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EXPLORATION OF MATHEMATICAL CONCEPTS IN THE LOCAL WISDOM OF THE MEKONGGA PEOPLE

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ABSTRACT

This study explores the mathematical concepts embedded in the cultural practices and local wisdom of the Mekongga people in Kolaka and East Kolaka Regencies, Southeast Sulawesi, Indonesia. Guided by an ethnomathematical perspective, the research aims to identify and describe how mathematical reasoning manifests through traditional architecture, art, rituals, and social systems. A qualitative approach with an ethnographic design was employed, involving purposive interviews with cultural informants such as the Deputy King of Mekongga, traditional artists, and *Tolea* (customary leaders). Data were collected through observation, interviews, documentation, and literature review, then analyzed using the Miles and Huberman interactive model consisting of data reduction, display, and conclusion drawing. The findings reveal that Mekongga culture embodies diverse mathematical ideas: set theory in cultural classification and royal genealogies; geometry and proportion in traditional houses; transformational geometry in woven fabrics and decorative motifs; plane geometry and ratio in the *kalo sara* symbol; social arithmetic in *mahar* (dowry) traditions; and alternative numeral systems in historical records. These results confirm that mathematical thought is inherently present within local wisdom and daily life. Theoretically, this study strengthens D'Ambrosio's framework of ethnomathematics by demonstrating how indigenous practices represent mathematical reasoning. Pedagogically, it highlights the potential of Mekongga cultural elements as contextual and meaningful learning resources, bridging abstract mathematical concepts with cultural understanding in mathematics education.

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1. INTRODUCTION

The relationship between mathematics and culture has become an increasingly significant area of inquiry in contemporary educational research. This interdisciplinary field, known as *ethnomathematics*, investigates mathematical ideas and practices that emerge from diverse cultural contexts. The concept was first introduced by Ubiratan D'Ambrosio (1985) in his seminal address at the International Congress on Mathematical Education (ICME) in Adelaide, Australia, emphasizing that mathematics should not be viewed merely as a universal and culture-free discipline, but as a human activity deeply rooted in cultural expressions and practices. Since then, the International Conference on Ethnomathematics (ICEm) has been regularly held every four years, fostering scholarly exchange among researchers worldwide. The most recent ICEm 7, conducted in the Philippines in 2022, further demonstrates the growing global recognition of ethnomathematics as an essential framework for exploring mathematics within human culture.

In the global academic landscape, ethnomathematics serves as an important bridge between cultural heritage and mathematical education. It encourages educators and researchers to identify mathematical structures inherent in cultural artifacts, symbols, and daily practices. By uncovering such relationships, ethnomathematics not only validates the diversity of mathematical thought but also contributes to inclusive and culturally responsive pedagogy. The sustained attention to this field shows that understanding mathematics through cultural perspectives can foster more meaningful learning experiences while simultaneously preserving intangible cultural heritage.

At the national level, Indonesia presents an exceptionally rich context for ethnomathematical exploration. Based on the 2010 census by Statistics Indonesia (BPS), the country is home to approximately 1,340 ethnic groups classified into 31 clusters and speaking around 652 regional languages. This cultural diversity provides a fertile ground for discovering mathematical ideas embedded in traditional practices across the archipelago. However, such vast potential has not been fully explored. Previous ethnomathematical studies in Indonesia have predominantly concentrated on Java Island, while other regions with equally complex cultural systems remain underrepresented in the literature. Systematic exploration of mathematics within local traditions outside Java, therefore, holds great promise both for expanding the geographical scope of ethnomathematics and for enriching mathematics education through cultural integration.

One of the indigenous communities with profound cultural heritage is the Tolaki-Mekongga ethnic group in Southeast Sulawesi. The Mekongga people maintain numerous forms of local wisdom, rituals, and artifacts that have persisted across generations. Among these, the *molulo* dance, a social dance traditionally performed in circular formation—embodies a clear geometric concept that can be linked to the mathematical study of circles and symmetry. Another significant cultural symbol is *kalo sara*, a sacred rattan object shaped as a circle, used in ceremonial events such as weddings and dispute resolutions, symbolizing unity and continuity. In addition, the calculation of dowries (*mahar*) for noble descendants (*anakia*) reflects systematic numerical reasoning, demonstrating the community's implicit engagement with mathematical thought. Further, traditional garments and architectural motifs of the Mekongga people often display repetitive geometric patterns, while historical relics such as the royal tomb of *Sangia Nibandera* in Kolaka Regency may also contain mathematical elements awaiting academic interpretation. These diverse manifestations illustrate that the Mekongga culture encapsulates rich mathematical potential that remains largely undocumented.

