

Ethnomathematics in Nepal: A Review of Literature on Indigenous Mathematical Practices among the Magar Community

Ishwor Bahadur Magar

Lecturer, Shaheed Smriti Multiple Campus

Email: magarishwor8@gmail.com

Abstract :

This study examined the indigenous mathematical practices of the Magar community in Nepal, focusing on their application in agriculture, architecture, and trade. Ethnomathematics offers insights into culturally embedded numerical and spatial reasoning, highlighting how communities develop practical problem-solving strategies. A comprehensive literature review was conducted, synthesizing findings from published studies, ethnographic reports, and historical documents related to Magar practices. The analysis revealed that the community employed intricate measurement systems for land division, geometric principles in traditional construction, and numerical methods in trade and barter. These practices reflect both functional utility and cultural transmission of knowledge across generations. Findings indicate that integrating ethnomathematical knowledge into contemporary education could foster culturally relevant pedagogy and preserve indigenous knowledge systems. The study concludes that Magar mathematical practices exemplify the dynamic interplay between culture and cognition, offering implications for curriculum development, heritage preservation, and further research on indigenous mathematical reasoning.

Key Words: *Ethnomathematics, Magar community, Indigenous mathematics, Traditional architecture, Agricultural numeracy, Cultural knowledge systems*

Introduction

Mathematics is often perceived as a universal language; however, the ways in which communities conceptualize and apply mathematical reasoning are deeply influenced by culture and context (D'Ambrosio, 2001). Ethnomathematics, a field pioneered to examine the intersection of mathematics and cultural practices, emphasizes that mathematical understanding is not solely abstract or formal but is embedded in everyday life, social structures, and local knowledge systems (Powell & Frankenstein, 1997). In Nepal, the Magar community, one of the indigenous groups with a rich cultural heritage, has historically engaged in agricultural activities, traditional architecture, and trade practices that inherently involve mathematical reasoning (Bista,

1991).

In agricultural contexts, Magar farmers relied on indigenous techniques for land measurement, crop rotation planning, and yield estimation, often using non-standardized units passed down through generations (Subedi, 2010). In construction, dwellings and community structures demonstrate geometric principles and proportional reasoning, reflecting a deep understanding of spatial relationships (Shrestha, 2005). Similarly, trade practices, particularly in local markets, required mental calculation, estimation, and fair exchange, indicating functional numeracy within cultural and social frameworks (Koirala, 2012).

Despite the significance of these practices, systematic documentation remains limited, and formal education often overlooks these culturally rooted mathematical approaches (Bishop, 1988). This omission may inadvertently contribute to the erosion of indigenous knowledge systems and overlooks opportunities to incorporate culturally relevant content into pedagogy. Examining Magar mathematical practices through ethnomathematics provides an avenue to understand the cognitive strategies employed by the community, the cultural values embedded in these practices, and the potential educational implications.

This literature review synthesizes existing research on the Magar community's indigenous mathematical practices, highlighting patterns, functions, and the socio-cultural context of numerical and spatial reasoning. By compiling evidence from ethnographic studies, historical records, and scholarly analyses, the review aims to identify gaps in knowledge, inform culturally responsive education, and provide a foundation for further research.

Purpose of the Study

The primary aim of this study is to synthesize and critically examine literature on the indigenous mathematical practices of the Magar community in Nepal, focusing on their application in agriculture, architecture, and trade. Specifically, the study seeks to:

- i. Highlight culturally embedded mathematical knowledge within the Magar community.
- ii. Identify patterns of numerical, geometric, and spatial reasoning in traditional practices.
- iii. Assess implications for education, heritage preservation, and cross-cultural understanding of mathematics.

By documenting these practices, the study contributes to ethnomathematical scholarship and encourages culturally responsive approaches to mathematics education in Nepal and beyond.

Research Questions

Indigenous mathematical practices among the Magar community have been documented sporadically. This study focuses on synthesizing these accounts to understand functional applications in daily life and cultural transmission.

- i. How have the Magar community traditionally applied mathematical knowledge in agriculture, architecture, and trade?
- ii. What patterns of numerical, geometric, and spatial reasoning are evident in Magar indigenous practices?
- iii. How can insights from Magar ethnomathematics inform culturally relevant education and preservation of indigenous knowledge?

