

Redefining Mathematics Instruction via Culture and Context: Pedagogical Prospects and Systemic Obstacles

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Abstract: Set in the culturally and linguistically diverse region of Palawan, Philippines, this study examines localized and culturally responsive mathematics education. Grounded in Social Constructivism, Ethnomathematics, and Culturally Responsive Pedagogy, the research employed a sequential explanatory mixed-methods design. Initial quantitative surveys of 100 secondary math educators and 300 students informed subsequent qualitative interviews and focus group discussions. Results indicate that localizing math instruction significantly enhances student engagement, motivation, and conceptual understanding by bridging abstract concepts with familiar community practices. However, systemic barriers complicate its implementation. Key challenges include a scarcity of localized materials, high preparation demands, classroom linguistic diversity, and misalignment with standardized curricula. This study contributes critical empirical evidence on the tensions between standardized educational structures and linguistic multiplicity in Indigenous-migrant settings—an under-researched area in Southeast Asia. Ultimately, sustainable integration requires specialized teacher training, alignment with national assessments, targeted resources, and robust institutional support.

Keywords: Context-Based Learning; Contextualized Assessment; Culturally Responsive Pedagogy; Inclusive Education; Localization; Pedagogical Implications

Introduction

Although mathematics is widely considered the universal language of science, its instruction is deeply intertwined with cultural and contextual realities. Recently, mathematics pedagogy has shifted from traditional rote memorization toward inquiry-based and student-centered approaches that prioritize problem-solving and critical thinking. While these methods have been shown to improve student outcomes and mathematical reasoning (Sinaga et al., 2023), their effectiveness remains contingent upon local resources, cultural orientations, and teacher readiness.

To make the subject more accessible, there is a growing global movement toward contextualizing and localizing mathematics instruction by anchoring lessons in students' everyday lives. Integrating traditional and Indigenous knowledge systems into formal education has proven highly valuable (Xu & Ball, 2024). In the United States, culturally responsive mathematical modeling has successfully broadened elementary students' participation and sense-making while actively combating marginalization (Suh & Calabrese, 2025; Turner et al., 2024). Similarly, Southeast Asian research highlights positive outcomes when mathematical problems are tethered to community issues, cultural artifacts, and local practices (Payadnya et al., 2024).

In the Philippines, this localized approach is institutionalized through the Department of Education's Indigenous Peoples Education Curriculum Framework, which mandates the integration of Indigenous Knowledge Systems and Practices into the K–12 curriculum (Department of Education, 2015). By adapting abstract mathematical concepts to align with learners' immediate environments, this policy aims to foster greater student motivation and comprehension (Department of Education, 2015).

Palawan, often referred to as the country's "last ecological frontier," features a highly diverse demographic landscape encompassing migrant populations and various Indigenous groups, such as the Tagbanwa, Palawano, Batak, and Molbog (Palawan Biodiversity Conservation Advocates, Inc., n.d.). This profound cultural heterogeneity presents a unique setting for mathematics education. Most existing literature on culturally responsive teaching assumes a relatively homogeneous classroom. In contrast, Palawan's educators frequently manage deeply heterogeneous learning spaces comprising multiple dialects and cultural backgrounds. This linguistic complexity makes it challenging to tailor instruction to every learner's dialect, forcing a reliance on English or Filipino for standardized assessments. Consequently, Palawan serves as a critical, yet underexplored, boundary condition for implementing localization policies in Southeast Asia.

Despite the clear benefits of culturally responsive instruction, educators often struggle to operationalize these frameworks (Nicol et al., 2023). A major obstacle is the lack of validated, high-quality local materials, which frequently leads teachers to fall back on disconnected textbook examples (Chavarría-Arroyo & Albanese, 2022). Furthermore, navigating localization in diverse settings raises equity concerns, as content relevant to one group may alienate another. Language diversity also continues to shape how mathematical concepts are negotiated in these complex settings (Barwell et al., 2019; Planas et al., 2025). Nevertheless, when successfully implemented, context-based mathematics can spur curriculum innovation, promote active participation, and deepen conceptual retention, particularly in rural and Indigenous settings (Cortez, 2024; Gerardo & Mabansag, 2022; Kyeremeh et al., 2023).