A review of existing literature reveals that ethnomathematics research in Indonesia has expanded in scope but remains geographically imbalanced. Numerous works by scholars such as Prahmana have investigated geometric ideas in Yogyakarta batik and bamboo weaving traditions, while others have analyzed mathematical concepts within *wayang kulit* (Javanese shadow puppetry), calendrical systems, and ritual-based measurements. Studies by Abdullah, Lidinillah, Muhtadi, Supriadi, and others have explored Sundanese culture, focusing on symbolic patterns, ornaments, and traditional architecture. Likewise, Purniati and Zuliana have analyzed mathematical symmetries in mosque decorations. Despite this growing body of work, nearly all of these studies originate from Java. A recent Scopus-indexed literature review (March 2025) identified 182 English-language articles on ethnomathematics and 556 related keywords, yet none of them were associated with research from Southeast Sulawesi.

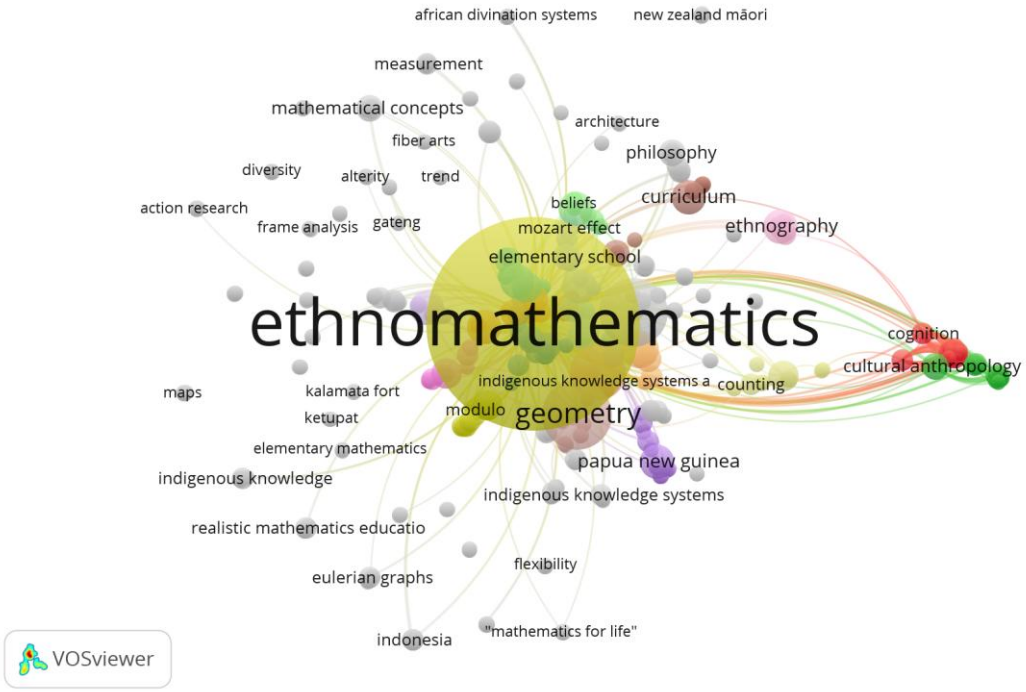

***Figure 1**. Keyword network visualization of ethnomathematics research.*

Although a few studies in other databases, such as Google Scholar and Dimensions, have examined ethnomathematical aspects of the Tolaki culture, very limited attention has been given to the Mekongga people specifically. Most of the existing works focus only on traditional houses, while other cultural forms such as rituals, symbols, and arts remain unexplored.

This evident absence of research indicates a clear *gap* in the ethnomathematics literature. Documenting and analyzing mathematical ideas embedded in the Mekongga cultural heritage not only fills this scholarly void but also contributes to a more balanced representation of Indonesia's cultural diversity in mathematical research. Moreover, identifying these mathematical concepts offers opportunities to integrate local wisdom into mathematics teaching and learning, especially in the Kolaka Regency region. Incorporating ethnomathematical perspectives into classroom instruction can enhance students' *mathematical connection skills*, as learners relate abstract concepts to culturally

familiar contexts. In this regard, the integration of culture and mathematics can make learning more meaningful, contextual, and relevant to students' lived experiences.

