



Research article

## Integrating Ethnomathematics in Indian Classrooms: Strengthening Conceptual Understanding through Cultural Relevance

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### Abstract

Ethnomathematics is an important subject in education, particularly in a heterogeneous nation like India. Students in Indian classrooms come from a wide range of ethnic backgrounds. By connecting mathematical ideas to students' everyday experiences and cultural contexts, the curriculum can be improved through the incorporation of ethnomathematics. This method not only acknowledges the mathematical methods present in other cultures but also makes learning more relevant. The current demands of Indian classrooms emphasize the necessity of engaging students and fostering their mathematical and conceptual understanding within cultural contexts. This need arises from a significant learning deficit in the education system, where, despite high Enrollment rates, many students struggle with basic literacy and numeracy skills. While curriculum development and teacher preparation present some substantial obstacles to the development of mathematical, conceptual understanding through an ethnomathematical approach, there are also many chances to boost student engagement and enthusiasm in mathematics. In this study, the researcher has four aims. The first aim is to learn about the research status of ethnomathematics in India. The second aim is to determine the technique for developing mathematical and conceptual understanding among students. The third aim is to understand the challenges that are associated with implementing ethnomathematics in the classroom, and the final aim is to identify the potential for improving ethnomathematics in the classroom.

### Keywords:

Ethnomathematics,  
Indian schools,  
Mathematical conceptual  
understanding, cultural  
practices

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## Introduction

India offers a distinctive educational environment shaped by its diverse populations and traditions, given its vast size and rich cultural diversity. The nation of more than 1.4 billion people is home to a diverse array of ethnic groups, dialects, and customs, all of which contribute to the cultural richness of India's classrooms (Government of India, 2021). This cultural diversity is reflected in the educational system of a democratic country like India, where students from diverse backgrounds, including gender, social, cultural, ethnic, and linguistic origins, are frequently present in the classroom (NCERT, 2020). The challenge for educators is to address this variety and foster an inclusive learning environment simultaneously. According to research, the use of culturally sensitive teaching strategies can significantly enhance outcomes for learning and engagement among pupils. (Gay, 2006) Instructors are encouraged to adapt their teaching strategies to accommodate diverse learning styles and incorporate culturally relevant topics into their curricula, thereby improving students' respect and understanding. (Ladson-Billings, 1994)

Ethnomathematics has become a prominent trend in mathematics classrooms in India, given the country's diversified educational landscape. The word 'ethnomathematics,' which was first used in 1977 during a lecture in the United States by Brazilian educator Ubiratan D'Ambrosio, describes the mathematical practices, applications, and knowledge that naturally develop within specific cultural and social settings (D'Ambrosio, 1985). This viewpoint emphasizes that mathematics is a human endeavor that evolves within a specific cultural context rather than merely a collection of abstract principles. According to D'Ambrosio (1985), a traditional educational system that frequently ignores the cultural relevance of mathematical concepts is the reason why many students struggle with mathematics. He pointed out that the way ancient mathematical methods are repackaged in this system can expropriate them and cause pupils to become disenfranchised from their cultural identities. An inclusive and stimulating learning environment can be created by educators by acknowledging and incorporating ethnomathematical practices within the curriculum. To help students connect with mathematics more deeply, ethnomathematics studies how cultural traditions influence mathematical ideas and procedures. For example, integrating traditional patterns, community-based problem-solving, and local counting systems can help make mathematics more accessible and applicable to students from diverse backgrounds (Bishop, 1988). This method fosters a deeper understanding of mathematical concepts while also validating students' ethnic identities. India is a country with immense cultural diversity, with each region having its unique customs, traditions, and practices. This diversity stems from India's long history, spanning thousands of years, and the influence of various civilizations and religions that have shaped the country's cultural landscape.

The Indian education system is systematically structured, facilitating a seamless transition from early childhood to higher education. Below is a breakdown of its various stages.

### 1. Compulsory Education (Ages 6–14)

This phase includes several foundational levels: Foundational Stage (Ages 3 to 8):

- **Preschool/Anganwadi (Ages 3-4):** Focuses on holistic development through play and social interaction (NCPCR, 2019).
- **Kindergarten (Ages 4-6):** Prepares children for formal education, emphasizing essential skills (NCTE, 2014).

- Grades 1-2 (Ages 6-8): Introduces basic literacy and numeracy, laying the groundwork for future learning.

#### Preparatory Stage (Ages 8–11):

- Grades 3-5: Concentrates on critical thinking and problem-solving alongside fundamental knowledge across subjects (NCERT, 2020).

#### Middle Stage (Ages 11–14):

- Grades 6-8: Offers a broader curriculum that includes subjects such as science, mathematics, and social studies, ensuring a well-rounded education.

### 2. Secondary Education (Ages 14–18)

This stage encompasses: Secondary Stage (Ages 14-16):

- Grades 9-10: Students focus on core subjects in preparation for board examinations, thereby fostering academic rigor (NCERT, 2020).

#### Senior Secondary Stage (Ages 16-18):

- Grades 11-12: Students specialize in streams such as Science, Commerce, or Humanities to guide their academic and career choices (MHRD, 2020).

### 3. Higher Education (Ages 18+)

Upon completing secondary education, students can pursue:

- Undergraduate Programs: Typically lasting three to four years, culminating in a bachelor's degree (UGC, 2020).
- Postgraduate Courses: These include master's degrees (typically two years) and doctoral studies, which offer advanced specialization and research opportunities (UGC, 2020).