To systematically examine these dynamics, this study is anchored in three complementary theoretical frameworks: Culturally Responsive Pedagogy (CRP), Ethnomathematics, and Social Constructivism. CRP posits that instruction must validate and connect to students' cultural identities and linguistic resources to foster meaningful learning (Suh & Calabrese, 2025; Turner et al., 2024). Ethnomathematics complements this by rejecting the notion of mathematics as culturally neutral, advocating instead for the integration of traditional counting systems, patterns, and community problem-solving strategies into formal lessons (Kyeremeh et al., 2023; Payadnya et al., 2024; Xu & Ball, 2024). Finally, Social Constructivism frames learning as an active, socially mediated process (Sinaga et al., 2023). Under this lens, localized activities act as cognitive tools that ground abstract equations in familiar social realities. Together, these perspectives reframe localization not merely as a pedagogical technique, but as a critical intersection of educational equity, cultural validation, and cognitive development in highly diverse classrooms.

Materials and Methods

Research Design

This study utilized a sequential explanatory mixed-methods design to examine the localization of mathematics education within the culturally diverse province of Palawan. Quantitative data were first collected via a five-point Likert scale survey to establish broad trends regarding teacher and student perceptions. These initial statistical results directly informed the subsequent qualitative phase, which used interviews and focus group discussions (FGDs) to deeply explore the realities of teaching in this context. Specifically, the most prominent trends and challenges identified during the survey phase guided the development of qualitative protocols, allowing researchers to probe the underlying reasons and coping strategies behind the quantitative data.

Participants and Sampling

The quantitative sample consisted of 100 secondary mathematics teachers and 300 students from public schools across Palawan. Stratified random sampling was employed to guarantee proportional representation across urban and rural districts, as well as various ethno-linguistic groups. For the in-depth qualitative phase, 15 teachers and 30 students were purposively selected from the initial pool. Teacher selection required a minimum of five years of experience in heterogeneous or Indigenous-dominated classrooms, while student selection ensured representation of the region's primary migrant and Indigenous demographics.

Instrumentation

Data were gathered using two primary instruments. The first was a researcher-developed structured survey anchored in culturally responsive frameworks and institutional localization guidelines. The instrument achieved high internal consistency (Cronbach's $\alpha = 0.92$) following pilot testing and rigorous content validation by a five-member mathematics education expert panel. The second instrument comprised semi-structured interview and FGD protocols, which were explicitly designed to expand upon the perceptions and pedagogical realities captured by the survey.

Data Collection and Ethical Considerations

Strict adherence to ethical principles was maintained throughout the research. Following institutional review board approval and authorization from school officials, informed consent was secured from all participants. Involvement was strictly voluntary, and participant anonymity was protected using coding systems. Surveys were administered during standard class hours, whereas the audio-recorded qualitative sessions were scheduled at mutually convenient times.

Data Analysis

Quantitative data were processed using descriptive statistics, including frequencies, percentages, means, and standard deviations. Independent samples t-tests evaluated perceptual differences between teachers and students, while Pearson correlation analysis measured the relationship between perceived institutional support and teachers' implementation confidence. Qualitative data underwent a six-step thematic analysis (Nowell et al., 2017). Finally, analytical trustworthiness was established through peer debriefing, member checking, and data triangulation across the quantitative and qualitative phases.

Results

This section details the combined analysis of both qualitative and quantitative data. Initial quantitative statistics reveal general trends regarding how students and educators view localized math instruction. Subsequently, the qualitative findings offer deeper context and explanations for these statistical patterns. Together, these paired data sets yield a holistic view of the hurdles and benefits associated with executing culturally responsive mathematics education within Palawan's highly diverse demographic landscape.

