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Lexical Equivalents in Native Tongue and L2 behind Agta-Tabangnon's Ethnomathematics and Cultural Practices

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Abstract[2]: This ethnography highlights the integration of Indigenous People (IP) learners into the mainstream, thereby preserving their cultural and linguistic background. Nonetheless, this pedagogical inclusivity poses challenges and apprehensions to teachers, such as book insufficiencies, localized and contextualized materials, and some noted linguistic blockades during actual teaching-learning courses. This paper correspondingly demarcates the tribe's ethnomathematical practices, leveraging an ethnographic-developmental research strategy. This inquiry found that culturally-sensitive and contextualized instructional resources are fundamental features of IP curriculum structure. In the context of the study, it nurtured instructional inclusivity, developed cultural and dialectal identity, and underscored the counting, measuring, ciphering, modelling, classifying, and inferring techniques of the explored aborigine community. From these principles, researchers recommend the use of the native tongue to teach IPs in the primary and developing years. Integration of IKSP in the teaching resources should be instigated to uphold educational inclusivity not just locally but internationally, catering to the learning prerequisites of the ethnic community.

Keywords: Agta-Tabangnon, cultural practices, ethnomathematics, lexical equivalent, native tongue

The Philippine educational system has been distraught by the 2024 PISA result lagging Filipino learners behind in Mathematics and Science subjects as likened to neighboring Asian countries, with many drifting questions left unanswered (Bernardo et al., 2022; Garcia et al., 2024). This seemingly multifaceted concern could be linked to many recurring issues, such as book inadequacies, teacher-learner ratios, professional trainings, meaningful exposures, budget allocations, buildings, and even teacher shortages (Zickafoose et al. 2024). As a preemptive response, all-out efforts are being exerted to ensure that the Philippines' performance will at least be on par with other ASEAN countries like Singapore and Malaysia, among others. These efforts, as ordered by the umbrella agency department, are pointed to mathematics education specifically. It was underscored that Mathematics concepts must be taught and should be absorbed uniformly based on standards and centrally-generated competencies. In the actual pedagogical practice, this directly implies that students should be trained homogenously without having at least to contextualize the concepts, taking into consideration localized materials (Núria Carrete-Marín et al., 2024; Pinnuela, 2025), cultural background (Gulzar et al., 2024), linguistic identity (Baliwas and Estremera, 2025; De Costa, 2025; Truong et al., 2025), and learning pace.

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This pedagogical practice has actually been prevalent countrywide to achieve learning uniformity among students. In some instances, the department likewise provides exclusive learning materials for (IP) students gearing towards pedagogical inclusivity (D'Elia et al., 2025), anchored in the Department order no. 62, s. 2011 was dubbed the National Indigenous Peoples Education Policy Framework. The primary aim is the integration of IP learners into the mainstream system, thereby preserving their cultural and linguistic background (Gulzar et al. 2024; Núria Carrete-Marín et al., 2024; Pinnuela, 2025). Similar findings are found in the studies of Núria Carrete-Marín et al., (2024) and Pinnuela (2025), who accentuated that this pedagogical inclusivity poses challenges and concerns to teachers, such as the book inadequacies, localized and contextualized materials, and some noted linguistic barriers during the actual teaching-learning process. In fact, the books provided by the department still contain the standard competencies expected of the learners based on their grade levels. This mismatch between the order and actual teaching scenarios forced teachers to innovate some teaching materials that are suited to the level of the learners and are culturally and linguistically relevant (Baliwas and Estremera, 2025; De Costa, 2025; Truong et al., 2025). Teachers make modules and Strategic Intervention Materials (SIM) to address learning gaps, and by considering the local learning systems, which are proven relevant. This is fervently underpinned by Favilli, and Tintori (2022), who underscored that teaching mathematics is not only a matter of linguistic proficiency, but it also contains diverse cultural variables that play a substantial role in the teaching of mathematical models. Every individual's socio-cultural upbringing should be considered part of the education process.

Research Gap and Questions

Considering the preceding scenarios, this ethnographic investigation aimed to develop some culturally-relevant instructional materials purposely designed for the Agta-Tabangnon tribe of Lourdes, Polangui, Albay, Philippines through the project KABALAT, delineated as (*KAtutubong Aralin Buhayin, Alagaan, Linangin at Tangkilikin*), signifying racial inclusivity irrespective of skin color and race, leaning towards cultural recognition and preservation while they are being taught formally with mathematical concepts and leveraging their cultural practices. To link, the dearth of studies locally and internationally exploring ethnomathematics is the perceived gap that the present exploration hopes to fill. Besides, this study also envisions communicating the importance of contextualization of competencies in the Philippines, known for its one-size-fits-all educational set-up, adopting a top-down and centralized educational policy. Meaning that books and reference materials are uniform throughout the country. For accuracy, this study has the following research gaps: (*i*) nonexistence of complete documentation and investigation of lexical counterparts between the native tongue of the Agta-Tabangnon and their L2 particularly in ethnomathematics and cultural tradition contexts; (*ii*) inadequate inquiry as to how language changes in the communication and preservation of native mathematical ideas rooted in the Agta-Tabangnon's social traditions; (*iii*) deficient pedagogical materials printed in the Agta-Tabangnon's native tongue that foster effective multilingual instruction for indigenous students to comprehend ethnomathematical ideas; and, (*iv*) the pressing need for profounder ethnographic and dialectal inquiries on the cultural influences prompting the use of lexical counterparts in L2 among Agta-Tabangnon tribe, providing understandings into language-cultural dynamic forces in ethnomathematics. The study then proposes the following research questions (RQs): (*i*) What are the ethno-mathematical practices with lexical equivalents of the Agta-Tabangnon tribe? and (*ii*) What culturally-relevant instructional materials may be executed to foster pedagogical inclusivity? Grounded on these questions, researchers formulated the following assumptions (*i*) The ethno-mathematical practices with lexical equivalents of the Agta-Tabangnon tribe are distinctive; and (*ii*) There are culturally-relevant instructional materials that may be executed to foster pedagogical inclusivity.

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Literature Review

Ethnomathematics in some countries

Ethnomathematical practices and knowledge systems among tribes pertain to the ethnically entrenched mathematical rehearses, models, and cognitive approaches that aboriginal communities cultivate and practice in their day-to-day lives (Cain & Johnson, 2021; Lekwa Mokwana et al., 2024; Lim et al., 2023). These practices span from the exclusive ancient, societal, and ecological backgrounds of each ethnic group, mirroring their customs of calculating, computing, categorizing, and spatial thinking, often interconnected faithfully to their traditional practices and means of support. For instance, the Tharu civic group in Nepal adopts a base-20 calculating system due to the close association with indigenous counting traditions and employs body-referenced parts like the finger (Anguli) and hand (Haat) for quantifying, incorporating these norms into farming, interweaving, and ceremonies (Lim et al., 2023). Correspondingly, Native American people show varied mathematical schemes based on bodily groupings, with bases like 2, 5, 10, or 20, and exhibit symmetrical understanding via complex shapes in arts as well as crafts. Ethno-mathematical customs are transferred through intergenerational storytelling, internships, and public undertakings, helping both real-world and emblematic purposes. These aboriginal mathematical applications offer treasured understandings into substitute means of understanding and learning mathematics by connecting prescribed school theories with an ethnically accustomed information, thereby augmenting learning relevance and respect for ethnic identity. Most essentially, ethno-mathematical models highlight the wide-ranging variety of mathematical cognitive processes rooted in cultural milieus, accentuating the significance of knowing and incorporating home-grown knowledge schemes in arithmetic teaching (Cain & Johnson, 2021; Morrison et al., 2021).

