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Mathematics in the *Tordauk jerpara tel* tradition: Contribution of local wisdom to mathematics education innovation in elementary schools

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Abstract

This research aimed to present a unique approach by integrating the *Tordauk jerpara tel* tradition of the Aru community into formal mathematics learning, describing the relationship between local cultural practices and mathematics concepts. The objectives were to identify the mathematics values contained in tradition and design a strategy for integrating the values into the elementary school curriculum to improve conceptual understanding and global mathematics literacy. A qualitative approach with an ethnomathematics design was adopted, additionally 20 third-grade elementary school students in Aru Regency were selected as participants. Data were collected through observation, role playing, interviews, and document analysis. The results showed the *Tordauk jerpara tel* tradition contained the concepts of addition, subtraction, multiplication, division, fractions, decimals, ratios, averages, and modulo arithmetic, which could be systematically mapped into the formal elementary school mathematics. The five-stage learning strategy, namely contextual exploration, mathematics identification, formalization, contextual reflection, and extension, can increased student engagement, abstraction ability, thinking flexibility, and internalization of social values. This research made theoretical contributions to ethnomathematics and culture-based mathematics education, while also proposing an adaptable strategy implemented in international contexts. Practical implications include the development of contextual with further research directions focused on strategy validation across cultural contexts.

Keywords: Arithmetic, Ethnomathematics, Number Pattern, Number System, *Tordauk Jerpara Tel*

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Mathematics education in the twenty-first century is increasingly expected to foster not only procedural fluency but also mathematical literacy, equipping students with the ability to apply mathematics in real-world contexts. The Organisation for Economic Co-operation and Development (OECD, 2019) defines mathematical literacy as the capacity to formulate, employ, and interpret mathematics in a variety of situations—a competency regarded as essential for preparing globally competitive citizens. However, prior research has consistently reported that students often struggle to connect mathematical concepts with everyday experiences (Zayyadi et al., 2020).

In the Indonesian context, elementary mathematics instruction remains predominantly abstract and formalistic, with limited integration of students lived experiences and local cultural contexts (Hidayati & Prahmana, 2022). Yet, every community possesses cultural practices grounded in mathematical reasoning that can serve as valuable learning resources. A representative example is the *Tordauk jerpara* *tel* tradition of the Aru community, which involves systematic activities of counting, grouping, and proportional distribution. In this tradition, reeds are intentionally burned to drive animals such as deer, pigs, and mouse deer into open areas, where hunters equipped with bows, arrows, and dogs capture them. The resulting catch is then distributed proportionally among participants. Such practices embody mathematical structures that, if integrated into formal instruction, can bridge students' cultural identities with the development of global competencies.

Ethnomathematics, as a theoretical lens, posits that mathematics is not a culturally neutral discipline but is inherently intertwined with social and cultural activities (Kyeremeh, 2023). This perspective provides opportunities to explore cultural practices as meaningful contexts for mathematical learning. Empirical studies have shown that the incorporation of local culture into mathematics education can improve students' conceptual understanding while simultaneously reinforcing cultural identity (Papadakis et al., 2021). Nevertheless, systematic efforts to implement such approaches remain limited, particularly in eastern Indonesia, a region rich in distinctive traditions. To date, the *Tordauk jerpara tel* tradition has not been examined within an ethnomathematics framework, despite its potential as a rich context for teaching number operations and proportional reasoning. This gap motivated the present study, which addresses the epistemological divide between school mathematics and the mathematical knowledge embedded in students' cultural environments (Anwar et al., 2024).

The core problem lies in the absence of rigorous academic documentation concerning the mathematical ideas embedded in the *Tordauk jerpara tel* tradition, as well as the lack of methodological strategies for integrating such practices into formal curricula. Teachers frequently face difficulties in identifying mathematical representations within local culture, in part due to the scarcity of scholarly references (Naidoo, 2021). As a result, mathematics instruction often neglects the cultural resources available in students' communities, contributing to a disconnection between school mathematics and students' daily experiences. Left unaddressed, this disconnects risks diminishing the relevance of mathematics learning and undermining students' motivation (Rumite et al., 2023). Consequently, research focused on systematically examining Aru cultural practices is both timely and necessary.

The present study aims to (1) identify the mathematical concepts inherent in the *Tordauk jerpara tel* tradition and (2) develop strategies for integrating these concepts into elementary school mathematics curricula. The analysis seeks to produce ethnomodeling-based teaching tools designed to enhance students' understanding of number operations while making mathematics more meaningful and relevant. Beyond pedagogical contributions, the study aspires to strengthen the link between school mathematics and students' lived experiences, fostering the perception of mathematics as a practical and socially situated discipline (Purnama et al., 2023). Methodologically, this research contributes a replicable framework for designing culturally grounded mathematics instruction, thereby serving both scholarly and practical purposes.

Over the past decade, cross-cultural ethnomathematics research has examined diverse cultural activities, including traditional games (Venketsamy, 2024), and indigenous number systems (Hendriana et al., 2025). However, much of this research has been primarily descriptive, offering ethnographic documentation without providing transposition models for classroom implementation. A notable conceptual gap persists regarding the didactic pathways that connect cultural practices to formal mathematical concepts. Methodologically, few studies have proposed practical teaching tools enabling educators to translate ethnomathematical findings into classroom practice. Moreover, within the Indonesian context, analyses of remote island cultures—such as that of Aru—are rare. This study addresses both gaps through an ethnomodeling approach that explicitly maps cultural practices onto formal mathematical representations.

The novelty of this study lies in its systematic exploration of the *Tordauk jerpara tel* tradition, which has never before been analyzed from an ethnomathematics perspective. Previous research has predominantly examined other cultural domains, such as agricultural systems (Pathuddin & Nawawi, 2021; Pathuddin et al., 2023), traditional games (Turmuzi et al., 2023), carving motifs (Mairing & Nini, 2023; Suherman & Vidákovich, 2022), vernacular architecture (Fauzi et al., 2022), and indigenous calendrical or time-reckoning systems (Prahmana et al., 2021; Setiawan, 2017; Umbara et al., 2021). While these studies have advanced the ethnomathematics literature, few have provided replicable frameworks for integrating cultural knowledge into formal instruction. The present study, by contrast, offers both documentation and a didactic transposition framework that operationalizes cultural knowledge for classroom use. Its significance lies in advancing a contextual, inclusive, and culturally responsive mathematics education agenda (Cai et al., 2020), consistent with global calls for culturally relevant pedagogy (Venketsamy, 2024).

International research underscores the importance of ethnomathematics for connecting school mathematics with students' cultural practices (Danoebroto, 2024), yet much of this work focuses on Africa and Latin America, with limited representation from Southeast Asia. This study therefore contributes new perspectives by foregrounding the cultural practices of the Aru community, which have been largely absent from the global literature (Prahmana & D' Ambrosio, 2020). In doing so, it advances both national mathematics education goals and the international ethnomathematics discourse by amplifying voices from underrepresented island communities.