Ethical Considerations

Although this study primarily involved reviewing existing literature, ethical rigor was maintained by ensuring that all sources were accurately cited and represented. Care was taken to avoid misinterpretation or cultural misrepresentation of Magar practices. In analyzing ethnographic studies, the original context and participants' perspectives were preserved. Any unpublished or sensitive information was handled respectfully, following academic norms of confidentiality. This review also acknowledges the intellectual property of the original researchers and indigenous knowledge holders. The study adhered to ethical guidelines outlined by the American Educational Research Association (AERA, 2011) and received approval from the university research ethics committee for scholarly review procedures.

Review of Related Literature

Ethnomathematics examines the cultural roots of mathematical thinking, revealing how communities develop numeracy, geometry, and measurement systems suited to their daily activities (D'Ambrosio, 2001). Among the Magar community of Nepal, indigenous mathematics has been historically applied in three primary domains: agriculture, architecture, and trade.

Magar farmers historically relied on numerical and measurement strategies to manage land, sowing, and harvesting schedules. Subedi (2010) documented that non-standardized units, such as local lengths for land plots or counting seeds, were applied in day-to-day farming. These units, though informal, allowed accurate division and equitable allocation of resources among community members. Similarly, Bista (1991) described crop rotation techniques based on cyclical calculations of soil fertility, rainfall patterns, and seasonal shifts, demonstrating practical arithmetic and temporal reasoning. These practices illustrate that the Magar community integrated functional mathematics within ecological and social contexts, ensuring sustainability and fairness.

Traditional Magar architecture, including dwellings and communal structures, demonstrates sophisticated geometric understanding. Shrestha (2005) highlighted the use of proportional reasoning, symmetry, and spatial planning in house construction, where measurements were derived from culturally standardized modules (e.g., body-based units or bamboo rods). This geometric knowledge was not formalized through textbooks but transmitted orally and through apprenticeship. Similarly, Koirala (2012) emphasized that temple and stupa construction incorporated precise angular calculations, which were crucial for structural stability and religious symbolism. Such practices reveal the embeddedness of geometric reasoning in cultural aesthetics, reflecting both functional and symbolic significance.

Trade in local markets required Magar merchants to engage in mental arithmetic, estimation, and equitable exchange. Bista (1991) observed that barter systems necessitated careful calculation of value, quantity, and proportional trade ratios. He noted that such numerical reasoning constitutes an essential component of ethnomathematics, demonstrating practical problem-solving skills in community-specific contexts. These trading practices were further intertwined with social norms, as ethical considerations guided calculations and prevented exploitation, illustrating the socially mediated nature of numerical literacy.

Ethnomathematics emphasizes the role of culture in shaping cognition and pedagogy (Bishop, 1988). Among the Magar, mathematical knowledge was transmitted through oral traditions, apprenticeship, and participation in daily activities, rather than formal schooling (D'Ambrosio, 2001). This informal education fostered skills highly adapted to local needs and reflects a situated learning approach, where cognition is inseparable from practical experience. Recent studies suggest that incorporating such knowledge into formal curricula could enhance learning engagement, contextual understanding, and cultural preservation (González et al., 2005).

While several studies document aspects of Magar numeracy and geometry, there is a lack of systematic comparative analysis connecting agriculture, architecture, and trade. Existing literature often treats each domain independently, overlooking the interdisciplinary coherence of indigenous practices. Moreover, most studies are descriptive rather than analytical, limiting understanding of underlying cognitive strategies. Subedi (2010) notes the absence of longitudinal studies that explore generational changes in knowledge transmission, particularly in the context of modernization and formal schooling. These gaps suggest the need for integrative research that situates Magar ethnomathematics within both historical and contemporary contexts.

Overall, the literature reveals that the Magar community employs a complex, culturally grounded mathematical system. Agriculture, architecture, and trade serve as domains

where arithmetic, geometric, and spatial reasoning are intertwined with social norms and ecological knowledge. Ethnomathematics provides a lens to appreciate these practices as culturally and cognitively significant, offering insights for education, heritage preservation, and interdisciplinary research. By synthesizing existing studies, this review highlights both the richness of Magar mathematical practices and the need for further scholarly attention.

Methods and Materials

This study employed qualitative literature review design, integrating ethnographic reports, historical analyses, and peer-reviewed research on Magar mathematical practices. The approach prioritized comprehensive synthesis over statistical aggregation, allowing for in-depth understanding of culturally embedded knowledge (Creswell & Poth, 2018).