Ethnomathematics lexicon

Conversely, lexical equivalents of ethnomathematical practices among ethnic groups involve particular expressions, signs, and jargons that native cultural individuals use to signify their distinctive mathematical models and practices (Machaba & Dhlamini, 2021; Nur et al., 2020; Umbara et al., 2021). The lexis "ethno-" signifies distinguishable cultural crowds categorized by their behaviors, tongues, codes, and habits of thinking, while "mathematics" comprises actions such as calculating, quantifying, categorizing, ordering, and forming designs within their location. The suffix "-tics" links to the practices or systems these individuals adopt to comprehend and cope with the reality of life scenarios. In tribal contexts, these mathematical practices with lexical equivalents divulge the indigenous calculating systems, measurement parts, and symmetrical patterns rooted in day-to-day doings, ceremonials, and crafts. For instance, the *Eskaya* community in the Philippines adopts a unique counting system with distinctive codes and dialect-based calculation, while the Tharu group in Nepal leverages body-referenced parts and a base-20 calculating scheme deeply-rooted in their ethnic traditions. Such lexical equivalents have not been simply linguistic tags but carry profound ethnic representations and serve as gears for conveying mathematical data among tribes (Olivero-Acuña et al., 2025; Putra et al., 2025; Rosa & Orey, 2021). Thus, being cognizant of these lexical equivalents in Mathematics education is fundamental for incorporating Aboriginal mathematical information into formal teaching, as it links cultural authenticities with theoretical mathematics, nurturing respect for ethnic identity and improving contextual knowledge. Accordingly, vocabulary equivalents in ethnomathematics reveal the rich relationship between linguistic, cultural, and mathematical understanding among tribal groups (Fie, 2025; Mania & Alam, 2021).

Methodology

This study is under the purview of the qualitative method, specifically leveraging ethnographic-developmental research design to comprehensively provide philosophical answers to the research questions (Ahmed, 2025). The ethnographic-developmental strategy fittingly applies to this inquiry as it permits profound investigation of Agta-Tabangnon's developing dialectal and social practices. It highlights normal linguistic usage contextually disclosing how lexical counterparts progress and function sociolinguistically within their ethnomathematical civilizations over time, elevating further the cognition of cultural and language interrelationships. This strategy paved the way for the exploration of the ethno-mathematical practices with lexical equivalents of the Agta-Tabangnon tribe in the locality (Machaba & Dhlamini, 2021; Nur et al., 2020; Umbara et al., 2021). The developmental component, on the other hand, concerns the instructional material developed by the implementers of the project taking into consideration the mathematical practices of the subject tribe incorporating likewise some mathematical concepts based on the standard competencies of the Department of Education (DepEd) Philippines as a national mandate (Olivero-Acuña et al., 2025; Putra et al., 2025; Rosa, & Orey, 2021). Moreover, as to the implementation phase, it involved a methodical gathering of lexical facts *via* interviews and ethnographic observation among Agta-Tabangnon interlocutors (*Table 2*). The chief intention was to identify native tongue and L2 counterparts in stating as well as solving ethnomathematical concepts and social practices. Assessment criteria include correctness of lexical plotting, cultural significance, participant authentication, and uniformity across information sources.

Framework and Partakers' Demography

The study locale was in Barangay Lourdes, one of the upland barangays of Polangui, Albay. It is a forty-five (45) minute drive from Polangui proper via *habal-habal* (for rent motorcycle). The community is located near Iriga and Buhi of Camarines Sur, and Malinao, Tiwi, and Tabaco City of Albay. Agta-Tabangnons are an indigenous Filipino tribe primarily located in the Bicol Region, specifically in Albay, Sorsogon, Camarines Sur, and Catanduanes. They are descendants of Agta people who have intermarried with lowland Filipinos and have shifted from a primarily nomadic hunter-gatherer lifestyle to a more settled, agricultural one.

Figure 1
Locale of the study

The community in Lourdes, Polangui, primarily depends on farming as its source of living. There is an elementary school near the community, and the group lives at the farthest part of the barangay. Figure 1 shows the map of the locale of the study. The forty (*40*) participants of the study were asked about their educational attainment using percentages (*%*) to determine the

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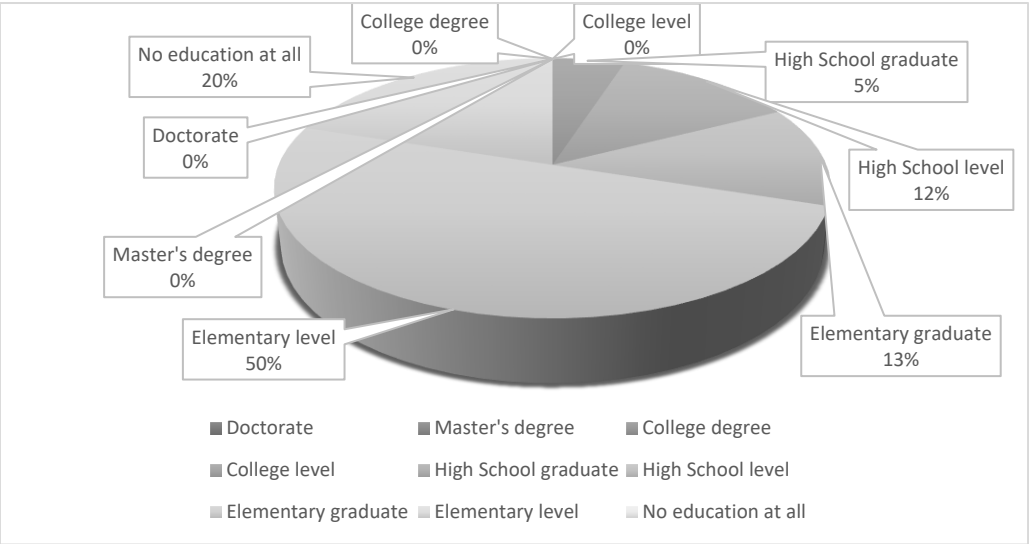
appropriate approach suited to instructional material development. Thus, the figure presents the data gathered showing that 2 or *5%* of Agta-Tabangnon participants are high school graduates. Five of them, or *12.5%,* are still at their high school level, another five, or *12.5%*, completed elementary, 20 or *50%* are pursuing their elementary education, and eight or *20%* were not able to attend any formal schooling. These data imply that all the participants have reached elementary high school levels of education, but none of them have reached college level. The data likewise shows that none of them pursued higher education. The statistics also reveal that for education to maximize the human potential of Agta-Tabangnon is very slim since they struggle to attain tertiary level education. The majority of the people are only able to attain elementary education because the elementary school is situated near their community.