Therefore, this study aims to identify and analyze mathematical concepts embedded in the cultural heritage, local wisdom, and traditional practices of the Mekongga ethnic group. Specifically, it explores (1) the types of cultural heritage, historical relics, and local traditions of the Mekongga people, and (2) the mathematical concepts that can be derived from these cultural elements. The findings of this research are expected to contribute theoretically to the development of ethnomathematics in Indonesia and practically to the implementation of culturally responsive mathematics education. Furthermore, this study serves as a pioneering effort to expand ethnomathematical exploration beyond Java Island, highlighting Southeast Sulawesi as a region with untapped potential for interdisciplinary research. Ultimately, this investigation not only preserves local cultural knowledge but also reaffirms the idea that mathematics is a universal human endeavor that transcends cultural boundaries while being deeply shaped by them.

2. METHOD

This study employed a **qualitative approach** with an **exploratory design** and an **ethnographic perspective** to investigate the mathematical concepts embedded in the cultural heritage, local wisdom, and traditional practices of the Mekongga people in Kolaka and East Kolaka Regencies, Southeast Sulawesi. The ethnographic approach was chosen because it allows the researcher to understand mathematical ideas within the social and cultural context of the community through prolonged engagement, participation, and interpretation of symbolic meanings. The exploratory design was particularly relevant since the research aimed not to test hypotheses but to reveal, describe, and interpret mathematical concepts that have not yet been documented.

To ensure methodological coherence, this section is organized into four main parts: (1) research location and participants, (2) data collection techniques, (3) data analysis procedures, and (4) data validity strategies.

2.1 Research Location and Participants

The research was conducted in two main regions—**Kolaka Regency** and **East Kolaka Regency**—which represent the cultural centers of the Tolaki-Mekongga ethnic community. These sites were purposively selected because they contain a concentration of historical artifacts, customary institutions, and cultural events that remain actively practiced today. Fieldwork was carried out between **July and September 2025**, coinciding with several major cultural ceremonies, allowing the researcher to conduct in-depth observations and interviews.

Participants were selected purposively according to their cultural expertise and involvement in traditional practices. The key informants consisted of:

- The Deputy King of Mekongga, who oversees traditional governance and ritual authority;
- Traditional artists engaged in performing arts such as the *molulo* dance; and
- *Tolea*, traditional leaders responsible for conducting wedding ceremonies and other cultural events.

Although three principal informants served as the primary data sources, the researcher also interacted with **community elders, cultural observers, and local educators** for supplementary insights. This broader engagement provided a triangulated understanding of both tangible and intangible elements of Mekongga cultural heritage.

2.2 Data Collection Techniques

Data were collected using multiple and complementary techniques to ensure richness and credibility of information. The process was conducted sequentially in the following stages:

- **Literature Review** – Conducted to examine prior studies, ethnographic reports, and written documentation related to Mekongga culture and ethnomathematics. This stage provided conceptual grounding and initial identification of potential cultural artifacts with mathematical relevance.
- **Direct Observation** – Performed during cultural activities such as the *Molulo* dance performances, wedding rituals, and visits to historical sites including royal tombs and traditional houses. Observations focused on identifying patterns, measurements, and geometric structures observable in these practices.
- **Semi-structured Interviews** – Conducted with key informants to gain deeper insight into the symbolic meanings and mathematical interpretations of cultural forms. The interviews followed a flexible guide that allowed participants to elaborate freely on their experiences.
- **Documentation** – Included photographing, sketching, and describing cultural artifacts such as traditional clothing, ornaments, symbols, and measuring instruments. Documentation served as visual evidence for subsequent analysis.
- **Field Notes** – Throughout the fieldwork, detailed field journals were maintained to record the researcher's reflections, contextual observations, and emergent analytical insights.

To maintain consistency, **interview guidelines and observation sheets** were developed as research instruments. These tools ensured that data collection remained focused and comparable across different events and informants.