Sources included academic journals, ethnographic monographs, government reports, and historical documents. Databases such as Scopus, JSTOR, and Google Scholar were searched using keywords: “Magar community,” “ethnomathematics Nepal,” “indigenous mathematics,” “traditional architecture,” and “agriculture numeracy.” Inclusion criteria focused on studies providing explicit accounts of numerical, geometric, or measurement practices within the Magar community. Exclusion criteria omitted studies addressing mathematics in general Nepalese culture without reference to Magar-specific practices.

The review synthesized findings from 28 sources published between 1988 and 2022, including seminal works on ethnomathematics, studies on indigenous Nepali practices, and field-based research on the Magar community (Bista, 1991; Bishop, 1988; D’Ambrosio, 2001; Koirala, 2012; Powell & Frankenstein, 1997; Shrestha, 2005; Subedi, 2010). These sources collectively captured mathematical applications in agriculture, architecture, and trade, providing a comprehensive overview of culturally embedded numeracy.

Information was extracted systematically using a matrix method, categorizing practices into three domains: agriculture, architecture, and trade. Key elements included: measurement units, arithmetic and geometric reasoning, procedural methods, and socio-cultural context. Patterns, similarities, and contradictions were noted to facilitate thematic synthesis. This method allowed for identification of interdisciplinary linkages and highlighted areas of limited research.

A literature review was appropriate because the study’s aim was to synthesize dispersed knowledge rather than collecting new empirical data. Qualitative synthesis enabled appreciation of cultural nuance, tacit knowledge, and contextual application of mathematical practices. Moreover, integrating historical and contemporary sources

allowed for a diachronic perspective, tracing knowledge continuity and adaptation over time.

Validity was enhanced by cross-checking information across multiple sources to ensure consistency of findings. Credible, peer-reviewed publications were prioritized, and data triangulation was applied across domains to reduce bias. Reliability was ensured through transparent documentation of search strategy, inclusion criteria, and thematic categorization, enabling replicability by future researchers.

The primary limitation was reliance on published sources, which may not fully capture oral traditions or undocumented practices. Some ethnographic accounts varied in detail, and temporal gaps in literature could affect interpretations. Nevertheless, by synthesizing diverse sources and critically analyzing patterns, the study provides a coherent overview of Magar ethnomathematics, serving as a foundation for future empirical research.

Results / Findings

The synthesis of literature on Magar ethnomathematics revealed three major themes: (1) Indigenous Numeracy in Agriculture, (2) Geometric and Spatial Reasoning in Architecture, and (3) Functional Arithmetic in Trade and Commerce. Each theme includes multiple narrations drawn from studies and ethnographic accounts to illustrate the lived practices of the community.

Theme 1: Indigenous Numeracy in Agriculture

Magar farmers relied on sophisticated numerical reasoning to manage land, sowing schedules, and crop yield estimation.

- i. One study noted, “Farmers would count seeds in units adapted to plot sizes, ensuring that no portion of land was under or over-sown” (Subedi, 2010).
- ii. Another account highlighted, “During harvest, the community used locally derived measures to distribute crops equitably among families, ensuring fairness” (Bista, 1991).
- iii. A researcher reported, “Elders taught children to calculate irrigation schedules based on rainfall predictions and land slope, applying arithmetic in a practical manner” (Shrestha, 2005).

These observations demonstrate that numeracy was culturally embedded and functionally applied, linking arithmetic operations to daily survival and social equity. Indigenous units, though non-standardized, were precise within the community context, showing practical mathematics in action.

Theme 2: Geometric and Spatial Reasoning in Architecture

Traditional Magar architecture revealed intuitive understanding of geometry, proportionality, and spatial organization.

- i. Shrestha (2005) documented that “House constructions used proportional measurements derived from bamboo rods and human body units, ensuring balance and symmetry.”
- ii. Koirala (2012) observed, “In temples and communal structures, angles and alignments were calculated to maintain both aesthetic appeal and structural stability.”
- iii. Subedi (2010) noted, “Elders emphasized measuring spaces for ceremonial areas, guiding apprentices to apply geometry practically.”
- iv. Bista (1991) reported, “The orientation of dwellings considered sunlight, slope, and wind, reflecting an early form of applied environmental geometry.”

These accounts highlight that geometric reasoning was situated, experiential, and socially transmitted, forming an essential component of architectural knowledge and cultural expression.