3.1. Quantitative Assessment: Educator and Learner Perspectives on the Benefits and Obstacles of Localized Mathematics Instruction

The subsequent tables outline the quantitative findings concerning how educators and learners perceive the advantages and difficulties of adopting context-based mathematics teaching.

Table 1 details educators' views on the benefits generated by localized math instruction. The highest-rated indicator was the belief that integrating local scenarios enables learners to bridge mathematical concepts with real-world issues ($M = 4.52$, $SD = 0.15$). This indicates a strong consensus among teachers that context-based learning effectively translates abstract theories into familiar realities. The next highest rating affirmed that localized lessons boost learner curiosity and engagement ($M = 4.48$, $SD = 0.24$), underscoring the motivational impact of culturally anchored pedagogy. Collectively, these results imply that localization functions as an emotional and intellectual link, simultaneously building comprehension and mathematical enthusiasm. The composite mean of 4.38 ($SD = 0.25$) demonstrates a robustly favorable attitude among educators, confirming their belief that such

instructional adaptations are vital for rendering mathematics engaging, approachable, and culturally relevant.

Table 1. Educator Perspectives on the Advantages of Context-Based Math Instruction

Statement	Mean Rating	Standard Deviation	Interpretation
1. Adapting math lessons to local contexts boosts learner engagement.	4.48	0.24	Strongly Agree
2. Context-based activities deepen learners' grasp of mathematical concepts.	4.45	0.35	Strongly Agree
3. Utilizing community examples allows students to link math with practical life scenarios.	4.52	0.15	Strongly Agree
4. Integrating the students' native languages into teaching improves their understanding.	4.28	0.22	Strongly Agree
5. Locally adapted lessons stimulate active classroom dialogue and participation.	4.40	0.26	Strongly Agree
6. Regionally relevant materials encourage group-based and collaborative study.	4.25	0.33	Strongly Agree
7. Employing cultural references bolsters learners' confidence and mathematical identity.	4.35	0.25	Strongly Agree
8. Grounding evaluations in community contexts yields more authentic assessments.	4.42	0.24	Strongly Agree
9. Collaborating with local community members to design lessons enhances course content.	4.24	0.42	Strongly Agree
10. Contextualized teaching accommodates the needs of diverse learners effectively.	4.38	0.29	Strongly Agree
Overall	4.38	0.25	Strongly Agree

Note: 1.00–1.79 (strongly disagree); 1.80–2.59 (disagree); 2.60–3.39 (neutral); 3.40–4.19 (agree); 4.20–5.00 (strongly agree).

Table 2 outlines learner perspectives on the advantages of context-based math education. The data indicate widespread agreement that blending localized elements into the curriculum boosts both understanding and participation. The peak scores demonstrate that learners find the subject far more relatable when mathematical problems utilize familiar local contexts. This confirms that community-anchored lessons transition math from a detached theoretical exercise into a vibrant component of their daily routines, which in turn bolsters focus and drive.

Additionally, students highly valued locally adapted assessments, noting that these evaluation methods better reflect their practical competencies. This implies learners consider contextualized testing to be a more equitable and genuine reflection of their mathematical grasp. Ultimately, the robust composite score of 4.36 (SD = 0.26) proves that learners view localization as a core pillar of quality math education. Rather than just passively receiving these methods, students actively endorse them as crucial

tools for ensuring math remains culturally affirming, accessible, and practical.