2.3 Data Analysis Procedures

Data analysis employed the **interactive model of Miles and Huberman (1994)**, which involves three interrelated stages—**data reduction, data display, and conclusion drawing/verification**.

- **Data Reduction** involved organizing and simplifying field data by identifying relevant patterns from interviews, observations, and documents. Cultural practices were categorized according to their potential mathematical ideas such as geometry, measurement, symmetry, and number patterns.
- **Data Display** included compiling the categorized information into descriptive matrices, diagrams, and narrative summaries. This process facilitated the identification of relationships between cultural representations and mathematical concepts.

- **Conclusion Drawing and Verification** entailed synthesizing the results to identify recurring mathematical structures in Mekongga cultural activities. Verification was achieved through triangulation of data sources and methods, ensuring that interpretations accurately reflected the cultural meanings shared by participants.

In addition, the identified mathematical elements were compared with competencies in the Indonesian mathematics curriculum to explore their potential integration into classroom learning. This comparative analysis was intended to bridge ethnomathematical findings with educational applications.

2.4 Data Validity and Trustworthiness

To ensure data validity, several **trustworthiness strategies** were implemented. These included:

- **Triangulation of data sources and methods**, by cross-verifying findings obtained from observations, interviews, and documentation;
- **Member checking**, whereby key informants reviewed preliminary interpretations to confirm their accuracy;
- **Prolonged engagement**, allowing the researcher to build trust within the community and gain a more authentic understanding of cultural meanings; and
- **Peer debriefing**, involving discussions with fellow researchers and academic supervisors to enhance analytical rigor and minimize researcher bias.

These validation strategies strengthened the credibility, dependability, and confirmability of the findings, ensuring that interpretations were grounded in authentic cultural experiences and not merely the researcher's assumptions.

3. RESULTS AND DISCUSSION

3.1. Results

Based on the exploration of the culture and local wisdom of the Mekongga people, several pieces of information and data were obtained through literature review, direct observation, and interviews.

Literature Review Findings

Differences were found regarding the lineage of kings who have ruled the Mekongga Kingdom, from the first monarch to the current ruler. According to (Jers, 2020) in his exploration of Mekongga folklore, the present king is the 20th ruler. Whereas (Suyuti, 2020) in his study of Mekongga culture, records him as the 27th. Meanwhile, the website https://sultansinindonesieblog.wordpress.com/sulawesi/raja-of-mekongga/ notes that Bokeo Khaerun Dahlan was the 19th king. However, based on the official historical documents of the Kolaka Regional Government and confirmation from an informant who also serves as the Deputy King of Mekongga, Bokeo Khaerun Dahlan is considered the 21st ruler.

The literature review also revealed several folktales preserved within the Mekongga community. Among them are the tales of *Sanggoleo Mbae* (the Rice Goddess), *Koloimba*, *Pasaeno*, *Lapau*, *Konggaaha*, *Lombo-lombo*, *Teporambe*, *Wasitau*, *Nanggomba*, and *Sangia Nibandera*. One of the most famous legends is the story of *Sangia Nibandera* and his conquest of the mythical *Konggaaha* bird.

In addition to royal histories and folktales, various cultural studios, associations, and community groups were identified as still actively engaged in cultural preservation. According to data from the Department of Education and Culture (2020), there are at least 37 active art studios (*sanggar kesenian*) in Kolaka Regency, four of which specialize in *Qasidah Rabbana* performances. Nine studios are part of larger community organizations, while around 28 family or ethnic associations (*paguyuban/kerukunan keluarga*) represent different ethnic groups residing in the Mekongga region.

These art studios teach a variety of traditional arts, one of which is dance. The Mekongga community preserves numerous traditional dances, including *Basolonde*, *Lariangi*, *Moese*, *Dinggu*, *Modelusi*, *Momaani*, *Umoara*, *Mombesara*, and *Lulo*. Among these, *Molulo* is regarded as the most popular, as it is regularly performed at weddings, semi-formal events, and official ceremonies—typically as a closing performance. Other dances are often used as opening performances at formal events. One example is *Mombesara*, a welcoming dance in which performers carry the symbolic *Kalosara* ring.

Figure 2. Welcome dance using kalosara

Traditional dances are always accompanied by music. These performances typically use traditional musical instruments. Examples of traditional instruments used to accompany dances can be seen in the following illustration.