Figure 2
Distribution of the Educational Attainment of the Participants



Sampling Approach

The study utilized purposive sampling (Memon et al. 2025; Cash et al. 2022) involving fifteen (15) elders and twenty-five (25) school children. Records from the Polangui Service Center of the National Commission on Indigenous Peoples (NCIP) served as a secondary source of data. The study was conducted in Lourdes, Polangui, Albay, one of the upland barangays in Polangui, and is situated beside the far-flung barangays of Tiwi and Tabaco in Albay and Buhi and Iriga in Camarines Sur.

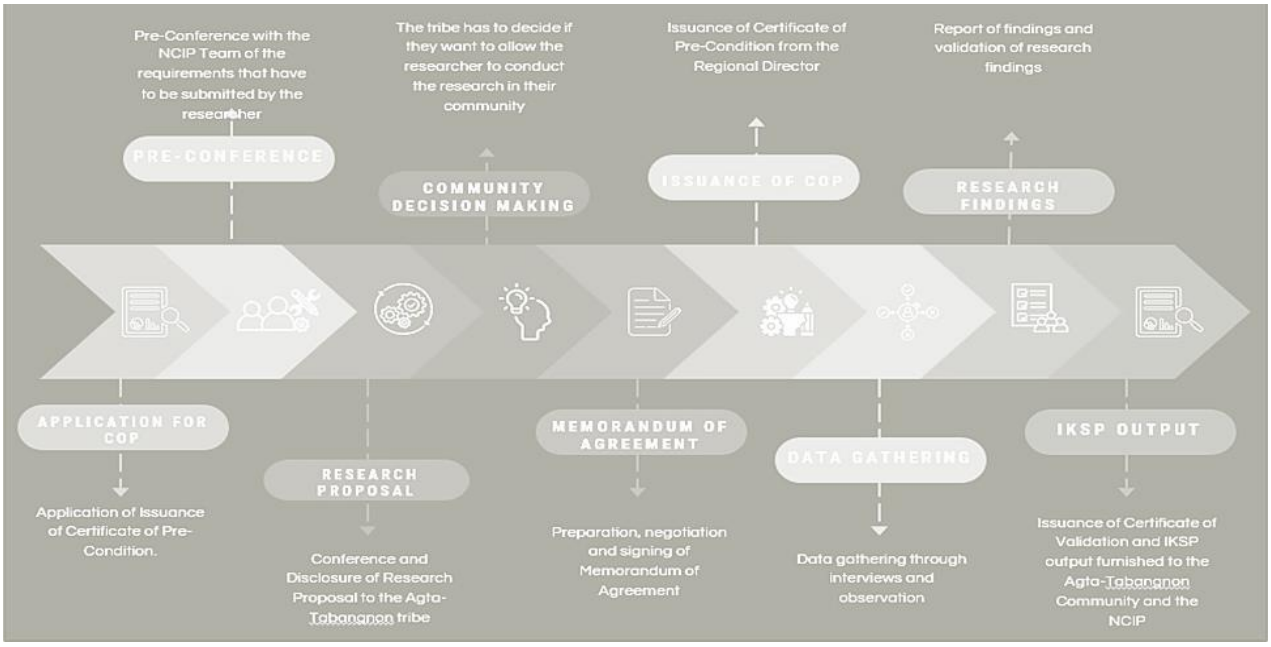
Data Gathering and Etiquettes

This paper made use of observation (Rossetti, 2023) as one of the gathering techniques. This is, in fact, the main business of this ethnography, which was undertaken to document the possible ethnomathematical practices, such as their (Agta-Tabangnon) counting strategies in their native tongue, rice planting techniques involving mathematical figures and shapes, weaving strategies with mathematical algebraic patterns, and most importantly, the native language and tradition that shapes their sociolinguistic community. In this phase, researchers examine and record occurrences where members use vernacular and L2 equivalents in communicating ethnomathematical ideas and social practices. Also, observing the lexical tones, language changes, contextual usage, and participant communications, capturing knowledge broadcast and cultural stability (*Table 1*). This protocol has led to a methodical observation of linguistic use and cultural-

mathematical interactions in genuine backgrounds, guaranteeing detailed data on lexical correspondences and their practical implications. Another strategy involves community immersion, which is one of the primary components of ethnographic inquiries to be able to document existing phenomena such as language use, community traditions, and cultural dynamics, learning phase, and existing mathematical concepts (Kjellsdotter and Erlandson, 2025; Roque et al., 2024; Thanem and Knights, 2019). These intervening variables were considered in the production of instructional materials to ensure that learners can connect to the lessons being offered. Consequently, researchers organized and taught the community, leveraging the developed instructional material upon approval and consultation with the tribe's leader, locally known as the *chieftain*. Besides, semi-structured interview [*Appendix 1*] was correspondingly undertaken to some of the members of the tribe particularly elderlies in order gather data concerning some key mathematical terms or concepts, cultural practices, native tongue and second language influence in understanding and usage of ethnomathematical concepts, instances of cultural practices that involve counting, measuring, or other mathematical activities, traditional mathematical knowledge passed down through generations, cultural beliefs and values that shape the mathematical concepts, and, resources to help preserve and nurture ethnomathematical knowledge. These had been carried out by the authors in the form of questions translated into the native tongue or Filipino to obtain philosophical data (Jayathilaka, 2021; Scott-Fordsmand, 2025; Trundle and Phillips, 2023).

Figure 3

Prior to and during the Informed Consent Procedure



Ethically, this paper likewise complied with Republic Act No. 8371, otherwise known as the Indigenous Peoples Rights Act (IPRA) of 1997 and National Commission on Indigenous People Administrative Order No.01, s.2012, otherwise known as Indigenous Knowledge Systems and Practices (IKSPs) and Customary Laws Research Documentation Guidelines of 2012, the researcher strictly followed the Pre, Prior and Informed Consent (PPIC) process before actually conducting the data gathering. This process is a requirement before conducting any study about indigenous people to protect their rights and interests. Figure 3 shows the process from the issuance of the certificate of pre-condition down to the submission of IKSP output to the community and the NCIP.