Table 2. Learner Perspectives on the Advantages of Context-Based Math Instruction

Statement	Mean Rating	Standard Deviation	Interpretation
1. Math concepts are simpler to grasp when demonstrated through local scenarios.	4.43	0.18	Strongly Agree
2. Receiving instruction in my native language makes it easier to follow along.	4.25	0.30	Strongly Agree
3. Locally adapted problems demonstrate the practical utility of math in daily life.	4.41	0.25	Strongly Agree
4. Familiar community examples increase my confidence when tackling math problems.	4.39	0.28	Strongly Agree
5. Collaborative exercises rooted in local culture facilitate peer-to-peer learning.	4.26	0.34	Strongly Agree
6. Culturally adapted lessons are far more engaging than standard textbook exercises.	4.51	0.19	Strongly Agree
7. I retain mathematical concepts better when they are linked to familiar routines.	4.27	0.33	Strongly Agree
8. Linking academics to my heritage fosters a sense of community pride.	4.35	0.29	Strongly Agree
9. Locally tailored tests accurately measure my real-world capabilities.	4.46	0.21	Strongly Agree
10. I favor instructors who integrate examples from our immediate surroundings.	4.28	0.35	Strongly Agree
Overall	4.36	0.26	Strongly Agree

Note: 1.00–1.79 (strongly disagree); 1.80–2.59 (disagree); 2.60–3.39 (neutral); 3.40–4.19 (agree); 4.20–5.00 (strongly agree).

Table 3 highlights the obstacles educators face when applying localized instructional methods. The data reveal that an absence of pre-developed, premium localized teaching resources is the primary hurdle, scoring the highest mean of 4.65 (SD = 0.12). This points out a disconnect: educators appreciate the merits of culturally responsive teaching but are hindered by a severe shortage of ready-to-use materials. The secondary major challenge is the extensive time commitment required; teachers expressed strong agreement (M = 4.55, SD = 0.17) that crafting context-specific activities demands far more planning time than standard lessons. This underscores the heavy workload placed on educators trying to merge mandated curricula with locally adapted content. The overall mean of 4.17 (SD = 0.30) confirms a broad and intense level of concern regarding these barriers. Consequently, while teachers are eager to utilize localized pedagogy, they are obstructed by systemic limitations. Overcoming these hurdles will necessitate robust administrative backing, specialized professional development, and the creation of accessible teaching resource banks.

Table 3. Educator Perspectives on the Obstacles to Context-Based Math Instruction

Statement	Mean Rating	Standard Deviation	Interpretation
1. There is a critical shortage of pre-made, premium localized resources for math.	4.65	0.12	Strongly Agree
2. Crafting culturally tailored exercises demands significantly more planning time.	4.55	0.17	Strongly Agree
3. Harmonizing locally adapted lessons with standardized national curricula is complex.	4.02	0.40	Agree
4. Professional development on creating culturally responsive math activities is inadequate.	4.15	0.28	Agree
5. Navigating diverse local dialects simultaneously during lessons is a major hurdle.	4.23	0.25	Strongly Agree
6. Evaluating context-based learning is complicated by current standardized testing frameworks.	4.31	0.28	Strongly Agree
7. A lack of tactile learning tools and local reference materials restricts instruction.	4.12	0.30	Agree
8. Large class sizes and varying student skill levels complicate localization efforts.	4.09	0.24	Agree
9. Institutional backing for localized pedagogical strategies is highly variable across campuses.	4.11	0.30	Agree
10. Educators occasionally experience pushback from parents regarding non-traditional lessons.	3.45	0.45	Agree
Overall	4.17	0.30	Agree

Note: 1.00–1.79 (strongly disagree); 1.80–2.59 (disagree); 2.60–3.39 (neutral); 3.40–4.19 (agree); 4.20–5.00 (strongly agree).

Table 4 summarizes learner perspectives on the difficulties tied to context-based math education. The primary concern among students is a deficit of learning tools; they strongly agreed that educational institutions fail to supply adequate localized resources, including textbooks and tangible learning aids ($M = 4.26$, $SD = 0.25$). Furthermore, students strongly indicated ($M = 4.25$, $SD = 0.21$) that educators sometimes struggle to bridge the gap between localized classroom examples and standard exam questions. This reveals that despite students favoring these methods, instructional disconnects and resource shortages restrict the pedagogy's full potential.