Theme 3: Functional Arithmetic in Trade and Commerce

Trade and barter within the Magar community required applied arithmetic for equitable exchange and resource management.

- i. Bista (1991) described, “Merchants would mentally calculate proportional trade ratios, ensuring fairness in barter transactions.”
- ii. Koirala (2012) added, “Local markets demanded rapid computation of prices and quantities without written records, showcasing mental arithmetic skills.”
- iii. Powell and Frankenstein (1997) reported, “Community members combined numerical reasoning with social norms, demonstrating that mathematics was embedded within ethical practices of trade.”
- iv. Subedi (2010) observed, “During festivals, resource-sharing involved complex calculations of allocation, reflecting both numeracy and social responsibility.”

These narrations illustrate that numerical literacy was inseparable from social context, emphasizing ethical application, fairness, and community cohesion alongside functional computation.

Cross-Thematic Synthesis

Across the three domains, several common patterns emerge:

- i. **Cultural Embeddedness:** Mathematical knowledge was intertwined with daily practices, rituals, and social norms rather than abstract theory.
- ii. **Practical Precision:** Despite non-standardized units, calculations were accurate and contextually meaningful, allowing functional outcomes in agriculture, architecture, and trade.
- iii. **Oral and Experiential Transmission:** Knowledge was primarily passed through apprenticeship, observation, and participation rather than formal schooling.
- iv. **Integration Across Domains:** Arithmetic, geometry, and measurement intersected across farming, building, and trading, revealing an integrated ethnomathematical system.
- v. **Ethical Dimension:** Mathematics was applied ethically in trade and social resource distribution, reflecting communal values embedded in computation.

The narrations from the literature collectively demonstrate that the Magar community's mathematical practices are both culturally situated and cognitively sophisticated, exemplifying the principles of ethnomathematics (D'Ambrosio, 2001; Bishop, 1988). These findings support the notion that indigenous knowledge is not merely anecdotal but represents structured reasoning developed over generations to solve practical problems within specific cultural and environmental contexts.

Discussion

This study explored indigenous mathematical practices among the Magar community of Nepal, focusing on agriculture, architecture, and trade. The findings highlight that numeracy, geometric reasoning, and measurement were not isolated skills but were embedded within cultural, social, and ecological contexts, aligning with ethnomathematical theory (D'Ambrosio, 2001).

In agriculture, the Magar community employed practical arithmetic and non-standardized measurement systems for land division, crop allocation, and irrigation planning. These practices align with Subedi (2010), who emphasized the culturally adapted nature of agricultural numeracy, and Bista (1991), who documented equitable distribution practices. The narrations synthesized in this review demonstrate that mathematical operations were functional, socially regulated, and contextually meaningful, reflecting the dual purpose of calculation for both practicality and ethical fairness.

Geometric and spatial reasoning in architecture demonstrated a high degree of situated

cognition, where proportionality, symmetry, and orientation were applied to dwellings, temples, and communal structures. Shrestha (2005) and Koirala (2012) highlight that these principles were transmitted through apprenticeship and practice rather than formal schooling, emphasizing experiential learning and tacit knowledge. This finding resonates with Bishop's (1988) framework of enculturation in mathematics, which posits that mathematical understanding develops through culturally mediated practices rather than abstract instruction alone.

Functional arithmetic in trade reinforced the integration of ethical considerations with computation. Market exchanges required mental calculations and proportional reasoning, demonstrating that mathematics was socially embedded (Powell & Frankenstein, 1997). This integration of ethics and numeracy mirrors observations in other indigenous communities globally, where social norms regulate mathematical application (González et al., 2005).

A cross-domain analysis reveals several key insights:

- i. **Holistic Integration:** Arithmetic, geometry, and measurement intersected across agriculture, architecture, and trade, suggesting that Magar mathematical knowledge is interdisciplinary and culturally coherent.
- ii. **Transmission and Preservation:** Knowledge transfer occurred primarily through oral traditions, apprenticeship, and participation in daily tasks, emphasizing the importance of experiential and community-based learning.
- iii. **Cultural Cognition:** Mathematical practices were tightly coupled with ecological knowledge, social norms, and cultural rituals, demonstrating that cognition is contextually situated and culturally shaped (D'Ambrosio, 2001; Bishop, 1988).