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Instrument Development and Use

Taking into account the ethnographic-developmental feature of this exploration (Kjellsdotter and Erlandson, 2025), this study crafted a digital instructional material (slide deck) and modules incorporating the ethnomathematical knowledge systems & practices of the Agta-Tabangnon tribe, leveraging also the lexical equivalents of numbers in their native language. The developed teaching aid was used in the teaching of mathematical concepts taken from the standard DepED competency for high school students. However, since most of the participants are elementary graduates and a minority reached the high school level, some competencies were unpacked to suit the cognitive level of the recipients. Assessment results during the teaching-learning process (TLP) are recorded accordingly by the implementers to track learning progress and for monitoring purposes of DepEd supervisors (*Appendix II*). This is also where comments and suggestions for enhancement of the ethnographic intervention had been given by the upper education officials. After the content validation of teaching materials, it underwent pilot testing with the target recipients to ensure its validity and reliability (López-Belmonte et al., 2022). In fact, the content validators of the materials are the research experts in the locality, composed of 2 Mathematics teachers, 2 English teachers, and 1 administrator, yielding a content validity index (CVI) of *8.596* and within the *8.5 – 9.4* moderate validity range (Estremera and Sarmiento, 2024).

Figure 4
Piloting of the Teaching Material

The developed instructional materials were then pilot-tested as a process of validation under the presence of key education officials. Their comments as to content, clarity of images, and suitability of included skills and reinforcement activities were revised accordingly. Concepts and examples were also made localized, incorporating some scenarios and activities of the concerned tribe.

Figure 5
Brief Orientation

After ensuring the suitability of the developed teaching materials, proponents convened the recipients of the project and conducted a brief orientation to the local community and participants as to the primary purpose of the civic activity that was well-coordinated with the proper authorities (Maclaren et al., 2025).

Figure 6
Actual Teaching

Actual teaching among the identified educational beneficiaries was undertaken as planned by the implementers in order to raise the numerical proficiency of the tribe, taking into consideration still the standard competency set by DepEd and the ensuing conceptual understanding of the leaners (*Appendix II*). Beforehand, the Agta-Tabangnon tribe was notified of the class schedule as well as the benefits that they may obtain throughout the duration of the ethnographic documentary. Immediately after the orientation, proponents now utilize the developed instructional material in order to elevate the numeracy and literacy level in order to keep pace with the demands of the outside world, thereby increasing their self-motivation and becoming better citizens of the locality (Ongkeko et al., 2025). As depicted, those participants needing close supervision were taught separately using a separate material. However, the majority were taught altogether based on the scheduled session. The test results during the actual utilization of the teaching were kept safely for content analysis and for possible follow up study. As a matter of fact, scores, lexical equivalents in the native tongue recorded during instruction, and transcribed speech attempts were kept safely for easy retrieval of relevant data.

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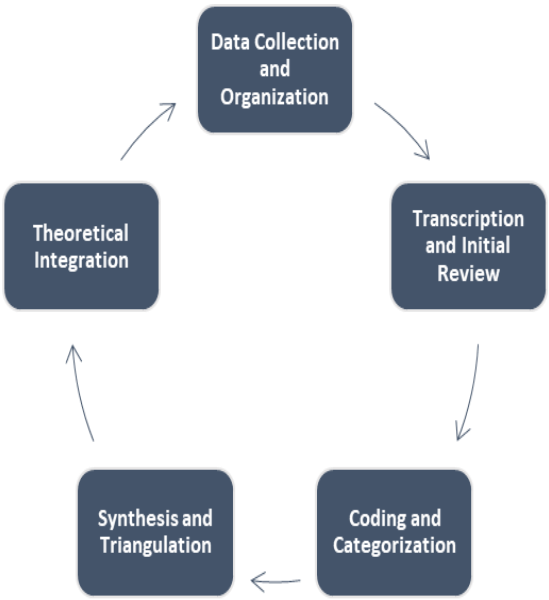
Data Processing

After instrument validation, researchers adopted a methodical qualitative data processing strategy anchored in ethnographic research techniques comprising data organization, transcription, coding and categorization, synthesis and triangulation, and most significantly, theoretical integration

- Data Assembly and Organization: Investigators conducted observations, in-depth consultations, and focused group discussions (FGD) with key participants from the Agta-Tabangnon community. Field records were methodically documented to obtain informal exchanges and ethnic events concerning mathematical models and practices (Gobo & Molle, 2017).
- Transcription and Preliminary Assessment: Interview footage and observational records were transcribed verbatim. These transcriptions were scrutinized to acquaint with the information and ascertain preliminary forms linked to ethnomathematical models rooted in ethnic practices (Copland & Creese, 2015).
- Coding and Labelling: By means of thematic content examination, the records were coded by categorizing keywords and expressions that mirrored mathematical concepts such as calculating, quantity, spatial thinking, and design recognition within traditional circumstances. This involves steps of thematic coding such as familiarization of data, generating initial codes, making codes into potential themes, reviewing themes, and defining themes linked with the RQs, highlighting how lexical counterparts in native language and L2 influence Agta-Tabangnon's ethnomathematical and cultural practices. Codes had been clustered into categories demonstrating diverse features of the Agta-Tabangnon's ethnomathematical understanding (Sun, 2017).

Figure 7
Data Processing Steps



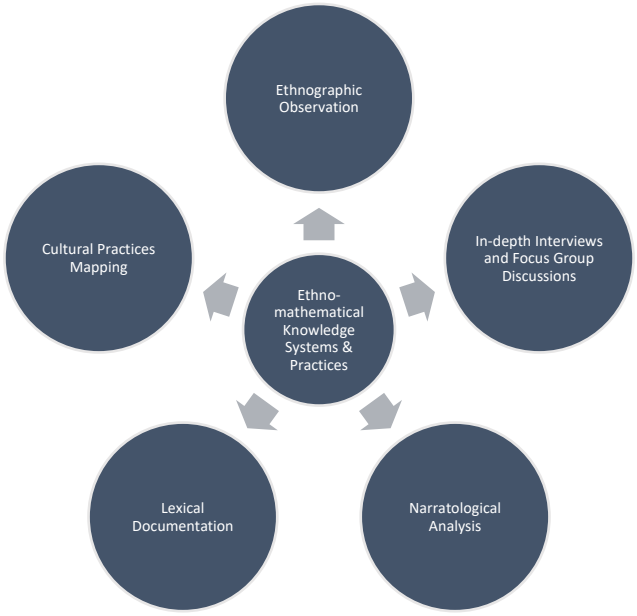
- Synthesis and Triangulation: Information from numerous sources (opinions, discussions, consultations) had been triangulated to corroborate results and ensure the dependability of data. This synthesis was used to create a wide-ranging depiction of how mathematical familiarity is ethnically conveyed and experienced within the subject tribe (Flick, 2007).
- Theoretical Integration: The treated data were examined, taking into consideration the

purview of ethnomathematics theory, associating mathematical models with ethnic values, etymology, and customs. This phase enabled the documentation of lexical counterparts and their educational inferences for nurturing inclusive teaching (Mensah-Brown, 2025).