Figure 3. Musical instruments in dance

Observation and Interview Findings

Royal Tombs and Historical Heritage

Figure 4. The tomb of King Sangia Nibandera

Although many kings have ruled the Mekongga Kingdom, only the tomb of the eighteenth monarch, *Sangia Nibandera*, located in Kolaka, has been designated a cultural heritage site. During the period of this research, the nineteenth king, *Bokeo Khairun Dahlan*, passed away on September 11, 2025. As of this writing, no new king has been inaugurated, as the community remains in a mourning period.

Each ethnic group traditionally has its own *rumah adat* (customary house), and the Tolaki-Mekongga people are no exception. The existing Mekongga traditional house is a reconstructed version of the residence once belonging to *Bokeo Latambaga*. Architecturally, the house embodies rich mathematical elements—it features twelve supporting pillars, thirty steps, and four interior chambers, each with measurable geometrical and proportional significance. The Mekongga traditional house is shown in the following figure.

Figure 5. Traditional house of the Mekongga people

Handwoven Textiles

In addition to traditional architecture, traditional clothing was also examined as a cultural artifact with mathematical relevance. In Kolaka Regency, there is a specialized shop named *Mantik Sangia*, which manually produces traditional woven fabrics using a handloom. The shop manufactures a variety of Mekongga textile motifs, though only seven of them have officially received copyright protection. Each motif demonstrates symmetrical patterns, repetitive sequences, and geometric arrangements—elements that reflect mathematical structures in cultural artistry. Examples of these motifs are presented below.

Figure 6. Variety of Mekongga traditional clothing

Kalo Sara

The final cultural object explored in this study is the *Kalo Sara*, a ceremonial symbol central to Tolaki-Mekongga tradition. It represents unity, peace, and marriage. The *Kalo Sara* consists of a circular coil of rattan placed on a rectangular base. Inside the circular rattan ring lies a square piece of white cloth, on top of which betel leaves and areca nuts are arranged. Each geometric component of the *Kalo Sara*—the circle and the square—corresponds to mathematical objects studied in the domain of plane geometry. The structure of the *Kalo Sara* is shown below. The philosophical meanings and mathematical interpretations associated with this cultural symbol will be discussed further in the following section.

Figure 7. Kalosara: Symbol of unity for the Mekongga people

3.2. Discussion

The findings of this study reveal that the cultural elements of the Mekongga people—including traditional houses, woven fabrics, *kalo sara*, traditional dances, and historical heritage, contain rich and diverse mathematical concepts. These results affirm that mathematics is not a detached or purely abstract discipline; rather, it is deeply embedded in daily life and cultural practices. In the ethnomathematical framework proposed by D'Ambrosio (1985), mathematics is understood as a human activity that emerges from cultural needs and everyday problem solving. It reflects how communities manage and make sense of spatial, numerical, and logical structures in their environment. This discussion interprets the results through six thematic lenses, each linking cultural findings with mathematical ideas and their pedagogical implications for culturally grounded mathematics education.

1. Cultural Knowledge and the Concept of Sets

The literature review revealed extensive cultural data, including royal genealogies, folktales, classifications of dances, and registries of art studios and community associations. When analyzed from a mathematical standpoint, these groupings reflect the concept of **sets**—collections of distinct but related objects sharing common characteristics. The classification of kings into a lineage set, folktales into narrative sets, or dance types into performance sets all exemplify how cultural categorization mirrors the logical structure of set theory.

In mathematics education, these cultural groupings can be transformed into tangible examples for teaching **set relations**. For instance, the set of Mekongga kings (A) and the set of Tolaki rulers (B) can be discussed in terms of intersection and union, thereby introducing basic operations in set theory. Prahmana and Istiandaru (2021), in their study of *wayang kulit*, demonstrated that cultural symbols could be used as media for teaching sets and subsets. Similarly, Mekongga's cultural classification can be contextualized in classroom learning, enabling students to relate abstract set concepts to local structures of categorization.

This integration reinforces D'Ambrosio's idea of mathematics as a cultural product. Categorization practices within local societies embody logical reasoning and classification skills, demonstrating that the act of grouping—whether cultural or

mathematical—is a universal human cognitive activity. Consequently, teaching set theory through local examples not only facilitates conceptual understanding but also validates indigenous systems of knowledge organization.