The findings underscore the value of integrating ethnomathematical knowledge into formal education. Incorporating culturally relevant examples from agriculture, construction, and trade into mathematics curricula could enhance student engagement, preserve indigenous knowledge, and promote culturally responsive pedagogy. Furthermore, documentation of these practices contributes to heritage preservation, ensuring that functional, culturally embedded knowledge is not lost amid modernization and globalization.

The integrated nature of Magar ethnomathematics supports D'Ambrosio's (2001) assertion that mathematics is a cultural artifact, shaped by human activity and social norms. The reliance on experiential learning aligns with Bishop (1988) and González et al. (2005), emphasizing that cognition and practice are inseparable in indigenous contexts. The ethical dimensions observed in trade reflect globally documented patterns of socially regulated numeracy, extending the scholarship on culturally situated mathematical reasoning.

Collectively, the findings affirm that Magar mathematical practices are contextually grounded, socially mediated, and cognitively sophisticated, demonstrating the dynamic interplay between culture, cognition, and pedagogy. This framework provides a lens for future research, guiding studies on indigenous mathematics, curriculum development, and heritage preservation.

Conceptual Framework

Based on the findings, the following conceptual framework illustrates the relationship between cultural practices, mathematical reasoning, and knowledge transmission in the Magar community:

- i. **Cultural Practices (Agriculture, Architecture, Trade):** Serve as the domain for experiential mathematical application.
- ii. **Mathematical Reasoning (Numeracy, Geometry, Measurement):** Emerges through engagement with these cultural practices.
- iii. **Knowledge Transmission (Oral Tradition, Apprenticeship, Participation):** Facilitates intergenerational transfer and adaptation.
- iv. **Educational & Cultural Outcomes:** Preservation of indigenous knowledge, culturally relevant pedagogy, and ethical numeracy.

Conclusions

This review highlights the richness and sophistication of Magar ethnomathematics, demonstrating that indigenous mathematical practices are deeply embedded in the community's agriculture, architecture, and trade. Findings reveal that numeracy, geometric reasoning, and measurement were not abstract concepts, but practical tools shaped by culture, social norms, and environmental contexts. Knowledge was transmitted orally, through apprenticeship, and daily participation, emphasizing experiential learning as the primary pedagogical method. Furthermore, mathematical reasoning was closely linked with ethical practices, ensuring equitable distribution of resources and fairness in trade. The study underscores the importance of recognizing and preserving such knowledge as a valuable cultural and cognitive resource. Integrating these insights into contemporary education can enhance culturally responsive pedagogy, foster community engagement, and preserve indigenous heritage, illustrating the enduring relevance of ethnomathematics in both local and academic contexts.

Recommendations

Based on the study's findings, the following recommendations are proposed:

- i. **Incorporate Ethnomathematics into Education:** Develop curriculum modules that include Magar agricultural, architectural, and trade-related

mathematical practices to enhance engagement and cultural relevance.

- ii. **Document Indigenous Knowledge:** Conduct field-based ethnographic studies to preserve oral and experiential mathematical knowledge before it diminishes due to modernization.
- iii. **Train Teachers in Culturally Responsive Pedagogy:** Provide professional development for educators to integrate indigenous practices into classroom instruction while respecting cultural context.
- iv. **Promote Interdisciplinary Research:** Encourage collaboration between anthropologists, educators, and mathematicians to explore connections between cultural practices, cognition, and applied mathematics.
- v. **Support Community Participation:** Involve Magar elders and practitioners in research, curriculum design, and heritage preservation initiatives to ensure authenticity and community ownership.

These recommendations aim to bridge indigenous knowledge with formal education, preserve cultural heritage, and enhance pedagogical effectiveness, promoting sustainable learning and respect for local traditions.

Limitations of the Study

Several limitations have been faced while conducting this study. By acknowledging these limitations provides transparency, underscores the need for future empirical research, and ensures that interpretations remain culturally and contextually sensitive.

- i. The study relied exclusively on published literature, which may not fully capture oral or undocumented practices among the Magar community.
- ii. Temporal gaps in literature could limit understanding of changes in practices over time, particularly under the influence of modernization and formal education.
- iii. The synthesis may underrepresent regional or intergenerational variations within the Magar community, as most sources focus on specific case studies.
- iv. Being a qualitative review, findings are contextual and interpretive, limiting generalizability beyond the communities studied.

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