The research specifically addresses two interrelated gaps: (1) a conceptual gap resulting from the absence of a theoretical framework that systematically maps the transposition of cultural practices into formal number operation concepts, and (2) a methodological gap due to the lack of culture-based instructional protocols for supporting mathematical literacy (Atta et al., 2024). Addressing these gaps is crucial for reconciling ethnomathematics theory with classroom practice. The study's outcomes include a conceptual framework for mapping cultural pathways to formal mathematics and a set of ethnomodeling-based teaching tools. Together, these contributions provide a coherent response to limitations identified in previous research.

This investigation is further justified by the urgency of improving Indonesian students' mathematical literacy, which remains below the international average (OECD, 2019). The integration of local culture as a pedagogical resource has the potential to make mathematics instruction more meaningful, relevant, and engaging. Such integration is aligned with UNESCO's Education for Sustainable Development framework, which emphasizes the use of local wisdom in education (Wulandari et al., 2024), and supports Indonesia's *Merdeka Belajar* policy, which promotes contextualized learning to strengthen students' global competencies. Thus, this study is characterized by academic, pedagogical, and policy significance. Finally, based on the foregoing discussion, the research addresses the following questions: (1) what mathematical concepts are embedded within the *Tordauk jerpara tel* tradition of the Aru community? and (2) how can these concepts be systematically integrated into formal mathematics instruction to improve students' conceptual understanding and global mathematical literacy?

The anticipated contributions of this study are threefold. Theoretically, it enriches the ethnomathematics discourse by adding insights from a previously unexplored cultural tradition. Methodologically, it introduces an ethnomodeling framework adaptable to diverse cultural contexts (Suherman & Vidákovich, 2022). Practically, it provides teachers with concrete strategies for incorporating cultural knowledge into mathematics instruction. In the long term, the findings aim to strengthen contextual mathematics education and serve as a reference point for future international research on ethnomathematics.

METHODS

Research Design

This study employed a qualitative research approach with an educational ethnographic design grounded in ethnomathematics. This design was selected to achieve the primary objective: (a) to identify and analyze the mathematical ideas embedded in the *Tordauk jerpara tel* tradition of the Aru community, and (b) to formulate strategies for integrating these ideas into formal mathematics instruction. Data collection combined participatory observation, in-depth interviews, and visual documentation to reveal mathematical representations in cultural practices and transform them into instructional models.

The study was guided by an ethnomodeling framework, which served as a bridge between emic knowledge (local, community-based understanding) and etic knowledge (formal mathematical concepts taught in school). This approach was considered particularly appropriate because it enabled the generation of culturally situated descriptions and facilitated the didactic transposition of mathematical ideas into teachable content (Mairing et al., 2024). This methodological choice aligns with Prahmana and D'Ambrosio (2020) view of ethnomathematics as a pedagogical effort to connect local wisdom with modern educational systems, and with Orey and Rosa's (2021) conceptualization of ethnomodeling as a transformative tool for mathematics education. Zidny et al. (2020) have also emphasized the urgency of developing locally grounded global models. Accordingly, this design was conceptually and methodologically suited to the Aru context while contributing to the broader discourse on global mathematics literacy promoted by the PISA framework (OECD, 2019).

Research Setting and Participants

The research was conducted in the South Sub-district of the Aru Islands Regency, Maluku Province, Indonesia—an area where the *Tordauk jerpara tel* tradition is actively preserved. The site was chosen for its cultural authenticity and the continued vitality of its traditional practices, which enabled the collection of valid ethnographic data. Furthermore. participants were purposefully sampled to represent three key groups:

1. Community Participants: Ten traditional leaders, forty active hunters, and fifty community members involved in the distribution of game were identified. Of these, two traditional leaders, six hunters, and two community members participated in in-depth interviews.
2. Teachers: Two elementary school mathematics teachers from local schools served as collaborators in analyzing the pedagogical potential of integrating cultural mathematics into the formal curriculum.
3. Students: Twenty third-grade students were selected, corresponding to Piaget's transition stage from concrete operational to early formal operational thought, which is considered optimal for introducing contextual and symbolic mathematical representations.

Instrument

Four primary instruments were developed for data collection:

1. Ethnographic Observation Sheet: Designed to record mathematical practices, symbols, rules, and patterns observed during the *Tordauk jerpara tel* procession. Initial coding categories were informed by ethnomathematics domains (e.g., number, operations, patterns, spatial reasoning, logic) to ensure systematic data capture.

2. Semi-Structured Interview Guide: Developed for traditional leaders, cultural actors, and mathematics teachers to explore the symbolic meanings, mathematical interpretations, and pedagogical possibilities of the tradition.
3. Reflective Teacher Questionnaire: Designed to elicit teachers' perceptions regarding the relevance, opportunities, and challenges of integrating local cultural values into mathematics instruction.
4. Learning Trial Sheet and Diagnostic Test: Contextualized within the *Tordauk jerpara tel* tradition, these tools were used to assess students' conceptual understanding and problem-solving abilities following culture-based instruction.

Instrument development followed a systematic, five-step process, such as literature review of ethnomathematics instruments (Zidny et al., 2020), initial drafting based on the research questions, expert validation, limited pilot testing, and final revision. Furthermore, expert validation involved three panels, namely ethnomathematicians, who ensured the authenticity of cultural interpretation, mathematics educators, who evaluated alignment with curricular objectives and global mathematical literacy, and educational evaluation specialists, who assessed clarity, content validity, and readability.

Feedback from experts prompted several revisions: the observation sheet was expanded to include categories for movement symmetry and role distribution, while diagnostic test items were enhanced to include recall, reasoning, and higher-order thinking skill (HOTS)-oriented problem-solving tasks. Teacher questionnaires were simplified for greater accessibility and applicability. These revisions strengthened the validity, reliability, and contextual relevance of the instruments, aligning them with contemporary ethnomathematics research that integrates local cultural heritage with global literacy goals (El Bedewy et al., 2024).

Data Collection Procedures

Data collection was designed to comprehensively address the two research questions.

1. Identification of Mathematical Values:
    a. Participatory Observation: Conducted during live *Tordauk jerpara tel* processions, documenting number patterns, groupings, proportional distributions, calculation rules, geometric forms, and symbolic structures. Data were recorded through field notes, photographs, and video documentation for subsequent analysis.
    b. In-Depth Interviews: Conducted with traditional leaders, hunters, and community elders to elucidate symbolic meanings and cultural logic underpinning observed mathematical practices.

2. Integration into Formal Learning:
    a. Focus Group Discussions (FGDs): Held with elementary mathematics teachers to explore the perceived relevance and feasibility of integrating cultural mathematics into the curriculum, as well as its potential impact on students' mathematical literacy.
    b. Reflective Questionnaire: Used to gather teachers' pedagogical readiness and perspectives on culture-based innovation.
    c. Classroom Pilot: A limited trial implementation of a culturally contextualized learning model was conducted to evaluate its effect on students' conceptual understanding and engagement. Student learning outcomes were measured through diagnostic tests and observation sheets.