2. Traditional Architecture and Geometric Reasoning

The Mekongga traditional house, characterized by twelve supporting pillars, thirty stair steps, and four main chambers, provides a concrete manifestation of geometric and numerical reasoning. Each architectural element embodies proportional and symmetrical relationships. The twelve pillars can be associated with **cyclic division** analogous to the 12-fold symmetry of a circle, while the 30 steps follow a pattern akin to an **arithmetic sequence**. The four chambers correspond to **quadrilateral partitioning**, providing a real-life representation of spatial subdivision.

Further structural analysis reveals geometric transformations in the ornamentation of walls and ceilings. The repetitive motifs along panels illustrate **reflectional and rotational symmetry**, while the triangular gable structure represents the **concept of congruence and similar triangles**. Counting the planks and measuring spatial ratios can serve as an entry point for problem-based learning in geometry and measurement.

These observations are consistent with Wangsa and Umasugi (2024), who identified similar geometric regularities in traditional architecture as expressions of mathematical thinking embedded in indigenous design. Supriadi (2019) further emphasized that ethnomathematical approaches grounded in local architecture help students comprehend geometric concepts through tangible experiences. By contextualizing geometry within the design of the Mekongga house, teachers can introduce topics such as ratio, area, symmetry, and sequence using culturally meaningful contexts. This integration aligns with the **didactic transposition** model, transforming cultural objects into pedagogical tools that bridge abstract mathematical theory and lived experience.

3. Woven Fabrics and Transformational Geometry

The traditional woven fabrics of the Mekongga people also display an intricate relationship between art and mathematics. The seven officially recognized motifs show **reflective, rotational, and translational symmetries**, illustrating the principles of **geometric transformations**. Each motif is systematically constructed through repeated weaving sequences, which involve spatial prediction, proportional scaling, and recursive patterning—core components of mathematical reasoning.

These characteristics resonate with Maryati and Prahmana's (2019) findings on Muntuk weaving patterns, which serve as tangible representations of symmetry and repetition. Similarly, Hidayati, Haidar, and Marillah (2025) demonstrated that Mekongga *tabere* motifs embody complex geometric transformation principles, making them valuable for mathematics instruction. When viewed through an educational lens, these fabrics can be used to teach **reflection, rotation, translation, and tessellation**.

For example, teachers might guide students to identify axes of symmetry or to calculate the angle of rotation that maps a motif onto itself. Such activities transform cultural artifacts into **learning resources for spatial visualization**. Furthermore, the process of weaving itself illustrates mathematical sequencing and algorithmic thinking—each thread movement following a precise, repeatable order similar to procedural reasoning in mathematics.

In this sense, the woven fabric not only preserves cultural identity but also acts as a pedagogical bridge linking artistry, logic, and mathematics. As emphasized by

Prahmana et al. (2017), ethnomathematics-based instruction strengthens not only conceptual comprehension but also cultural appreciation, promoting culturally responsive mathematics learning.

4. Symbolic Representation in Kalo Sara: Plane Geometry and Arithmetic Meaning

The *kalo sara*, a sacred ceremonial object symbolizing unity, offers a powerful example of how geometry and social symbolism intersect. Structurally, it consists of a **circular rattan coil**, a **rectangular base**, and a **square white cloth** positioned at the center. These shapes correspond to fundamental two-dimensional figures: the circle, square, and rectangle. Their spatial arrangement exemplifies geometric relationships such as **a circle inscribed in a square**, or conversely, **a square inscribed within a circle**—concepts that can be discussed using properties of area, radius, and proportion.

Mathematically, the circular rattan—coiled three times and tied into a single knot—demonstrates repetition and rotational symmetry. Culturally, these three coils represent the interrelation of people, government, and customary authority, while the knot signifies unity among these social institutions. The symbolic hierarchy between the higher and lower ends of the rattan embodies proportional relationships, mirroring how mathematical proportion reflects hierarchical balance in form.

Beyond geometric form, *kalo sara* ceremonies include the offering of dowries (*mahar*) denominated in **rial**, representing social arithmetic and currency conversion. The customary distinction—88 rial for nobles and 44 for commoners—illustrates a simple **ratio of 2:1**, an authentic example of mathematical proportionality grounded in cultural values. This aligns with the concept of *ethno-arithmetic*, where quantitative reasoning emerges naturally from social practices.