Data analysis Procedures

To delineate the processed data, researchers employed varied analysis techniques to generate philosophical results. These involve ethnographic observation strategy (Rossetti, 2023), in-depth interviews with the local tribes, narratives, documentation technique, and essentially cultural practices mapping, paving the way for empirical evidence (Jayathilaka, 2021; Scott-Fordsmand, 2025; Trundle and Phillips, 2023). In effect, the participatory surveillance of day-to-day doings where mathematical models surface—calculating, computing, planning, swapping, or calendaring—permits investigators to pinpoint embedded mathematical thinking and practices distinctive to the Agta-Tabangnon. This comprises field records, audio and video footage, and actual events to highlight background and detail (Kjellsdotter and Erlandson, 2025). Organized and semi-planned consultations with community seniors, consultants, and information holders elucidate how mathematical models are practiced, imparted, and applied. FGDs also disclose collective cultural tales and shared memory linked to mathematical understanding. Vocabulary focus, conversely**,** has probed on the aboriginal expressions, symbols, and tales used to define mathematical models (e.g., calculating systems, measurement components, geometric designs). These lexical equivalents come in both the native tongue and English (or Filipino) with notable semantic hints. Moreover, collecting and analyzing the tribal stories, ceremonies, and oral customs embedded in mathematical practices supplemented further data.

Figure 8
Analyses Techniques



Researchers likewise systematically listed and defined all ethnic lexes associated with mathematical models (sums, operations, figures, forms, dimensions). This redounded to the creation of a mini-bilingual wordlist (Table 1) with lexical equivalents in English and Filipino with notable phonetic transcriptions, usage, and contextual applications. The links to specific mathematical rehearses as well as cultural traditions involving weaving designs, hunting tactics, and seasonal calendars reflective of how math is entrenched in day-to-day life are also captured and analyzed closely.

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Ethical Considerations

The study on the Agta-Tabangnon tribe strictly adhered to ethical guidelines for research involving Indigenous Peoples (IPs) as mandated by the Philippine Health Research Ethics Board (PHREB) and the National Commission on Indigenous Peoples (NCIP). Key ethical considerations included obtaining free, prior, and informed consent through an iterative and documented community consultation process, ensuring that participants fully understood the research aims and methods, preferably in their native language (Sugiman et al., 2025). The research respected the tribe's cultural knowledge and practices, recognizing their intellectual property rights (Aquidado et al., 2025). Data privacy was maintained in compliance with the Data Privacy Act of 2012. The study also ensured benefit-sharing and cultural sensitivity, fostering trust and collaboration with the community while protecting their dignity and autonomy throughout the research process. This study also passed the university's in-house Research and Ethics Review Committee (RERC) for completed studies on November 7, 2025**,** with approval number 011725.

Results and Discussion

Culling out data from the community immersion experienced among the Agta-Tabangnon tribe, several knowledge systems with lexical equivalents have surfaced. These have to do predominantly with their counting system, ciphering, measuring, ordering, classifying, inferring, and modelling cultural practices similarly (Nurdauletova et al., 2024).

Table 1
Mathematical Symbols, Equivalents and Transcriptions

Symbols Used in Formal Mathematics	Counting in Native Tongue	Agta-Tabangnon Symbol	Filipino Equivalent (L1)	English Equivalent (L2)	IPA Phonetic Transcription
1	*usad/saro'*	1	Isa	One	wʌn
2	*Duwa*	2	Dalawa	Two	tuː
3	*Tulo*	3	Tatlo	Three	θriː
4	*upat/apat*	4	Apat	Four	fɔː
5	*Lima*	5	Lima	Five	faɪv
6	*unom/anom*	6	Anim	Six	sɪks
7	*Pito*	7	Pito	Seven	ˈsɛvᵊn
8	*Walo*	8	Walo	Eight	eɪt
9	*Syam*	9	Siyam	Nine	naɪn
10	*sampulo'*	10	Sampo	Ten	tɛn
11	*Onse*	11	labing-isa	Eleven	ɪˈlɛvᵊn
12	*Dose*	12	labing-dalawa	Twelve	twɛlv
13	*Trece*	13	labing-apat	Thirteen	θɜːˈtiːn
14	*Katorse*	14	labing-lima	Fourteen	fɔːˈtiːn
15	*Kinse*	15	labing-anim	Fifteen	fɪfˈtiːn

The first column is the internationally known counting symbols in Mathematics class. Additionally, the second and third highlight the unique phonological feature of the tribe's counting system that is likewise linked with the formal counting system, confirming the tribe's prior knowledge in the target language. Lexically, it sounded close to its Filipino equivalent. Researchers deem it relevant to provide the IPA transcription for lexical comparison and etymological features. Pedagogically, comprehending the lexical counterparts between the vernacular and L2 behind Agta-Tabangnon's ethnomathematical practices provides substantial didactic implications enabling teachers to come up with culturally receptive instructional materials

that link dialectal gaps, thereby enhancing understanding of mathematical concepts entrenched in native culture (Pérez et al., 2024). Distinguishing these equivalents nurtures bilingual instruction by recognizing schoolchildren's native facts while simplifying L2 acquisition. This perceived link encourages deeper intellectual involvement and regard for cultural individuality, nurturing inclusive learning atmospheres. In due course, it aids in developing instructional approaches that incorporate language and culture, refining linguistic ability and mathematical comprehension concurrently within Agta-Tabangnon tribal groups.

The underscored Mathematical cyphers and their phonetic counterparts, considering the Agta-Tabangnon's milieu, signify ethnically the implanted numerical perceptions associated with their day-to-day practices in their native tongue. These codes are articulated through natural lexicon with spoken patterns, epitomizing how the Agta-Tabangnon translate arithmetic, measurement, and interactive ideas by means of the sounds and structure of their native tongue, enabling authentic mathematics knowledge within their social setting. This is substantiated by the verbatim responses highlighted below.

Ang mga angal sa mga konsepto tapos mga bagay bagay na gamit namu sa

pang urualdaw na may matematika parehas san saro', duwa, tulo, apat, lima, iyo man yan po, halos parehas man sana, gan kinse yan [*Our mathematical concepts being used in our daily calculation are as follows: one, two, three, four, five,… things like that…almost the same, until fifteen*]

Pigasurat o pigasabi namun kading mga konsepto sa matematika sa diyalekto sa sadiri mi mismong sasabyon, sa linggwahe mismo nyamu [*We are writing or speaking the mathematical concepts based on our own language itself*]

Correspondingly, Mathematical cyphers in the Agta-Tabangnon setting are semantically connected to perceptible objects, doings, and dealings commonly in everyday life. Local terms signify amounts, figures, and processes, encoding not just mathematical value but meaning entrenched in their indigenous practices. This finding is further vouched by the transcribed answer below.

Nakaapekto siyempre samuya ang pangduwang lingwahe sa pagintindi mi kan mga konseptong pang ethnomathematical ta iba man ang basa buda taramun kesa sa naukdan nan tradisyun mi sa tribu mismo, mejo deficil [*Of course, second language really affects our mathematical understanding since there is Mathematical lexicon that is way different from our daily practices and traditions in the tribe*]

These counterparts disclose culturally grounded judgement, nurturing community-inspired mathematical understanding. In pedagogy, the semantic and cultural-phonetic landscapes of mathematical cyphers in the Agta-Tabangnon dialect may enhance instruction by linking abstract notions with acquainted realities. When imparted in the local tongue, these cyphers carry reliable meanings and resonances refining understanding, nurturing cultural pride, and encouraging locally relevant mathematics teaching.