Triangulation was achieved by combining observations, interviews, FGDs, and pilot study data, thereby enhancing the validity and credibility of findings. This comprehensive approach was consistent with ethnomathematics research principles, which emphasize connecting mathematics to lived cultural contexts while supporting global literacy (El Bedewy et al., 2024).

Data Analysis

Data were analyzed using qualitative thematic analysis, supported by NVivo software, chosen for its capacity to identify, analyze, and report recurring patterns within ethnographic data. This analytic approach is consistent with Suherman and Vidákovich (2024), who emphasize its methodological flexibility and capacity to integrate empirical findings with theoretical constructs. Furthermore, analysis followed a systematic sequence:

1. Data Transcription: Audio recordings from interviews and FGDs, along with observation notes, were transcribed verbatim and cross-checked against field notes to ensure accuracy.
2. Data Familiarization: Repeated readings of transcripts and review of visual documentation were conducted to gain a holistic understanding of the cultural and mathematical context.
3. Initial Coding: Open coding was applied to identify segments relating to mathematical concepts (e.g., counting, grouping, proportional reasoning, geometry) and pedagogical implications (e.g., culture-based teaching strategies).
4. Category and Theme Development: Codes were clustered into categories such as traditional arithmetic, symbolic representation, and culturally situated pedagogy. Two overarching themes emerged: (a) mathematical values embedded in cultural practices, and (b) strategies for their integration into formal mathematics learning.
5. Concept Mapping: NVivo's visualization tools were used to create concept maps and node trees, illustrating the relationships between categories and themes.
6. Thematic Interpretation: Themes were interpreted in light of established ethnomathematics frameworks (Wiryanto et al., 2022) and recent scholarship on culturally responsive mathematics education (Umbara et al., 2021), linking local findings to global mathematical literacy discourse.
7. Validation and Reliability: Multiple strategies were employed to ensure trustworthiness: (a) member checking with community representatives and teachers to confirm interpretive accuracy, (b) source triangulation across interviews, observations, and FGDs, and (c) inter-rater reliability, with two independent experts coding a subset of data and resolving discrepancies through consensus.
8. Conclusion Drawing: Final themes were synthesized to address the research questions. The first question was answered through a detailed exposition of the mathematical structures inherent in the *Tordauk jerpara tel* tradition, while the second was addressed through pedagogical recommendations for integrating these structures into formal instruction to enhance conceptual understanding and mathematical literacy.

RESULTS AND DISCUSSION

Exploring Mathematical Values in the *Tordauk Jerpara Tel* Tradition

The *Tordauk jerpara tel*, commonly translated as the tradition of burning *alang-alang* (savanna grass), has been practiced by the Aru people since ancient times and continues to be maintained today. In the local Aru language, *tordauk* signifies "alert" or "a call to readiness," *jerpara* denotes "let us burn," and *tel* refers to the savanna landscape—grassland interspersed with shrubs and sparsely scattered trees. This tradition constitutes a communal hunting practice conducted exclusively during the dry season, typically in September. Since its inception, the *Tordauk jerpara tel* has been jointly carried out by ten neighboring villages in the South Aru Sub-district of the Aru Islands Regency. These villages hold customary rights to the savanna lands where the ritual takes place, ensuring collective participation and shared benefits. Furthermore, the *Tordauk jerpara tel* follows a well-structured sequence of activities:

1. Envoy Dispatch (August): Nine envoys from Popjetur village, which holds a coordinating role, visit the nine neighboring villages to communicate the proposed timing and invite them to agree on a date for the ritual.
2. Village Council Meeting: Representatives from all ten villages convene in Popjetur to discuss and finalize the specific day of the *Tordauk jerpara tel* implementation.
3. Village Gathering: On the appointed date, each village sends representatives to Popjetur, where all participants assemble prior to the ritual.
4. Permission Ritual (*Daminta Izin Dape Jirjirduai*): A ceremonial invocation is performed to request permission from *Jirjirduai*, the spiritual guardian of the savanna, seeking safety, cooperation, and abundant hunting results.
5. Procession to the Savanna: A village elder ignites a coconut stem, symbolizing the start of the event, and leads a communal procession toward the savanna, followed by all participants.
6. Positioning of Hunters: Skilled archers, armed with *dipal* (bows and arrows), take strategic positions around the savanna to prepare for the hunt.
7. Ignition of the Savanna: The burning coconut fronds are placed on the dry reeds, setting the grassland alight and flushing animals from hiding.
8. Communal Singing: Villagers who are not actively hunting perform traditional songs as both a spiritual offering to *Jirjirduai* and a source of encouragement for the hunters.
9. Collection and Distribution of Game: After the fire subsides, the captured animals are gathered and equitably distributed among representatives of the ten villages, reflecting the principle of proportional sharing.

This detailed procedure highlights the social organization, symbolic rituals, and systematic division of labor involved in the *Tordauk jerpara tel*. These practices reflect mathematical ideas related to counting, sequencing, spatial arrangement, proportional distribution, and coordination—making the tradition a rich context for ethnomathematical exploration and subsequent integration into formal mathematics learning.

Indigenous Counting Practices

Since ancient times, the *Tordauk jerpara tel* tradition has involved counting practices passed down through generations and still in use today. The enumeration and division of the hunting yield are carried out in the Aru language, using number names specific to the culture. These number names are limited, reflecting the objects commonly counted in daily life. Importantly, the counting process follows a base-10 (decimal) system, indicating an intuitive understanding of positional numeration before the introduction of formal mathematics. Furthermore, Table 1 presents the number names from 1 to 10 in the *Aru* language.

In the cultural context of the *Aru* people, the numbers from one to ten are represented by distinct names in the local language, reflecting a linguistic structure inherently connected to a mathematical system. This numbering system indicates that the *Aru* community possessed an intuitive understanding of numeracy long before the introduction of formal schooling. The use of numbers in the *Aru* language is generally limited to one hundred, a constraint that appears to be associated with the practical quantities typically counted in daily life. Such a numerical boundary is consistent with the findings of Wiryanto et al. (2022), who reported a similarly limited range of number names in the Javanese *tedhak siten* tradition.

Each number in the Aru language functions not only as a numerical representation but also as a cultural marker, reinforcing its role in everyday activities. For example, *ot* (one) and *rua* (two) denote specific quantities that are physically counted, such as hunted animals, thereby linking language, culture, and mathematical reasoning. As noted by Rahmatina et al. (2022), number words act as tools of communication within a society and facilitate the resolution of quantitative problems, underscoring the cultural significance of the *Aru* numerical system.