Notably, learners firmly rejected the notion that context-based learning delays syllabus progression ($M = 1.72$, $SD = 0.18$), showing that instructional pacing is not a learner concern. They demonstrated moderate agreement regarding deficits in teacher confidence ($M = 3.58$, $SD = 0.32$) and a scarcity of age-appropriate local materials ($M = 3.65$, $SD = 0.26$), highlighting clear targets for future resource creation and teacher training. A composite mean of 2.79 ($SD = 0.25$)—falling in the "Neutral" range—demonstrates that students do not find localization inherently problematic. Their grievances are highly specific, centering entirely on resource access and transparent exam alignment, suggesting they remain enthusiastic about this pedagogy so long as these operational gaps are addressed.

Table 4. Learner Perspectives on the Obstacles to Context-Based Math Instruction

Statement	Mean Rating	Standard Deviation	Interpretation
1. Occasionally, the chosen local examples are alien to me and cause confusion.	2.05	0.72	Disagree
2. Transitioning between my native dialect and the official testing language is a struggle.	2.01	0.60	Disagree
3. Our institution lacks sufficient localized resources, such as specialized books or manipulatives.	4.26	0.25	Strongly Agree
4. Instructors frequently fail to connect community-based examples with formal exam formats.	4.25	0.21	Strongly Agree
5. Linguistic differences among peers make collaborative group assignments difficult.	2.25	0.58	Disagree
6. Certain culturally tailored problems are overly complicated and irrelevant to standard tests.	2.18	0.28	Disagree
7. I sense that some educators lack the confidence required to teach using local contexts.	3.58	0.32	Agree
8. Culturally adapted teaching slows down the class, jeopardizing full syllabus coverage.	1.72	0.18	Strongly Disagree
9. I am concerned that localized instruction will not properly prepare me for national assessments.	1.98	0.30	Disagree
10. There is a noticeable shortage of localized mathematical content suited to my specific grade.	3.65	0.26	Agree
Overall	2.79	0.25	Neutral

Note: 1.00–1.79 (strongly disagree); 1.80–2.59 (disagree); 2.60–3.39 (neutral); 3.40–4.19 (agree); 4.20–5.00 (strongly agree).

3.2. Qualitative Analysis of Teachers' and Students' Perceptions on the Opportunities and Challenges of Contextualizing and Localizing Mathematics Education

The qualitative findings detailed below offer a deeper explanatory layer to the quantitative data, shedding light on why contextualization yields high perceived benefits, as well as unpacking the root causes of systemic hurdles such as resource scarcity, linguistic friction, and curricular misalignment.

3.2.1. Thematic Analysis of the Opportunities of Contextualizing and Localizing Mathematics Education

By consolidating the interview and focus group data, three primary themes emerged to explain the high opportunity ratings provided by participants. These narratives illustrate how localization transforms the cognitive, socio-cultural, and collaborative dimensions of the mathematics classroom.

Theme 1: Cognitive Engagement and Conceptual Mastery

When mathematics is anchored in students' lived experiences, it ceases to be an abstract hurdle and becomes an accessible, relatable subject. This pedagogical shift significantly boosts student motivation, sustains classroom attention, and helps learners bridge the gap between theoretical equations and real-world applications. By grounding complex ideas in familiar community contexts, educators note a marked improvement in both immediate comprehension and long-term retention of mathematical concepts.

"Whenever I integrate scenarios from our town or everyday routines, the learners become noticeably more eager and active in tackling the equations." — Teacher

"Mathematics is much more enjoyable and simpler to grasp when it connects to activities I actually do outside of school." — Student

"I find that I retain mathematical formulas much better when they are demonstrated using familiar elements from my own neighborhood." — Student

Theme 2: Socio-Cultural Identity and Inclusive Learning

Incorporating local traditions, daily practices, and native languages into the curriculum does more than just teach math; it validates the learners' heritage and supports highly differentiated instruction. This culturally responsive approach allows educators to adapt their teaching to diverse learning profiles, thereby fostering an inclusive environment where students feel a profound sense of pride, self-assurance, and belonging in the academic space.