These findings echo Abdullah's (2017) research on Sundanese artifacts, which identified mathematical and symbolic values intertwined within cultural objects. The Mekongga *kalo sara* functions similarly: the circle symbolizes perfection and continuity, the square stability and justice, and their integration reflects the harmony of mathematical and moral order. From a pedagogical standpoint, this artifact provides opportunities to teach **plane geometry, ratio, and proportional reasoning**, while also fostering cultural awareness and ethical reflection.

5. Traditional Dance, Music, and the Mathematics of Motion

The *molulo* dance of the Mekongga people exemplifies mathematics through bodily movement and spatial organization. Typically performed in a circular formation, the dance represents the **equal division of a circle into central angles**. When twelve dancers form the circle, each occupies a position separated by **30°**, thereby embodying the mathematical concepts of central angles, arc length, and angular measurement. The rhythmic alternation between steps reflects a **cyclic pattern** analogous to modular arithmetic, where repetition occurs after a fixed interval.

This integration of rhythm and symmetry parallels Sirate's (2011) findings among the Tolaki people, who associated traditional movement patterns with geometric reasoning. The *molulo* dance thus serves as an applied model for teaching angular measurement, rotation, and periodicity. Moreover, the accompanying musical instruments—such as drums and gongs—represent **three-dimensional solids** (cylinders and hemispheres). These forms can be analyzed using **solid geometry and volume formulas**, transforming everyday cultural objects into learning aids for abstract concepts.

The rhythmic sequence of drum and gong beats further reflects **arithmetic and geometric progressions**, offering an authentic example of temporal patterning. As noted by Muhtadi et al. (2017), rhythmic estimation and measurement within traditional music are integral components of mathematical cognition. Therefore, the *molulo* dance and its musical accompaniment demonstrate that **mathematical structures exist not only in objects but also in movements, rhythms, and social coordination**, reinforcing D'Ambrosio's assertion that ethnomathematics encompasses all forms of human mathematical practice.

6. Historical Heritage and Number Systems

The historical documentation of Mekongga kings employs **Roman numerals**, offering an entry point for discussing alternative **numeral systems** and cross-cultural representations of numbers. Students can compare these with Arabic numerals and indigenous systems, thereby understanding the diversity of mathematical expression. Ramadhani, Kadir, and Prajono (2020) similarly found that Tolaki textiles contained numerical motifs illustrating pattern recognition and symbol-based counting.

Integrating such numeral systems into learning activities can expand students' conceptual horizon beyond the conventional base-10 notation, demonstrating that numeric representation is a cultural construct. This aligns with Lidinillah et al. (2022), who emphasized that embedding ethnomathematics in the curriculum increases motivation and contextual comprehension. Likewise, Brandt and Chernoff (2015) asserted that ethnomathematics promotes meaningful learning by connecting mathematical structures to social contexts.

Purniati et al. (2022) and Zuliana et al. (2023) identified similar geometric and numerical patterns in mosque ornaments, reinforcing the universality of cultural mathematics. These comparative findings suggest that every community, including the Mekongga, contributes unique representations of mathematical ideas. Through such integration, students can appreciate mathematics not as a foreign abstraction but as a reflection of human creativity and cultural identity.

7. Theoretical and Pedagogical Implications

Collectively, the above findings provide empirical evidence for **D'Ambrosio's (1985)** foundational thesis that mathematics is a product of human culture rather than an independent, culture-free system. The Mekongga people's cultural artifacts, movements, and rituals embody mathematical reasoning manifested in tangible and symbolic forms. From a theoretical standpoint, this supports the argument that **ethnomathematics is both descriptive and transformative**: it describes the mathematical practices embedded in cultural life while transforming them into educational resources that bridge traditional knowledge and formal learning.

Pedagogically, the integration of Mekongga cultural elements offers several advantages. First, it fosters **contextual understanding**—students learn mathematical concepts through familiar environments, reducing cognitive distance between theory and experience. Second, it promotes **cultural identity and pride**, aligning with the goals of culturally responsive education. Third, it enhances **mathematical connection skills**, as emphasized by Hidayati and Jahring (2021), by allowing students to relate diverse representations of mathematics—numerical, spatial, and rhythmic—within coherent cultural narratives.

