphasizing that culture must serve as the source of mathematical knowledge rather than as a superficial contextual add-on. The analysis shows that current curriculum frameworks tend to present ethnomathematics implicitly and in fragments, limiting cultural references to motivational examples rather than positioning them as legitimate epistemological foundations. Teachers' accounts further confirm that, while local practices such as weaving, farming, and trading are occasionally integrated, these efforts remain inconsistent due to a lack of structured guidance and resources. In response, there is a need for systematic cultural mapping and the transformation of indigenous knowledge into formal mathematical content. This aligns with the assertion of D'Ambrosio (2001) that ethnomathematics necessitates a reorganization of curriculum structures grounded in cultural practices, as well as Rosa and Orey (2011), who emphasize the systematic documentation and curricular transformation of community knowledge. Thus, curriculum design must institutionalize culture as the starting point of mathematical learning to ensure epistemic inclusivity and contextual relevance.

The result also identifies transformative, experiential, and scaffolded pedagogy as a critical component that operationalizes ethnomathematics in classroom practice. While curricular documents encourage contextualization, they lack explicit pedagogical frameworks, resulting in uneven implementation. Teachers consistently report that culturally grounded instruction enhances student engagement, conceptual understanding, and identity formation; however, they also express a need for structured guidance to translate cultural experiences into formal mathematical reasoning effectively. The findings highlight the importance of a scaffolded learning progression, from cultural immersion to abstraction and eventual generalization, which bridges informal community knowledge with formal mathematical concepts. This pedagogical orientation is supported by Civil (2007), who emphasizes leveraging community knowledge to deepen understanding and promote equity, and Hunter et al. (2016), who demonstrate that culturally responsive teaching strengthens learners' mathematical identity and sense of belonging. Consequently, pedagogy in ethnomathematics must move beyond transmission-based instruction toward inquiry-driven, culturally mediated learning experiences.

Culturally aligned assessment systems are essential to ensure coherence between instruction and evaluation. The result reveals a persistent misalignment wherein culturally contextualized teaching is evaluated through standardized, decontextualized assessments that fail to capture learners' authentic understanding. Teachers report that this disconnect undermines the effectiveness of ethnomathematics integration, as assessment practices remain rooted in procedural and culture-neutral paradigms. To address this, the findings advocate developing authentic, performance-based assessments that reflect real-life applications and diverse forms of mathematical reasoning, including oral, collaborative, and experiential demonstrations of knowledge. Empirical support is provided by Ntumi et al. (2026), who found that students perform significantly better on culturally familiar tasks, suggesting that conventional assessments may function as cultural filters. This underscores the need to design evaluation systems that validate, rather than marginalize, culturally grounded mathematical competencies.

The synthesis of findings demonstrates that these three components function as an integrated system rather than discrete elements. Culturally grounded content requires pedagogical approaches that enable learners to experience and interpret it, and these pedagogies must be supported by assessment practices

that authentically measure the learning they promote. The alignment of these components ensures that ethnomathematics integration becomes systematic, meaningful, and sustainable within the secondary mathematics curriculum. Ultimately, the discussion affirms that effective integration requires deliberate structural transformation in curriculum design, instructional practices, and assessment frameworks to achieve culturally responsive, inclusive, and contextually relevant mathematics education.

Discussion of findings

The study reveals that effective integration of ethnomathematics into the secondary mathematics curriculum requires a coherent, systemic alignment of curriculum design, pedagogy, and assessment within a culturally responsive framework. Culture must be positioned as a foundational source of mathematical knowledge through deliberate cultural mapping of community practices, which are then translated into formal mathematical concepts. Instructionally, this integration is realized through experiential and scaffolded learning processes that move learners from cultural immersion to abstraction and symbolic generalization, reinforcing the view that mathematical knowledge is socially constructed and culturally embedded (Luga et al., 2024). Empirical evidence further supports the claim that culturally responsive approaches enhance student engagement, conceptual understanding, and performance (Dilor, 2025; Kyeremeh, 2023; Balacuit & Oledan, 2024).

However, the findings indicate that ethnomathematics remains implicitly and inconsistently represented in existing curriculum frameworks. While policy documents promote contextualization and inclusivity, they do not explicitly institutionalize ethnomathematics, resulting in fragmented, teacher-dependent implementation and assessment practices that remain largely procedural and decontextualized (Rosa & Orey, 2021). Teachers' accounts highlight both their transformative potential—enhancing engagement, cultural identity, and understanding—and the challenges of limited resources, insufficient training, and weak alignment with curricular demands. These constraints underscore the need for structured support, professional development, and community collaboration (Averill, 2011; Wulandri et al., 2024).

The study advances ethnomathematics by reinforcing constructivist and culturally responsive perspectives and promoting epistemic pluralism that recognizes indigenous knowledge systems as legitimate sources of mathematical knowledge (Rosa & Orey, 2011). The findings call for the explicit institutionalization of ethnomathematics in curriculum standards, the development of culturally grounded instructional and assessment materials, and sustained teacher capacity-building aligned with national policy directions on contextualization and inclusivity (DepEd, 2011; DepEd, 2024).

Conclusion

The study concludes that ethnomathematics integration in the secondary mathematics curriculum remains conceptually endorsed but structurally underdeveloped, functioning more as an implicit pedagogical possibility than a formally institutionalized practice. While curriculum frameworks such as the MELCs and the MATATAG Curriculum promote contextualization, inclusivity, and real-life applications (DepEd, 2020; DepEd, 2024), they do not explicitly embed ethnomathematics within curriculum content, pedagogy, or assessment. As a result, cultural elements are often treated as contextual examples rather than legitimate sources of mathematical knowledge, reflecting a persistent

tension between policy intentions for inclusivity and the dominance of Western-oriented mathematical structures.

These findings confirm that by contextualizing mathematics within learners' real-life experiences, ethnomathematics has a powerful transformative potential to improve student engagement, conceptual understanding, and cultural identification. These results align with constructivist and culturally responsive perspectives that view learning as socially and culturally situated. However, the study also reveals that systemic challenges, including limited instructional resources, insufficient teacher training, time constraints, and misalignment with standardized assessment practices, constrain effective implementation. This indicates that successful integration requires not only teacher initiative but also institutional support and systemic coherence across instructional and assessment structures.

The study advances ethnomathematics by reinforcing its foundation in epistemic pluralism and by extending the view of mathematics as a culturally situated discipline within formal education systems. It contributes new knowledge by emphasizing that meaningful integration requires a coherent alignment among curriculum, pedagogy, and assessment, rather than fragmented applications. At the practical and policy levels, the findings underscore the need for the explicit institutionalization of the curriculum, the development of culturally grounded instructional and assessment materials, and sustained teacher capacity-building programs. Such reforms are essential to transform ethnomathematics into a systematic, equitable, and sustainable approach to mathematics education, aligned with national directions for inclusive, contextualized learning.

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