Counting

Deducing from the community immersion and the table above, counting is one of the most important systems in a tribal community. It is used in their daily transactions with peers to trade, record, and observe time. This involves the use of fingers, toes, dots, and even bars to counter numbers manually and traditionally. With this system, the subject tribe is able to link numerals to body parts to aid them in counting cognitively. It was likewise empirically noted that many of the tribe members were deprived of the Mathematics education. However, if likened to formal schools, their manner of writing mathematical symbols is the same as that of formal Mathematics teaching. They, in effect, use Hindu-Arabic numerals in their native tongue as well. For instance, it can be noted that for some numbers like one (1), four (4), and six (6), they are phonetically pronounced

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in their own dialect due to peripheral linguistic influence. This implies that the neighboring tribal group does have influence on their mathematical etymology. The first district of Albay, having *saro* for one (1), *apat* for four (4), and *anom* (6). Furthermore, the *usad* for 1, *upat* for 4, and unom for 6 are the lexical items used in the third district of Albay. This result is likewise linked to the recorded response below.

Ang mga angal sa mga konsepto tapos mga bagaybagay na gamit namun sa pang rualdaw na may matematika parehas san saro', duwa, tulo, apat, lima, iyo man yan po, halos parehas man sana, gan kinse yan [*Our mathematical concepts being used in our daily calculation are as follows: one, two, three, four, five,… things like that…almost the same, until fifteen*]

This counting system divulges culturally entrenched scientific concepts, elevating formal mathematics teaching by linking it to native practices, conserving cultural uniqueness, and nurturing significant learning processes embedded in customs and community traditions (Assurini et al. 2025; Kabuye Batiibwe, 2024; Pratama & Yelken, 2024). Similarly, this revealed counting system may be exploited by teachers in the teaching of mathematics concepts by recognizing the tribe's vernacular counting style before teaching the universal counting system.

Ciphering

In the context of the study, ciphering denotes a written code in which the letters of a text are replaced with others according to a system. The activity involves signs, symbols, and human gestures, which are other ways of conveying the message to their fellow Agta-Tabangnon locals. The ethnomathematical practice of the tribe, insofar as ciphering is concerned, it was evident during local rituals and gatherings. For instance, shouting can be deciphered as a signal to assemble for an impending congregation. Hence, in Mathematics education, ethnic ciphering indicates the practice of ethnically specific ciphers, codes, and signals to express a message within the learning context. It divulges how ethnic groups cultivate distinctive communication schemes incorporated with scientific calculation processes, maintaining ethnic individuality and elevating home-grown scientific understanding through emblematic depiction and actual practice in everyday routines (Age, 2025; Cahya Sari Putra & Nur Mahmudah, 2021; Wulandari et al., 2024). Pedagogically, ciphering practice could potentially enhance theoretical understanding and cross-linguistic influences by establishing a culturally appropriate curriculum to promote both meaningful linguistic acquisition and mathematical proficiency.

Measuring

The tribe's practices in measuring reveal an inspiring connection in the field of ethnomathematics. As documented, elders would usually be guided by the environmental cues such as sun rays, object shadows, and even the extent and magnitude of daylight to determine the time of the day. Interestingly, Agta-Tabangnon associates the sound produced by a hornbill bird as a time signal and gauge apart from the customary sound echoed and crowed by roosters early in the morning, cueing for another ethnic day. As documented, another measuring practice among the tribal community is the use of a finger (usually the middle) in calculating the water volume before cooking their rice. This practice, in effect, has been handeddown from generation to generation already as an effective way of measuring water level. Another captured measurement technique in measuring the rice field is by the approximate number of sacks of rice that can be harvested instead of using square meters (sq. m.) or hectares (ha). The lexical item *topones* is the term used to measure the land area of a rice field. Two hundred twenty-five *topones* is equivalent to one hectare (*1 ha*). They likewise use the body parts to measure the distance between one object to another. For this claim, Table 2 presents the ethnomathematical terms they used in measuring distances. As noted, ethnic measuring in reflects how the tribe improves real-world, ethnically

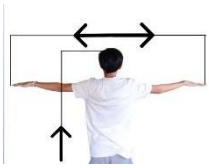
rooted dimension systems leveraging body portions like fingers and limbs or any ordinary items around. To substantiate these claims, a verbatim response is given below.

Ang mga pagkakataon na pinakita kang tribu namun kung pawno kami magbilang, magsukol, o kaya mga iba mga aktibidad na may kinaaraman sa matematika, ining pag dangaw buda lakbang kung minatanum kaming paroy o sa lati mi mismo [*The instances that show how we measure can be seen during rice plantation and crop cultivation where we just estimate through hand span and feet span*]

These methods of measuring are deeply linked to their day-to-day errands, such as farming, handicraft making, and sales, maintaining their cultural distinctiveness and elevating mathematical acumen through context-inspired processes and practical apparatuses. Such methods enable ethnic knowledge communication that is potentially adoptable in formal mathematics teaching anchored on inclusive education principles (Kyeremeh et al., 2025; Putra et al., 2025; Sunzuma & Umbara, 2025; Toibazar et al., 2025). Further, these documented tribe's practices underscore an ethnically contextualized mathematics instruction to enhance students' academic engagement and understanding through actual ethnomathematical applications.

Table 2

Native Tongue equivalents in measuring distances among Agta-Tabangnons

Measurement lexical items	Description	Illustration	Native Tongue Equivalents
hand span	The distance between the tip of the thumb and the tip of the little finger on an outstretched hand		*Dangaw*
foot span	The distance between the tip of the toe and the foot's heel		*Lakbang*
pace movement	Two natural steps are equal to a pace		*Lakad*
span/wingspan	The physical measurement of the length from one end of an individual's arms (measured at the fingertips) to the other when elevated parallel to the ground at shoulder height		*dupa/dipa*

Ordering

Some of the notable local practices of the tribe linked to ordering is ethnically known as *pagnganga*, a usual practice in planting crops within their tenured lot. One of the activities of the tribe, which is considered part of their customs in agriculture, is *pagnganga,* equivalent to putting lime, betel leaf, a quarter of sweetened tobacco, and 1/8 of betel nut chewed altogether, coupled with a wish for abundance during harvest season. Connecting this knowledge system to ethnomathematics, such practice may be contextualized by incorporating concepts relative to their customs to ensure that learners will be able to link their schema to the formal Mathematics concepts, by degrees. Some of the observed ordering activities manifested by the ethnic group are as follows: (*i*) making bamboo sticks to guard the plant, (*ii*) putting available fertilizer around the roots, (*iii*) harvesting the crops and vegetables according to size category, (*iv*) weighing of crops

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and vegetables, (*v*) selling the harvested crop in the local market, and (*vi*) earning money in return. It is worth noting that each activity involves ethnomathematics, which guides them in doing their tribal practices. Thus, ordering among the ethnic group involves the ethnically accepted ways of arranging or sequencing items, events, and time that are based on resident rules and requirements. It mirrors real-world organization in day-to-day life—in agriculture or sales—that develops their mathematical concepts by associating nonconcrete models of order and arrangement to lived practices and knowledge systems. This nurtures significant mathematics acquisition that is culturally embedded in nature (Fouze & Amit, 2023; Radzi & Mahmud, 2025). Therefore, the underscored ordering practice of the tribe emphasizes the significance of recognizing a culturally precise sequencing and vocabulary of Agta-Tabangnon, promoting bilingual lexical correspondence and protecting indigenous data in ethnomathematics and social practices.