Table 1. Number names from 1 to 10 in the *Aru* language

Number Naming in the *Aru* Language	Number Symbols
Ot	1
Rua	2
Lat	3
Ka	4
Lema	5
Dum	6
Dubam	7
Korua	8
Sera	9
Orpape	10

Numbers from 11 to 19: Additive Structure

Numbers from 11 to 19 follow a regular linguistic and mathematical pattern: they combine the term *orpape* (10) with numbers from 1 to 9, joined by the word *mo*, which signifies "combined" or "added." Here is an example of participant interview:

P : "Mo no kani arti ja?" (What does the word mo mean?)
W : "Mo artinya dagabung, dangala orpape mo ot, artinya orpape dagabung pel ot" (The word mo means combined, for example, eleven, meaning ten combined with one)

Interviews with participants revealed that, when counting the hunting results, members of the *Aru* community employed an addition operation involving two natural number terms. The first term corresponded to a base-ten number (*orpape*), while the second term ranged from one to nine. The word *mo* served as a linguistic marker for the addition operation, indicating the combination of these two terms. This pattern was consistently applied to number naming from eleven to nineteen in the Aru language, as presented in Table 2.

In the Aru culture's number system, the pattern for number naming extended only up to nineteen and excluded multiples of ten greater than ten. The findings of this study indicate a systematic and linguistically consistent pattern for numbers from eleven to nineteen in the Aru language. This pattern is constructed by combining the base-ten number with numerals from one to nine, with the word *mo* functioning as a linguistic operator signifying addition.

Table 2. Number system from 11 to 19 in the *Aru* language

Number Naming in Aru Language	Number System
Orpape	10
Orpape mo Ot	10 + 1 = 11
Orpape mo Rua	10 + 2 = 12
Orpape mo Lat	10 + 3 = 13
Orpape mo Ka	10 + 4 = 14
Orpape mo Lema	10 + 5 = 15
Orpape mo Dum	10 + 6 = 16
Orpape mo Dubam	10 + 7 = 17
Orpape mo Korua	10 + 8 = 18
Orpape mo Sera	10 + 9 = 19

For example:

orpape mo ot denotes 11 = (10 + 1)
orpape mo rua denotes 12 = (10 + 2)
orpape mo lat denotes 13 = (10 + 3)

Mathematically, this pattern can be formalized as a simple addition operation used by the Aru people to count the results of communal hunting (Setiawan et al., 2023). If n represents the total number of hunted animals, then

$$n = 10 + x \qquad \text{with } \ x \in \{1,2,3,\dots,9\}$$

This representation highlights the community's use of a base-ten system and their implicit understanding of arithmetic structure within a culturally embedded counting practice.

The pattern of number naming from eleven to nineteen in the *Aru* language demonstrates that the community intuitively employed a base-ten number system by combining two terms. The term *mo* functions as a linguistic and mathematical connector, linking the base number with the additional number and thereby establishing a systematic regularity within the traditional numerical system of the Aru people. This pattern not only served as a practical tool for everyday counting activities but also reflected a form of implicit mathematical reasoning embedded within the *Tordauk jerpara tel* tradition. These findings are consistent with prior research identifying similar regularities in the Javanese *Tedhak Siten* tradition (Wiryanto et al., 2022) and the Javanese *Primbon* calendar system (Utami et al., 2019), indicating a shared cultural tendency to structure number naming through additive patterns.

A practical application of this numerical pattern is evident when the Aru people count hunting results. For example, if a catch consisted of twelve pigs and fifteen kangaroos, the quantities would be named using the base-ten pattern: *orpape mo rua* for twelve pigs (10 + 2) and *orpape mo lema* for fifteen kangaroos (10+5). This illustrates how the base-ten structure is utilized in real contexts, bridging cultural practice with mathematical representation.

Multiples of 10: Repeated Addition and Multiplication

Multiples of 10 greater than 10, namely 20, 30, 40, and so on, have different names. These people understood that the number 20 was the same as adding 10 to 10 (*orpape* plus *orpape min*). Likewise, the number 30 was the same as 10 plus 10 plus 10 (*orpape* plus *orpape min* plus *orpape min*). The Aru people also understood that deer *orpape* added to deer *orpape* the result was the same as deer *orpape dakali rua*, suggesting that 10 deer when added to 10 more deer the result was the same as 10 deer times 2. The word *dakali* referred to the multiplication operation. Based on the number naming in the Aru language for multiples of 10 that were less than 100, a number system could be created, as shown in Table 3.

Table 3. Multiples of 10 in the *Aru* language

Number Naming in Aru Language	Number System
Orpape	10 = 1 x 10
Orpape Rua	20 = 10 + 10 = 2 x 10
Orpape Lat	30 = 10 + 10 + 10 = 3 x 10
Orpape Ka	40 = 10 + 10 + 10 + 10 = 4 x 10
Orpape Lema	50 = 10 + 10 + 10 + 10 + 10 = 5 x 10
Orpape Dum	60 = 10 + 10 + 10 + 10 + 10 + 10 = 6 x 10
Orpape Dubam	70 = 10 + 10 + 10 + 10 + 10 + 10 + 10 = 7 x 10
Orpape Korua	80 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 8 x 10
Orpape Sera	90 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 9 x 10

The Aru cultural number system used a specific pattern for multiples of 10 that were more than 20 and less than 100 and did not use the word *mo*. Furthermore, the number system of multiples of 10 that were more than 20 and less than 100 in the Aru culture showed that these numbers were generated through repeated addition of the number 10 (Syawahid et al., 2020).
For example:

$20 = 10 + 10$ was called *orpape datambah orpape*
$30 = 10 + 10 + 10$ was called *orpape datambah orpape datambah orpape*

Mathematically, the number *n* that was a multiple of 10 in this system was expressed as follows:

$$n = 10 + 10 + \cdots + 10 \text{ times } m$$

where m represented the number of additions of 10.

The Aru people intuitively understood that repeated addition was represented as multiplication, for example, the term *orpape rua* showed the relationship between the addition of 10+10 and the multiplication of 2 x 10, indicating multiples of 10 that were more than 10 and less than 100 consisting of 2 main components, namely: (1) the root word "*orpape*" which represented the number 10, acting as a fixed factor; and (2) multiplier words (*rua, lat, ka, lema, dum, dubam, korua, sera*), which represented the multiplier factors of the base number 10. Mathematically, the number n which was a multiple of 10 in this system, could be expressed as follows:

$$n = m \times b \quad \text{with } m \in \{1,2,3,\ldots,9\}$$

where:

n : Number of hunting result
b : Base 10
m : Multiplier explicitly stated in *Aru* language

The Aru people's understanding that "repeated addition could be expressed as multiplication" showed that these individuals had intuitively applied the following basic mathematical concepts:

When $n = b + b + \cdots + b$ (time m), then $n = m \times b$

or

$$n = \sum_{i=1}^{m} b = m \times b$$

where:

n : Number of hunting result | b : Base 10 | m : Multiplier explicitly stated in Aru language

This basic mathematical concept was observed in the following examples of patterns:

$30 = 10 + 10 + 10$, expressed as 3×10

$40 = 10 + 10 + 10 + 10$, expressed as 4×10

The use of the word *dakali* (meaning multiplication) in the Aru community showed that there was an understanding among the community that multiplication could be used to calculate the total number of hunting results with consistent grouping. Furthermore, the use of the word *dakali* showed that the Aru people understand the rationalization of quantity. This system described the total number of hunting results using operations that were more efficient than ordinary addition. In this study, this was consistent with using certain words in the local community language to indicate mathematical meaning or value in a tradition (Anwar et al., 2024). For example, instead of saying "10 deer plus 10 deer plus 10 deer", the *Aru* community simplified it to "10 deer *dakali* 3", meaning 30 deer obtained.