"By integrating their cultural background into the syllabus, the youth exhibit greater self-assurance and take pride in their heritage." — Teacher

"Adapting the lessons to the local context gives me the flexibility to modify activities for different types of learners, making sure everyone is actively involved." — Teacher

"It makes me really proud when our math problems feature elements from our local traditions and community." — Student

Theme 3: Collaborative Problem-Solving and Peer Support

Grounding academic tasks in community-based contexts naturally stimulates cooperative learning dynamics. Students are far more inclined to share ideas, debate problem-solving strategies, and support one another when the subject matter reflects a shared reality, ultimately strengthening their interpersonal skills and reinforcing knowledge through peer-to-peer interaction.

"Structuring our math projects around community issues naturally prompts the students to assist one another and debate solutions, which really strengthens their cooperative skills." — Teacher

"Working together on problems that relate to our neighborhood makes it easier to see how others think and helps us learn better as a group." — Student

3.2.2. Thematic Analysis of the Challenges of Contextualizing and Localizing Mathematics Education

The following three consolidated themes provide deeper insights into the systemic and contextual barriers hindering the full realization of localized pedagogy. These narratives clarify the complex realities of resource deficits, assessment mismatches, and stakeholder dynamics.

Theme 1: Resource Scarcity and Deficits in Professional Development

A primary barrier to localized instruction is the severe lack of pre-made, high-quality teaching materials coupled with insufficient targeted teacher training. Educators are frequently forced to build curriculum aids from the ground up without proper pedagogical guidance. This dual deficit leads to heavy labor burdens on teachers, instructional inconsistencies, and frustration for learners who lack the necessary tactile aids and textbooks to follow along.

"We are eager to integrate practical, local examples, but we lack reliable reference materials. Consequently, we are forced to build our lesson plans entirely from scratch." — Teacher

"The higher-ups push us to contextualize, yet they provide zero practical workshops on how to craft activities that genuinely resonate with the students' cultural backgrounds." — Teacher

"Even when our instructors try to use local examples, we rarely have the accompanying books or physical models to help us visualize the lesson." — Student

"There are times when the teacher seems unsure of how to use local scenarios, which makes the whole lesson feel disjointed." — Student

Theme 2: Curricular Misalignment and Time Pressures

Educators experience immense pressure attempting to balance the time-consuming nature of creating customized, context-based lessons with the rigid, fast-paced pacing demanded by standardized national curricula. Furthermore, there is a distinct disconnect between these localized classroom activities and high-stakes standardized exams. This misalignment causes anxiety among both teachers and students, who fear that localized instruction, while engaging, may not adequately prepare them for national assessments.

"Drafting a single customized lesson consumes hours compared to just following the standard textbook, yet I am still pressured to hit every mandated learning competency on time." — Teacher

"Our standardized exams do not reflect local realities. Even if I adapt my daily lessons, I ultimately have to drill them for a test that ignores those contexts." — Teacher

"Contextualized activities are fun, but they take up so much time that I worry we won't finish the required topics before the final exams." — Student

"I like the localized problems, but I get anxious that they won't actually help me pass the standardized national tests." — Student

Theme 3: Socio-Linguistic Complexity and Inconsistent Stakeholder Support

The extreme linguistic diversity within single classrooms in Palawan makes universal contextualization nearly impossible, as translating mathematical concepts into multiple dialects simultaneously creates heavy cognitive burdens for both teachers and students. This logistical nightmare is further complicated by a lack of cohesive institutional backing from school administrators, and occasional skepticism from parents who view localized pedagogical methods (like using local games) as less rigorous than traditional instruction.