Classifying

Putting objects or things based on their common characteristics is the documented knowledge system and practice linked to classifying things by the featured tribe. It usually communicates a model for organizing things in the real world, divulging their logical thinking skills. As claimed during the close interview, classifying objects is important to some of the tribe's customary rituals and survival. This can be observed around the community through their way of arranging things together in constructing their nipa huts, farming, growing plants, and selling home-grown products, revealing arithmetic concepts. Table 3 highlights the ethnic system's way of classifying the kind of harvested rice plant as their primary source of living. As captured, classifying in the field of ethnomathematics nurtures the different ethnic mathematical knowledge systems, upholding inclusivity in teaching students. It links formal mathematics with learners' traditional experiences, increasing engagement, enthusiasm, self-confidence, and impetus, thereby ensuring academic feat and ethnic individuality among varied students (Ajani, 2025; Endang, 2023; Nur et al., 2020; Nurhanan & Santoso, 2025). In effect, classifying practice mirrors the necessity to precisely determine and categorize native tongue and L2 lexical items, paving the way to understanding the Agta-Tabangnon's cultural-mathematical information schemes. This fosters language precision and cultural conservation in the ethnomathematics field. To provide substantial evidence about classifying, a recorded answer is highlighted hereunder.

Sa pag klase-klase po mam kan mga bagay-bagay, naka depende po sa kulay, klase o hitsura kan satung bagay; hal., presko, alusamug, medya ga-ngo, ga-ngo, maluyang liyempesa, etc. [*In classifying things, mam it depends really on the physical appearance or even smell of things for them to be classified properly; i.e., newly threshed, fresh rice harvest with slightly higher moisture content, rice harvest from dried to a moisture content of slightly higher than 14%, etc.*]

Table 3
Ethnomathematical terms used in classifying the palay

Native Tongue Classifying Terms	Description
Presko	newly threshed
Alusamug	fresh rice harvest with slightly higher moisture content
medya ga-ngo	rice harvest from dried to a moisture content of slightly higher than 14%
ga-ngo	rice harvest from dried to 14% moisture or less
maluyang liyempesa	freshly threshed rice harvest with unripe seeds (matured rice harvest but not yet greenish in hull color)

Inferring

In this study, inference was used in the context of deriving meanings from the observed patterns in the environment. In the case of Agta-Tabangnon, inferring is evident when predicting weather through cloud formations and moon shapes, signifying an impending good or bad weather, helping them when to conduct rituals, congregations, likewise cueing them when to cultivate their farm lots. This tribe also made use of the sound produced by dogs to signal a bad omen, or that luck was about to happen, assisting them to analyze and predict future events. These knowledge systems, if linked to the lessons in Mathematics, may be applied as a way to connect with the ethnic group and stimulate their active participation. Teachers may leverage this predicting technique as a preliminary activity or a motivational technique to arouse the interest of the students. As a matter of fact, one key finding verified by this qualitative immersion is the fact that inferring supports learners in developing significant mathematical understanding anchored on their cultural backgrounds, upholding rational thinking and a profounder understanding of the concepts being explored. It also links mathematical models to realistic cultural understandings, increasing relevance, enthusiasm, and problem-solving abilities, thereby nurturing equitable and efficient education for varied students. This method boosts learners to make and construct mathematics according to their socio-cultural upbringings, enhancing commitment and academic achievement (Kevser & Mithat, 2023). Essentially, inferring practice involves originating meaning from native tongue and L2 lexical counterparts to enhance comprehension of Agta-Tabangnon ethnomathematics within the social context and communication.

Modelling

The patterns documented by this study are mostly produced by nature and of the tribe themselves, revealing practical Mathematical applications, specifically geometrical figures. Such patterns are evident in weaving, handicraft, and rice planting. In the straight method of planting patterns, geometric concepts are observed. The mathematical concepts palpable in this pattern are the undefined terms – points, lines, and planes. The planted rice represents points forming a line. The rectangular figure formed by the planted rice spacing also applies the plane concept. The lines created by the planted rice also form parallel lines (*see figure 9*). Operationally, modelling empowers students to generate scientific illustrations embedded in their traditional perspectives, improving understanding and germaneness in Mathematics by promoting a comprehensive and conducive learning atmosphere (Bulut & Borromeo Ferri, 2025; Saparbayeva et al., 2025; Uba et al., 2023). Thus, the modelling practice of the featured tribe highlights the dynamic interaction between language, culture, and cognition, emphasizing how native terms and L2 counterparts reflect the community's worldview and mathematical reasoning.

Geometric concepts are also evident in the designs of the *lanub* or walls of some of their houses. The sidewalls are made of woven bolo (bamboo), ethnically known as *sawali*. The woven bamboo follows a pattern in such a way that it appears neat and cannot easily be deformed. The patterns formed in the weaving of *sawali* illustrate geometric concepts such as congruency and geometric transformations: translation, reflection, and rotation. Inferring from these patterns, these can be a good source of localized instructional materials that are relevant and practical to be used as concrete samples adaptable to almost all fields like geometry, arithmetic, statistics, and algebra making, Mathematics more stimulating and meaningful to study on the part of the students underpinning, accordingly inclusive education (Paquiao, 2025).