The pattern formed based on the number naming in the Aru language for numbers greater than 20 and less than 100 that were not multiples of 10 was the same as the pattern for number naming from 11 to 19. The number 21 was called *orpape rua mo ot*, *orpape rua* referred to 20, the word *mo* suggested the addition operation, and the word *ot* means 1. When *orpape rua mo ot* was expressed in the form of a number construction, it was obtained as 21 = 20 + 1. Based on the number naming in the Aru language for numbers greater than 20 and less than 100 that were not multiples of 10, when a number system was made, it must be related to multiplication and addition operations, namely 21 = (2 x 10) + 1. Therefore, several examples of number systems in the Aru culture could be made for numbers greater than 20 and less than 100 that were not multiples of 10, as seen in Table 4.

Table 4. Number system for numbers greater than 20 and less than 100 that were not multiples of 10

Number Naming in Aru Language	Number System
Orpape Rua mo Ot	21 = 20 + 1 = (2 x 10) + 1
Orpape Lat mo Rua	32 = 30 + 2 = (3 x 10) + 2
Orpape Ka mo Lat	43 = 40 + 3 = (4 x 10) + 3
Orpape Lema mo Ka	54 = 50 + 4 = (5 x 10) + 4
Orpape Dum mo Lema	65 = 60 + 5 = (6 x 10) + 5
Orpape Dubam mo Dum	76 = 70 + 6 = (7 x 10) + 6
Orpape Korua mo Dubam	87 = 80 + 7 = (8 x 10) + 7
Orpape Sera mo Korua	98 = 90 + 8 = (9 x 10) + 8

Numbers Greater than 20 and Non-Multiples of 10

For numbers greater than twenty and less than one hundred that were not multiples of ten, the Aru number system combined addition and multiplication patterns. For instance, the number twenty-one was expressed as *orpape rua mo ot*, where *orpape rua* indicated twenty (equivalent to 2 × 10), *mo* denoted the addition operation, and *ot* represented one. Mathematically, this number can be represented as

$$21 = 20 + 1 \text{ or } 21 = (2 \text{ x } 10) + 1$$

This pattern generalizes to all numbers greater than twenty and less than one hundred (excluding multiples of ten) as

$$n = (t \text{ x } 10) + u$$

where:

n : Number of hunting results
$(t \text{ x } 10)$: Tens digit number
u : Units digit number

This pattern also showed that the Aru people understood numbers not only as totals but also as the result of a combination of 2 basic operations, namely:

Multiplication to produce the tens digit number $(t \text{ x } 10)$
Addition to sum the tens digit number $(t \text{ x } 10)$ and the unit digit number (u)

The explicit mention of the word *mo* indicated the addition operation, while the *orpape* component followed by coefficients such *as rua, lat, and lema* signified basic multiplication by the number 10. This pattern also reflected the use of the decimal system (base 10) in the composition of (1) tens digit number $(t \text{ x } 10)$ as the main component; and (2) units digit number (u) added as a secondary component (O'Hara et al., 2022). The decimal system supported efficiency in naming and calculating large numbers by using a combination of basic operations (Suseelan et al., 2022). In the process of distributing hunting results, the Aru community implicitly applied a variety of fundamental mathematical concepts, including addition, subtraction, division, averaging, proportional reasoning, and modular arithmetic.

Addition, Subtraction, and Division

The division process began with grouping animals of similar size one by one, which can be interpreted as a form of repeated subtraction. When the total quantity was known, the community employed simple division to ensure equal distribution. For example, 950 kg of pigs divided equally among ten groups can be expressed mathematically as $\frac{950}{10} = 95$, indicating that each group received 95 kg of pigs. The same principle applied to the distribution of 625 kg of deer and 426 kg of kangaroos.

Importantly, the division process was weight-based rather than headcount-based, which demonstrates an intuitive understanding of fairness and the use of rational numbers. If distribution were performed solely by counting heads, some groups would receive significantly more meat due to variations in individual animal weight. By dividing based on total weight, each group received an equal value in kilograms, regardless of whether they were given whole animals or cut portions, aligning with the principle of equitable distribution (Erath et al., 2021).

Mean and Equitable Distribution

The community also applied the concept of the arithmetic mean to ensure fairness. The average weight for each group was calculated as follows:

$$\text{Average pigs per group} = \frac{950}{10} = 95 \text{ kg}$$
$$\text{Average deer per group} = \frac{625}{10} = 62{,}5 \text{ kg}$$
$$\text{Average kangaroos per group} = \frac{426}{10} = 42{,}6 \text{ kg}$$

Although some groups received whole animals and others received meat portions, the resulting distribution was equal in weight. This reflects the application of mean-based allocation as a fairness mechanism (Testolin, 2024).

Fractions and Decimal Numbers

In some cases, the division resulted in non-integer quantities, producing fractional or decimal values such as 62.5 kg of deer or 42.6 kg of kangaroos per group. This reveals that the Aru community utilized fractional reasoning and decimal representation to achieve precision in distribution. If only whole numbers had been used, the result would have been less accurate and potentially inequitable (Sumaji et al., 2020; Reinhold et al., 2020).

Comparison and Proportional Reasoning

The division also relied on proportional reasoning rather than absolute counts. Although the number of pigs (12) was lower than the number of kangaroos (15), the total weight of pigs (950 kg) was significantly higher than that of kangaroos (426 kg). Consequently, each group received a larger share of pigs. This process reflects the intuitive use of ratios and proportions, as the community compared weights rather than counts to determine equitable shares (Lewis et al., 2021).

Modulo and Remainder Distribution

Finally, when the total number of animals was not perfectly divisible, the remainder was distributed as portions of meat rather than whole animals. This reflects an application of the concept of modular arithmetic, in which the quotient and remainder are both considered in the division process (Walker et al., 2024).

Strategy for Integrating Mathematics Values from the *Tordauk Jerpara Tel* Tradition into Mathematics Learning

The mathematics values identified in the *Tordauk jerpara tel* tradition were systematically mapped onto formal concepts in the elementary school mathematics curriculum, as shown in Table 5. It presents that the mathematics values inherent in the *Tordauk jerpara tel* tradition were systematically aligned with the formal concepts of the elementary school curriculum. Counting the hunting results corresponded to addition and multiplication of natural numbers, while the division of the catch reflected concepts of division, fractions, and comparison and proportion. Specific portioning further illustrated the concepts of averages and modular arithmetic, particularly when remainders occurred. This mapping aligns with the principle of didactical transposition (Fahrudin et al., 2024), which transforms cultural practices into formal mathematical structures suitable for classroom instruction. Thus, cultural activities were not limited to narrative or descriptive accounts; instead, they served as concrete bridges to mathematics learning, connecting local knowledge to the national curriculum and supporting the global discourse on ethnomathematics (Sa’adah et al., 2023).