To operationalize these benefits, educators can design **learning trajectories** (Risdiyanti & Prahmana, 2021) that incorporate Mekongga cultural artifacts into lesson plans. For example:

- Using the architecture of traditional houses to explore proportion and scale;
- Employing woven motifs to study symmetry and transformation;
- Interpreting *kalo sara* to discuss ratio, circle–square relationships, and social arithmetic;
- Analyzing dance movements and musical rhythms to learn periodic functions and angular measurement.

Such applications transform ethnomathematical insights into **concrete pedagogical strategies**, enriching both curriculum content and teaching methodology. They also align with UNESCO's vision for integrating intangible cultural heritage into education, thereby advancing both mathematical literacy and cultural sustainability.

8. Integrative Synthesis

Overall, the exploration of Mekongga culture demonstrates that mathematical reasoning permeates every aspect of daily life—manifested in architecture, art, ritual, and performance. The study contributes to expanding the geographical and conceptual scope of ethnomathematics research in Indonesia, particularly in regions outside Java that remain underrepresented in academic discourse.

From an analytical perspective, each cultural element embodies one or more mathematical dimensions:

- **Set structures** in cultural classification,
- **Geometric symmetry** in architecture and weaving,
- **Arithmetic progression** in structural and rhythmic sequences,
- **Ratio and proportion** in ceremonial artifacts, and
- **Alternative numeral systems** in historical inscriptions.

The convergence of these mathematical ideas within cultural expressions validates the premise that mathematics is a living, dynamic human activity, evolving from collective experience and social organization. This insight transforms ethnomathematics from a descriptive study of cultural practices into a **philosophical and pedagogical framework** for reconstructing mathematics education—one that honors cultural diversity while nurturing analytical thinking.

In conclusion, the discussion affirms that the ethnomathematical knowledge of the Mekongga people provides not only evidence of inherent mathematical thought but also a foundation for educational innovation. Integrating these cultural forms into mathematics teaching will help students perceive mathematics as meaningful, contextual, and human-centered—bridging the gap between cultural identity and scientific reasoning. Through such integration, mathematics education can serve both as a tool for cognitive development and as a means of preserving Indonesia's rich cultural heritage.

CONCLUTION

This study identified and described various mathematical concepts embedded within the cultural practices of the Mekongga people in Kolaka and East Kolaka Regencies, Southeast Sulawesi. The exploration revealed that mathematics is inherently present in traditional life and expressed through art, architecture, social customs, and symbolic systems. These findings confirm that mathematics, as conceptualized in ethnomathematics, is a human activity shaped by cultural experience and local wisdom.

Several cultural elements were found to embody mathematical reasoning. The classification of royal genealogies, folktales, and art associations reflects concepts of **set theory and categorization**. The architectural features of the Mekongga traditional house illustrate **geometry, proportion, and spatial symmetry**, while the repetitive motifs of woven fabrics represent **transformational geometry**, including reflection, rotation, and translation. The *kalo sara* ceremonial symbol integrates **plane geometry and ratio**, demonstrating relationships between circles and squares, while the *mahar* (dowry) tradition reflects **social arithmetic** and proportional reasoning. In addition, the use of **Roman numerals** in historical records highlights the diversity of **number systems and symbolic representation**.

Theoretically, these results reinforce D'Ambrosio's view that mathematics arises from cultural practices and human creativity. Pedagogically, they provide authentic and meaningful contexts for mathematics learning. Each cultural form offers a potential entry point for integrating ethnomathematics into the classroom—helping students connect abstract ideas to real-life experience while fostering cultural pride and identity. Such integration aligns with contemporary approaches to culturally responsive and contextual mathematics education.

It is recommended that future research develop and test learning materials based on Mekongga cultural elements to evaluate their effectiveness in enhancing students' conceptual understanding and engagement. Collaboration among educators, cultural experts, and curriculum developers will be essential to ensure the accuracy and pedagogical soundness of such materials.

In summary, the mathematical ideas embedded in Mekongga culture illustrate the inseparability of knowledge, tradition, and human thought. Recognizing these relationships not only preserves cultural heritage but also enriches mathematics education—bridging the gap between abstract reasoning and cultural experience, and affirming that mathematics is both universal and profoundly human.

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