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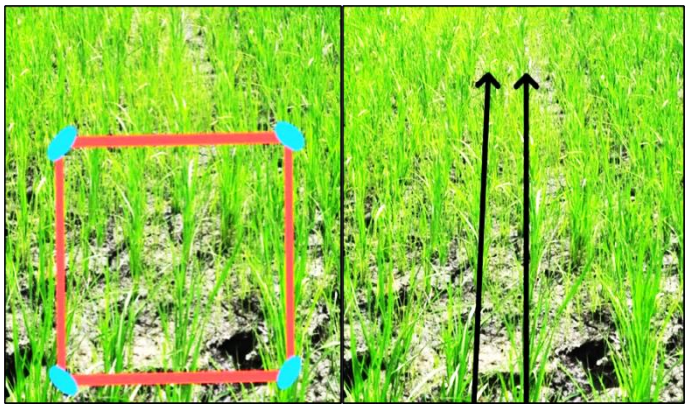
Figure 9
Illustrations of how rice is planted in parallel lines and rectangular forms



Conclusion and Research Implications

This study has emphasized the relevance of educational inclusivity and activating the prior knowledge of the ethnic minority, leveraging their knowledge systems and practices, including their cultural and linguistic background, in the form of contextualized instructional materials and reinforcement activities (Assurini et al., 2025; Kabuye Batiibwe, 2024; Pratama & Yelken, 2024). This exploration has likewise verified the importance of understanding learners' background as the starting point of educational delivery. These considerations will lead to the preservation of the tribe's identity and customs (Age, 2025; Cahya Sari Putra & Nur Mahmudah, 2021; Wulandari et al., 2024). In fact, the comprehensive footage of their scientific models and lexicon in both the native tongue and L2 guarantees that these ethnic practices are preserved for future applications to uphold their cultural inheritance (Kyeremeh et al., 2025; Putra et al., 2025; Sunzuma & Umbara, 2025). Moreover, reconnoitering the knowledge systems in L1 with highlighted lexical equivalents provides awareness for crafting ethnically-inspired mathematics programs that will fortify inclusive teaching by linking prescribed mathematics with the community's lived familiarities and socio-cultural authenticities (Fouze & Amit, 2023; Radzi & Mahmud, 2025). As to lexical equivalence and linguistic preservation, the key points of this immersion will aid Mathematics educators in crafting relevant bilingual instructional materials that regard both language and theoretical integrity, transcending linguistic blockades in teaching (Ajani, 2025; Endang, 2023; Nur et al., 2020; Nurhanan & Santoso, 2025). In the same vein, the comprehensive ethnomathematical information contained in this study may apprise local and countrywide education officials to craft and issue policies designed to incorporate indigenous rich heritage in the school syllabi. This will contribute to a more evenhanded educational structure and support ethnic privileges in education, anchored with UNESCO and other international pronouncements on native peoples' traditional and scholastic civil rights (Kevser & Mithat, 2023). Most essentially, it offers some comparative findings with other ethnomathematics inquiries to expand understanding of the multiplicity and intricacy of ethnic mathematical knowledge systems and practices across the world (Paquiao, 2025). From these premises, it can be inferred that the participant tribe does its own calculating systems which can be applied and incorporated by Mathematics teachers in their lesson preparation and extension activities. The tribe is responsive to the lesson if their language is used initially before introducing mathematical lexicon. Cultural practices and rituals, such as their weaving, farming, and counting models, may be used as a springboard to make sure that the content is contextualized and made relevant to the learners.

Recommendations

Taking into consideration the key findings, researchers recommend an enhanced delivery of educational services to Agta-Tabangnon in particular and to the IP learners at large. Implementation of L1 as a medium of instruction should not be for primary grades exclusively, but for all IP learners as well, to recognize and preserve their unique language features. Similarly, the Integration of Indigenous Knowledge Systems and Practices (IKSP) that are unique to the tribe is also recommended to make the lesson more relevant and meaningful. Teacher training on the culture, beliefs, and practices of the community will help educators to be aware of the leaners' background and identity. Community-based tourism and livelihood programs have also been recommended to augment the economic status of IP and of the learners in the process. Ample resource allocation is necessary to bring fair and quality government service to the native people worldwide.

Study Limitations and Direction

This study primarily looked into the knowledge and systems, and practices of the tribe to capture their ethnomathematics models, which can be adopted pedagogically to improve learning delivery and inclusivity. The community immersion strategy and its ethnographic-developmental nature have unveiled some significant results as to the counting system and other mathematical implications. Lexical equivalents in the native tongue allowed for the discovery of the tribe's rich linguistic heritage. Be that as it may, researchers might have captured some essential components if other research designs were used to provide a more informative picture of the study. Future researchers may then delve into the relevant pursuits anchored on the quantitative field of inquiry to gauge the mathematical acumen of the learners using a standardized test.

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Appendix 1 – Interviews with native tongue translation

1. Can you please describe some key mathematical terms or concepts in your native language that you use in daily cultural practices? [*Pwede tabi ninyo sabyon ang mga angal ninyo sa mga konsepto tapos mga bagaybagay na gamit ninyo sa pang rualdaw na may matematika*?]
2. How do you express these mathematical concepts when speaking your second language? Do you observe any changes in meaning or use? [*Pawno ninyo pigasurat o pigasabi kading mga konsepto sa matematika sa diyalekto ninyo? May mga pagbabago kamung narisa sa ibig sabyon o sa gamit nikadi?*]
3. Are there any mathematical ideas or cultural practices you find hard to describe in either your native language or second language? [*May mga ideya kamu o mga pigagibo sa tribo nyo na dipisil idescribe sa sasabyon nyo o sa Filipino?*]
4. How do the native tongue and second language influence your understanding and usage of ethnomathematical concepts? [*Pawno nakaapekto ang primero kina pangduwang lingwahe ninyo sa pagintindi nyo nikan mga konseptong pang ethnomathematical?*]
5. Can you please share some instances of cultural practices that involve counting, measuring, or other mathematical activities in your tribe? [*Pwede tabi maisabi mo saku ang mga pagkakataon na pinakita kang tribu nyo kung pawno kamu magbilang, magsukol, o kaya mga iba mga aktibidad na may kinaaraman sa matematika?*]
6. How is your traditional mathematical knowledge passed down through generations in your tribe? Do you think this language transfer affect communication? [*Pawno ninyo naipapasa ang mga tradisyonal na aram ninyo sa mga susunod Ninyo henerasyon? Sa kita' mo ang lengwahe nakaapekto sa komunikasyon?*]
7. What trials do you come across when learning or teaching mathematical concepts in your native language compared to the second language? [*Ano ano ang mga naranasan nyo pag nagaturo o kaya pigaturuan kamung konsepto sa matematika gamit ang sadiri nyong lengwahe sa pangduwa ninyong lengwaheng pigagamit?*]
8. How do changes in language use affect the conservation of your community's ethnomathematical knowledge? [*Pawno ang pagsalida nikan lengwaheng pigagamit nakaapekto sa pagpreserba nikan mga naaraman nikan tribo ninyo?*]
9. In what ways do your cultural beliefs and values shape the mathematical concepts used in your tribal group? [*Sa paunong paagi kan mga pinaniwalaan at pinahalagahan ninyo nakatabang sa pagmukna nikan mga konseptong matematika sa tribo?*]
10. What kind of support or resources do you think would help preserve and nurture ethnomathematical knowledge in both your native language and ESL? [*Anong klaseng mga suporta o mga gamit kung ayu man ang sa pagkikita Ninyo nakatabang para mapreserve kina mapakaray pa lalo kan mga naaraman nikan tribo nyo sa sadiri kina pangduwang lengwahe na gamit nyo?*]

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Appendix 2 – Sample academic progress track