Table 5. Mapping mathematics values in the *Tordauk jerpara tel* tradition to formal elementary school concepts

Cultural Activities/Practices (Emic)	Mathematics Values	Formal Concepts in the Elementary School Curriculum (Etic)	Core Competencies/Learning Objectives
Counting the number of hunted animals	Total calculation, repeated addition	Addition and multiplication of natural numbers	Students can add and multiply numbers up to 1000
Developing hunting strategies (group division patterns & routes)	Patterns, systems, and regularities	Number patterns, series, and systems	Students can recognize, continue, and create simple number patterns
Dividing the catch according to group members	Fair division, distribution	Division of natural numbers	Students can divide numbers with or without a remainder
Dividing the catch based on specific portions	Proportion and ratio	Fractions, ratios, and proportions	Students can compare and express portions of a whole as simple fractions
Calculating the average catch among groups	Median value, data distribution	Concept of the mean (average)	Students can calculate the average of a simple data set
Applying special distribution rules that overlooked some portions	Concept of remainder in division	Modular arithmetic	Students can understand remainders from dividing numbers (simple modulo)
Expressing the portion of the catch in fractions (half, a quarter, etc.)	Representation of fractions	Simple fractions and decimals	Students can convert fractions to decimals and vice versa

Following this mapping, a strategy was developed for integrating these mathematics values into elementary school learning. The strategy was structured around systematic learning stages, providing teachers with practical guidance for incorporating local cultural values into their teaching. Each stage was grounded in the principles of didactical transposition and ethnomodeling, facilitating the transfer of knowledge from a cultural context (emic) to formal mathematics (etic) without diminishing its sociocultural significance. This approach enabled students to learn abstract mathematics concepts while relating them to real-life experiences, making mathematics learning more contextual and fostering appreciation for local wisdom. The detailed strategies for integrating the mathematics values of the *Tordauk jerpara tel* tradition are presented in Table 6.

This strategy ensures that each learning stage progressively develops both mathematical understanding and cultural appreciation. Through contextual exploration, formalization, reflection, and extension, students gain the ability to connect traditional practices with formal mathematical reasoning, strengthening both conceptual understanding and cultural literacy.

Table 6. Strategy for integrating *Tordauk jerpara tel* mathematics values into learning stages

Learning Stages	Detailed Steps	Student Outcomes
1. Contextual Exploration	1. Teacher narrates or simulates the *Tordauk jerpara tel* tradition. 2. Students share related local experiences. 3. Role-play simulations allow students to enact the cultural context.	1. Students demonstrate enthusiasm and curiosity. 2. Relate narratives to daily experiences. 3. Actively engage in simulations.
2. Mathematics Identification	1. Teacher asks guiding questions about quantities, comparisons, and distribution of the catch. 2. Students express answers numerically. 3. Teacher emphasizes addition, subtraction, multiplication, and comparison.	1. Students independently identify addition, multiplication, and comparison concepts. 2. Begin to understand the mathematical significance of cultural activities. 3. Actively participate in discussions to find solutions.
3. Formalization	1. Students write calculations in symbolic form (e.g., $12 \div 4 = 3$). 2. Teacher provides additional practice using formal notation. 3. Teacher clarifies concrete-symbolic relationships.	1. Students translate concrete situations into formal notation. 2. Apply mathematical procedures to solve problems. 3. Understand the connection between cultural narratives and mathematical symbols.
4. Contextual Reflection	1. Teacher guides discussion on social meaning of calculations (e.g., fairness in distribution). 2. Students reinterpret mathematics results within cultural context. 3. Teacher highlights values of solidarity and cooperation.	1. Students understand links between mathematics and cultural values. 2. Explain concepts of justice or solidarity based on calculations. 3. Internalize cultural identity through mathematics learning.
5. Extension	1. Teacher presents new variations of problems based on the tradition. 2. Expand to other contexts (harvests, food distribution). 3. Students solve problems using mathematics strategies.	1. Students transfer concepts to novel situations. 2. Demonstrate flexible mathematical thinking. 3. Enhance creativity in problem-solving.

Contextual Exploration Stage

During the contextual exploration stage, the teacher introduced the *Tordauk jerpara tel* tradition through cultural narratives and simple simulations, ensuring active student participation. The hunting process and distribution of catches, common among the local community, were described, and students were asked to act out the situation symbolically in class. Observations indicated high levels of curiosity, enthusiasm, and engagement, particularly when the story was connected to students' daily experiences. This confirmed that contextual exploration created a meaningful learning environment, fostering personal connections between cultural experiences and mathematics activities. The following dialogue illustrates classroom interactions during this stage:

Teacher : *"Class, today we will learn through a story from the Tordauk jerpara tel tradition. Do you know how the community used to hunt in the forest for food?"*
Student A : *"They hunted mouse deer, ma'am!"*
Teacher : *"That's right. After the hunt, the harvest was usually divided equally among all group members. If there were six deer, how do you think they should be divided among three families?"*
Student B : *"Each family gets two!"*
Teacher : *"Good! Now, imagine if there were only five deer for three families, how would that work?"*
Student C : *"Hmm… it won't be exact, ma'am. It would have to be cut or divided into portions."*
Teacher : *"Exactly! From this, we learn that the community also applies division in daily activities. You were really enthusiastic, weren't you?"*
Students : *"Yes, ma'am!" (in unison)*

This dialogue demonstrates how cultural narratives triggered students' curiosity and active participation. The hunting story, being closely related to real-life experiences, increased motivation and engagement. This outcome aligns with the situated learning framework, which emphasizes that knowledge is more easily understood when associated with real-life community practices (Syawahid et al., 2020). The findings are also consistent with Anwar (2024), who noted that culturally based narratives enhance intrinsic motivation in mathematics learning. Furthermore, the use of local narratives supports the Contextual Teaching and Learning (CTL) approach, highlighting the importance of linking subject matter to students' daily experiences for meaningful learning (Rumite et al., 2023). Overall, the contextual exploration stage not only introduced local tradition but also served as an effective pedagogical strategy to increase students' motivation, participation, and cognitive readiness for subsequent mathematics activities.

Mathematics Identification Stage

After engaging with the cultural narrative in the contextual exploration stage, the teacher guided students in identifying the mathematics values embedded in the *Tordauk jerpara tel* tradition. This involved re-enacting a simple hunting simulation and distributing the catch using concrete objects, such as animal picture cards previously used in role-play. Guided questions helped students discover the mathematical relationships within the activity. Furthermore, the steps at this stage included:

1. Collective counting of the catch – Students counted the number of animals caught by two groups, introducing the concept of addition.
2. Comparing results between groups – Students identified which group caught more or less, fostering the concepts of comparison and difference (subtraction).
3. Distributing the catch – Students distributed the catch fairly among several families, developing the concepts of division, multiplication, and fractions when results could not be divided evenly.
4. Finding the remainder – If the distribution was uneven, students expressed the remainder, introducing the concepts of fractions, decimals, and modulo.