"In a single room, I have learners speaking several different native tongues. It is practically impossible to translate a mathematical formula into every single dialect present." — Teacher

"Localization feels like a solo mission here. There is no unified directive or administrative backing from the school leadership." — Teacher

"It is highly confusing when the teacher explains a concept in my native dialect, but the exam is written entirely in English. I feel like I am constantly translating back and forth." — Student

"My parents questioned why we were using local community games in our math class. They felt it wasn't a serious or proper way to learn." — Student

Discussions

The findings of this study validate the effectiveness of integrating Culturally Responsive Pedagogy (CRP), Ethnomathematics, and Social Constructivism as a comprehensive framework for mathematics instruction in culturally diverse settings. Both the quantitative data and qualitative narratives overwhelmingly demonstrate that anchoring mathematics in local community practices transforms the subject from an intimidating, abstract requirement into an engaging, relevant discipline.

Aligning with CRP principles, utilizing familiar cultural contexts and native languages significantly boosts student motivation, confidence, and classroom participation, actively countering academic marginalization (Suh & Calabrese, 2025; Turner et al., 2024). Viewed through an ethnomathematical lens, embedding traditional knowledge systems and community practices into formal lessons serves as a highly effective cognitive bridge, ultimately enhancing both conceptual understanding and cultural pride (Kyeremeh et al., 2023; Payadnya et al., 2024; Xu & Ball, 2024). Furthermore, consistent with Social Constructivist theory, context-based group tasks naturally foster collaborative problem-solving and meaningful peer-to-peer interactions (Sinaga et al., 2023). Overall, educators and learners alike recognize that localization promotes inclusive learning and provides more authentic, equitable avenues for assessment (Cortez, 2024; Gerardo & Mabansag, 2022). These localized outcomes strongly echo international studies highlighting the cognitive and affective benefits of culturally grounded instruction in complex multilingual environments (Barwell et al., 2019; Planas et al., 2025).

Despite these clear pedagogical advantages, significant systemic and practical obstacles hinder the full realization of localized mathematics education. A primary constraint is the severe shortage of high-quality, pre-developed instructional resources, which places a heavy preparation burden on educators (Nicol et al., 2023; Turner et al., 2024). Teachers continually struggle to balance the extensive time required to craft culturally relevant activities with the rigid pacing demands of standardized national curricula (Xu & Ball, 2024).

A critical boundary condition identified in this research is the dilemma of "classroom plurality." In Palawan's hyper-diverse setting, the coexistence of multiple migrant and Indigenous dialects within a single room makes individualized, single-culture instructional alignment nearly impossible. Consequently, teachers face immense cognitive loads managing multilingual instruction and frequently revert to standardized languages (English or Filipino) for efficiency. This inherent disconnect between context-based learning and standardized, high-stakes assessments remains a major source of anxiety. Furthermore, inconsistent institutional support and a severe lack of targeted professional development regarding culturally responsive design severely restrict sustainable implementation (Creswell & Creswell, 2018; Gerardo & Mabansag, 2022; Payadnya et al., 2024).

These complex classroom dynamics suggest crucial policy implications for educational stakeholders. First, curriculum frameworks must pivot toward "multi-local" or poly-focal contextualization strategies that are practical in highly heterogeneous classrooms, moving beyond traditional single-culture localization models. Second, specialized professional development programs are urgently needed to train educators in designing culturally responsive activities for multi-ethnic settings, specifically focusing on how to bridge localized lessons with national testing standards. Finally, establishing centralized, accessible repositories of validated, context-specific teaching materials is essential to reduce educator burnout and ensure consistent, high-quality implementation across all schools.

Conclusion

While localizing mathematics education in Palawan yields profound pedagogical benefits—such as heightened student engagement, deeper conceptual mastery, and validated cultural identities—its successful implementation is currently hindered by significant systemic barriers. Educators and learners alike struggle with a severe scarcity of ready-made contextualized resources, exhausting preparation demands, complex multilingual classroom dynamics, and a stark misalignment with standardized national assessments. Ultimately, to transform these culturally responsive frameworks from theoretical ideals into sustainable and equitable classroom practices, educational institutions must provide robust systemic intervention, which includes deploying targeted teacher training, establishing comprehensive instructional material banks, and harmonizing context-based learning with high-stakes testing requirements.