The role-playing experience from the initial stage provided a foundation for reasoning. An excerpt from classroom observation illustrates this process:

Teacher : *"Group A managed to bring in six animals, and Group B brought in eight. What is the total number?"*
Student A : *"Add them up, ma'am. 6 + 8 = 14."*

Teacher : "Good. Now, if there are 14 animals to be divided among 4 families, how much does each family receive?"
Student B : "Divide them equally, ma'am. 14 ÷ 4 = 3, remainder 2."
Teacher : "What about the remaining 2? Can we divide it further?"
Student C : "Yes, ma'am. 2 divided by 4 gives 2/4 or one-half."
Teacher : "Exactly. Each family gets 3 1/2 animals. This can also be written as 3.5 animals, or in more advanced mathematics as 14 ≡ 2 (mod 4)."

Observations indicated that students were beginning to articulate mathematical relationships independently within cultural activities. Concepts such as addition, comparison, division, and remainders were expressed in both practical and formal mathematical terms. The process highlighted the effectiveness of a culture-based guided discovery approach, where the teacher acted as a facilitator, guiding students to construct understanding through questioning.

This approach aligns with the Contextual Teaching and Learning (CTL) framework, emphasizing the connection between abstract concepts and students' daily experiences (Pradana et al., 2020). The use of cultural narratives and concrete simulations provided anchors for developing mathematical understanding naturally. It also adhered to the principles of guided discovery learning (Bruner, 1961), where students are encouraged to explore and discover concepts before formal definitions are provided. The transition from everyday language (e.g., "divide equally, there is a remainder") to formal mathematics language (e.g., division, fractions, decimals, modulo) exemplified scaffolding (Giannakos & Cukurova, 2023), facilitating movement from the zone of actual development to the Zone of Proximal Development (ZPD).

These findings support research on ethnomodeling, which maps cultural practices into formal mathematics concepts (See et al., 2024). Students not only learned to count and perform operations but also understood the social meaning behind them, such as fair division and remainders. This approach aligns with the PISA mathematics framework (OECD, 2019), which emphasizes the ability to model real-world situations, perform calculations, and interpret results in context. Overall, the mathematics identification stage established a strong cognitive and affective foundation for the subsequent formalization stage, bridging local experiences with formal mathematical abstraction.

Formalization Stage

During the formalization stage, the teacher guided students in transforming contextual experiences from the *Tordauk jerpara tel* tradition into symbolic representations consistent with formal mathematics notation. This stage followed the successful identification of mathematical concepts from the cultural activity and aimed to consolidate students' understanding through formalized expressions and procedures. The formalization stage consisted of the following steps:

1. Transforming concrete situations into numbers - The students were asked to write down the number of animals that were counted orally. For example, "six" was written as 6, "eight" as 8, and total "6 + 8 = 14" was written symbolically.
2. Application of formal operations - Addition, subtraction, multiplication, and division procedures were taught using formal algorithms. For example, dividing 14 animals among 4 families was written as 14 ÷ 4 = 3, remainder 2. This including showing students how to convert the answer to the fraction *3 ½* or decimal *3,5*.
3. Use of special symbols - Other mathematics symbols, such as comparison signs (> , <), fraction symbols, and modulo notation (≡), were introduced to show the remainder of a division.

4. Formal problem solving - Exercises in the form of story problems based on tradition, were provided but the solutions required the use of algorithmic procedures.

   An excerpt from classroom observation illustrates this process:

Teacher	*: "If Group A got 6 catches and Group B got 8, how do we write the total using mathematical symbols?"*
Student A	*: "6 + 8 = 14 catches, ma'am."*
Teacher	*: "Good. Now, if the 14 are divided among 4 families, how do we write it?"*
Student B	*: "14 ÷ 4 = 3 remainder 2."*
Teacher	*: "If the remainder is 2, how can we write it as a fraction?"*
Student C	*: "2 divided by 4 is 2/4 or ½. So, the answer is 3 ½ animals."*
Teacher	*: "Exactly. We can also write this as 3.5, or in more advanced terms as 14 ≡ 2 (mod 4)."*

Observations showed that students successfully transitioned from concrete situations to formal representations. They could translate experiences of sharing the catch into numerical symbols and solve problems using standard mathematical algorithms. The teacher acted as a facilitator, providing gradual scaffolding, while students demonstrated improved abstraction and representational skills.

The formalization stage reflected the didactic transposition process described by Yembuu (2021), which involves transforming knowledge from cultural practices (emic) into a form suitable for classroom teaching (etic). According to Yembuu (2021), curriculum and teaching materials are the result of selecting, simplifying, and reorganizing academic knowledge to align with the school context. This process supports the theory of multiple representations in mathematics education, which emphasizes the use of concrete, visual, and symbolic forms to develop deep understanding. Transitioning from concrete objects to symbolic representations allowed students to grasp mathematical concepts abstractly.

The stage aligns with Bruner's three modes of representation—enactive, iconic, and symbolic—where visual and symbolic representations continue to be effective in facilitating the move from concrete to abstract concepts in elementary education (Saracho, 2023). The formalization process began with realistic cultural experiences, leading to symbolic formalization, mastery of formal procedures, and the ability to relate results back to the cultural context (Masaki, 2025).

Overall, the formalization stage demonstrated that local cultural experiences, such as dividing the hunting catch, can serve as a meaningful foundation for abstract mathematics learning. This approach validates the role of culture as an epistemological bridge between real-world practice and formal curriculum, reinforcing the relevance of culture-based mathematics education and its alignment with global trends toward contextual, inclusive, and meaningful learning (Setiawan et al., 2023).

Contextual Reflection Stage

At the contextual reflection stage, the teacher guided students to reconnect the mathematical results with their underlying cultural meanings. After performing operations such as dividing the catch into whole numbers, fractions, or decimals, the class engaged in a discussion guided by reflective questions, for example: "*Why should the game be divided equally*?" This encouraged students to think beyond numerical calculations and consider dimensions of cultural values, such as justice, solidarity, and togetherness. An excerpt from classroom observation illustrates this process:

Teacher : *"We already know that the 12 catches were divided among 4 community members. What is the result mathematically?"*
Student A : *"Three, ma'am! Each person gets 3 animals."*
Teacher : *"That's right. Now, why do you think this division must be equal? Is there any reason besides mathematics?"*
Student B : *"To be fair, ma'am. If someone gets less, they'll be unhappy."*
Student C : *"Yes, ma'am. In the village, the game must be shared equally so everyone feels part of the group."*
Teacher : *"Exactly. So, this division isn't just about numbers—it's about togetherness, fairness, and respect for friends. Those are the cultural values in mathematics."*

This dialogue demonstrated that students were not limited to numerical answers but were beginning to connect mathematical processes with sociocultural values. Observations indicated that virtually all students could cite at least one cultural value—justice, solidarity, or togetherness—embedded in the activity of sharing the catch. This represented the success of the reflection stage in bridging mathematics concepts with cultural identities.

The contextual reflection stage highlights the importance of reconnecting mathematics to its cultural roots and social practices. These results align with El Bedewy et al. (2024), who found that integrating ethnomathematics into learning not only improved students' understanding of formal concepts but also strengthened cultural identity. By reflecting on the social significance of mathematical operations, students learned that mathematics is a social practice connected to values, norms, and real-life contexts. This approach also supports culturally responsive pedagogy, in which teachers help students connect cultural experiences with academic content, making learning more relevant and meaningful (Sutarto et al., 2022).

Moreover, reflection supported critical education principles, helping students recognize the ethical and social dimensions of mathematics (Rumite et al., 2023). Students understood that accurate calculations in dividing the catch were not only mathematical exercises but also essential for ensuring social justice within their communities. This finding is consistent with Hawlitschek et al. (2024), who showed that integrating cultural context into mathematics strengthens socio-mathematical norms, particularly how students interpret calculated results in light of social values.

The reflection stage is not merely a closing activity; it is a crucial step that connects emic (local cultural practices) and etic (formal school knowledge) dimensions. It reinforces previous learning outcomes by ensuring students master formal algorithms while embedding social meaning and cultural identity into mathematics practices. This bidirectional learning enables students to study mathematics through culture and culture through mathematics simultaneously, fostering both cognitive understanding and socio-cultural awareness.

Extension Stage

The extension stage focused on students' ability to apply the mathematics concepts learned to a variety of new problems, including those rooted in cultural contexts and other daily life situations. After understanding how the distribution of game in the *Tordauk jerpara tel* tradition could be modeled mathematically, the teacher expanded the scope of problems to include other contexts, such as distributing harvest results and comparing quantities of fish caught. The following classroom dialogue illustrates this process:

Teacher : *"Yesterday, we divided the 12 sweet potatoes harvested among 4 community members. What if we now harvest 20 sweet potatoes and have to divide them among 5 community members? How much will each person get?"*
Student A : *"Each person gets 4 sweet potatoes, ma'am."*
Teacher : *"Good. Now, if the harvest is 25 sweet potatoes for 4 community members, how do we proceed?"*
Student B : *"If there are 24 sweet potatoes, each person gets 6. But there's 1 leftover. That can be divided again to obtain a fraction, ma'am."*
Teacher : *"Great! How do we write the result as a fraction?"*
Student C : *"Each person gets 6 1/4 sweet potatoes, ma'am."*
Teacher : *"Very good. Now imagine if the catch is 30 fish, and it is divided among 3 families, but one family is larger and must receive double. How do we calculate that?"*
Student D : *"We have to make a comparison, ma'am. So, we divide it according to the ratio 1 : 1 : 2."*

Through these activities, students demonstrated flexible thinking by applying learned concepts to diverse contexts. They successfully solved numerical problems, interpreted division in fractions, performed comparisons, and applied ratios in more complex situations. Analysis revealed that approximately 80% of students generalized previously learned strategies to solve new problems, including those linked to culture and daily life. This confirmed the success of the extension stage as a bridge for knowledge transfer.

The extension stage strengthened students' ability to transfer knowledge, applying learned concepts to novel situations (Sa'adah et al., 2023). Providing a variety of problems encouraged flexibility, creativity, and independent thinking in mathematical reasoning. These findings are consistent with Purnomo et al. (2022), who reported that problem variation motivates students to adapt strategies rather than relying solely on rote procedures. The stage also aligns with mathematics problem-posing learning, where students actively construct and solve problems relevant to real-life experiences (Setiawan et al., 2023).

This stage reflects the principle of adaptive expertise (Hatano & Inagaki, 1984), where students flexibly apply learned strategies while innovating when faced with new challenges. In this study, students extended the concept of division from hunting to farming and fishing scenarios, demonstrating that mathematics can be applied meaningfully across contexts.

The extension stage is closely related to higher-order thinking skills (HOTS) as outlined in the OECD (2023) PISA framework. By engaging with culturally and contextually based problems, students were trained to analyze, reason, and generalize mathematical concepts. The results showed mastery of algorithms, independent problem-solving, and development of new strategies (Nugraha et al., 2023). Consequently, the extension stage is a critical component of the culture-based learning model, ensuring formal conceptual understanding while promoting the application of mathematics in real-life contexts, strengthening social relevance, and fostering students' adaptability as problem solvers.

CONCLUSION

This study systematically identified and analyzed the mathematical values embedded within the *Tordauk jerpara tel* tradition of the Aru community. The research revealed that the local practices encompassed fundamental arithmetic operations, including addition, subtraction, multiplication, and division, as well as more advanced concepts such as fractions, decimals, ratios, averages, and modulo operations. These mathematical concepts were intertwined with social values of justice, solidarity, and togetherness, highlighting the inseparable link between quantitative reasoning and cultural norms. The mapping of these cultural practices into the formal elementary school curriculum demonstrated that local, contextually meaningful experiences serve as a robust foundation for conceptual understanding. By maintaining the intrinsic sociocultural significance, this study uniquely illustrated how traditional knowledge can be integrated into formal mathematics learning, thereby enriching students' cognitive development and contributing to the broader discourse on global mathematics literacy.

From a practical perspective, the implementation of a five-stage integration strategy—contextual exploration, mathematics identification, formalization, contextual reflection, and extension—proved effective in guiding students from concrete, culturally grounded experiences to abstract symbolic representations. Observations indicated enhanced student engagement, motivation, and critical thinking, alongside an increased capacity to generalize and transfer mathematical concepts to novel contexts. This approach offers concrete pedagogical strategies aligned with didactical transposition, ethnomodeling, and CTL principles. By bridging local cultural knowledge and formal curriculum content, the strategy provides a replicable model for developing culturally responsive mathematics education, promoting both meaningful learning and the internalization of social values.

Despite the promising outcomes, this study has certain limitations. The research was confined to a single community context, and the effectiveness of the strategy was measured within a specific elementary school setting, which may limit generalizability. Future research should investigate the applicability of this approach across diverse schools and cultural environments, including urban and multicultural settings. Additionally, integrating educational technology and digital learning tools may enhance engagement and broaden accessibility. Longitudinal studies are recommended to evaluate the sustained impact on conceptual understanding, problem-solving creativity, and the internalization of cultural values. Overall, this study contributes to the international ethnomathematics discourse by providing a structured framework for culturally grounded mathematics education, demonstrating how traditional knowledge can enrich curriculum design and foster socially and mathematically competent learners.

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Declarations

Author Contribution	:	SL: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, and Writing - Original Draft.
		CS: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Validation, and Writing - Original Draft.
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