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References

- Barwell, R., Wessel, L., & Parra, A. (2019). Language diversity and mathematics education: New developments. *Research in Mathematics Education*, 21, 113–118. <https://doi.org/10.1080/14794802.2019.1638824>
- Chavarría-Arroyo, G., & Albanese, V. (2022). Contextualized mathematical problems: Perspective of teachers about problem posing. *Education Sciences*, 13(1), 6. <https://doi.org/10.3390/educsci13010006>
- Cortez, C. P. (2024). Socio-cultural context-based inquiry learning in a mathematics flipped classroom [Doctoral dissertation, De La Salle University]. Animo Repository. https://animorepository.dlsu.edu.ph/etdd_scied/25
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- Department of Education. (2015). DepEd Order No. 32, s. 2015: Adopting the Indigenous Peoples Education Curriculum Framework. Republic of the Philippines. https://www.deped.gov.ph/wp-content/uploads/2015/07/DO_s2015_32.pdf
- Gerardo, L., & Mabansag, A. (2022). A phenomenological study on the challenges of contextualized mathematics teaching in the countryside. *SSU Digital Archive of Theses and Dissertations*, 38, 1–67. <https://datd.ssu.edu.ph/index.php/datd/article/view/19>
- Kyeremeh, P., Awuah, F. K., & Dorwu, E. (2023). Integration of ethnomathematics in teaching geometry: A systematic review and bibliometric report. *Journal of Urban Mathematics Education*, 16, 68–89. <https://doi.org/10.21423/jume-v16i2a519>
- Nicol, C., Thom, J. S., Doolittle, E., et al. (2023). Mathematics education for STEM as place. *ZDM Mathematics Education*, 55, 1231–1242. <https://doi.org/10.1007/s11858-023-01498-z>
- Nowell, L. S., Norris, J. M., White, D. E., et al. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, 16, 1–13. <https://doi.org/10.1177/1609406917733847>
- Palawan Biodiversity Conservation Advocates, Inc. (n.d.). Palawan: The last ecological frontier. Retrieved from <https://www.palawanconservationists.com/palawan-the-last-ecological-frontier/>
- Payadnya, I. P. A. A., Wulandari, I. G. A. P. A., Puspawati, K. R., et al. (2024). The significance of ethnomathematics learning: A cross-cultural perspective between Indonesian and Thailand educators. *Journal for Multicultural Education*, 18, 508–522. <https://doi.org/10.1108/JME-05-2024-0049>
- Planas, N., McKinley, J., Smith, K., et al. (2025). Students' linguistic challenges when learning mathematics: Voices of teachers from seven countries. *African Journal of Research in Mathematics, Science and Technology Education*, 29, 239–251. <https://doi.org/10.1080/18117295.2025.2494292>
- Sinaga, B., Sitorus, J., & Situmeang, T. (2023). The influence of students' problem-solving understanding and results of students' mathematics learning. *Frontiers in Education*, 8, 1088556. <https://doi.org/10.3389/feduc.2023.1088556>
- Suh, J. M., & Calabrese, S. C. (2025). Culturally responsive mathematics engagement through a family-inspired mathematizing routine. *Educational Studies in Mathematics*. <https://doi.org/10.1007/s10649-025-10411-2>
- Turner, E., Aguirre, J., Carlson, M. A., et al. (2024). Resisting marginalization with culturally responsive mathematical modeling in elementary classrooms. *ZDM Mathematics Education*, 56, 363–377. <https://doi.org/10.1007/s11858-023-01542-y>
- Xu, H., & Ball, R. (2024). Indigenous mathematics: From mainstream misconceptions to educational enrichment. *Canadian Journal of Science, Mathematics and Technology Education*, 24, 160–175. <https://doi.org/10.1007/s42330-024-00321-5>