Key Features of the Indian School System are:

- Compulsory education: Elementary education (grades 1-8) is compulsory for every child aged 6 to 14 years (Ministry of Law and Justice, 2009).
- Standardized curriculum: Most schools follow the "10+2" pattern with a common curriculum prescribed by the state or central boards (NCERT, 2020).
- Diverse school types: There is a trio of schools: government, private, and government-aided private schools. Private schools represent 29% of overall enrolments. (NIEPA, 2016).
- Multiple boards: In addition to state boards, there are central boards like CBSE and ICSE that have affiliated schools across the country (Ministry of Education, 2021).
- Increasing access: The government has made efforts to improve access to education through schemes like Sarva Shiksha Abhiyan and Right to Education Act (NCERT, 2020; Ministry of Education, 2021).

Ethnomathematics is an educational approach that focuses on the relationship between mathematics and cultural activities. In Indian classrooms, integrating ethnomathematics helps improve students' understanding of mathematical topics by connecting them to their cultural backgrounds and daily experiences. This approach acknowledges that mathematical knowledge is not universally fixed and is impacted by cultural circumstances (D'Ambrosio, 1985). Ethnomathematics provides a culturally appropriate framework for mathematics teaching, especially in Indian institutions where varied cultural practices are prevalent. By incorporating students' cultural experiences into mathematical principles, educators can create a stronger conceptual grasp and make mathematics more relevant (Bishop, 1988). This integration helps bridge the gap between abstract mathematical theories and real applications

in students' lives, encouraging engagement and enthusiasm in the topic. An ethnomathematical curriculum is designed to reflect the cultural identities of students. It encourages educators to utilize local knowledge and practices as a foundation for teaching mathematics. This approach not only validates students' cultural backgrounds but also empowers them academically by linking their identity with their learning process. (Rosa & Orey, 2016)

In this study, the researcher is focused on the following objectives based on an analytical study. They are:

- To identify the status of Ethnomathematics in India.
- To develop a Conceptual understanding of mathematics among the students using by Ethnomathematics approach
- To identify issues and challenges in the implementation of the Ethnomathematics approach in the classroom.
- To identify the opportunities for enhancing Ethnomathematics skills among the students in the classroom.

### **Methodology**

This study adopts a descriptive and qualitative research design. The analysis process follows a descriptive qualitative approach, where data are interpreted systematically to describe and explain facts, patterns, and information meaningfully. This method involves interpreting material through expression and discussion, ensuring logical coherence and contextual understanding. The data for this research consists primarily of secondary sources, which were obtained from existing publications, including literature, traditional knowledge, and indigenous records. These data sources—such as cultural accounts, statistical records, and community-based information—have been carefully selected and adapted for scientific validity and relevance. The collected materials were organized systematically, and the data were analyzed descriptively and qualitatively. The process included tabulating the information in alignment with the research objectives, ensuring a clear and comprehensive presentation of findings.

### **Result and Discussion**

#### **Identifying the status of Ethnomathematics in India.**

India is a geographically diverse and culturally rich country, home to over 705 ethnic groups classified as Scheduled Tribes. (Census of India, 2011) In central India, these groups are commonly referred to as Adivasis, meaning “original dwellers” or Indigenous Peoples. Alongside these groups, India also has numerous other communities with distinct cultural practices and knowledge systems. According to the Census of India (2011), the Scheduled Tribe population stands at approximately 104 million, representing 8.6% of the total population. India’s linguistic diversity is equally remarkable, with 121 languages and 270 mother tongues recorded. Out of these, 22 languages have been recognized as official languages under the Eighth Schedule of the Indian Constitution (Census of India, 2011).

Within these diverse communities, ethnomathematical ideas are deeply embedded in learners' everyday cultural practices, forming an essential aspect of their cognitive frameworks and learning processes. According to Adam (2004), the importance of integrating

ethnomathematical concepts into mathematics education is emphasized, as these ideas provide valuable connections between students' cultural backgrounds and formal school mathematics. Cultural activities, according to Adam, serve as pedagogical tools that bridge learners' cultural knowledge with the structured concepts taught in classrooms. This perspective acknowledges that schools and learning environments are not isolated from the communities they serve; rather, they are inextricably linked. Students bring with them cultural values, conventions, and mathematical understandings derived from their everyday lives, which can be harnessed to enrich classroom learning. By recognizing and integrating these cultural foundations into mathematics instruction, educators can foster a more inclusive and meaningful educational experience (Adam, 2004).

The Indian school curriculum now overlooks indigenous tribes' knowledge and talents, notably in fields such as ethnomathematics, which investigates how mathematical concepts are interwoven in cultural practices. Although these tribes have rich traditions that might substantially benefit the education system, ethnomathematics study is still in its early stages in India. The government and academic organizations have paid little attention to studying cultural knowledge and its potential impact on national educational growth. There has been little academic research into Indian ethnomathematics, particularly in postgraduate degrees such as Master's, M.Phil., and Ph.D. programs in Mathematics Education.

NCERT's Position Paper of the National Focus Group on Mathematics (NCERT, 2006, p. 11) highlights the importance of multicultural and ethnomathematical aspects in mathematics education, citing an example from Southern India. In India, Kolam intricate patterns created on the floor with white powder, similar to Rangoli in the northern regions, but typically without colour, are commonly seen in front of homes. These designs often involve complex closed curves and symmetries, offering rich opportunities for mathematical exploration in the classroom. Integrating such cultural practices into mathematics education not only enhances students' understanding of mathematical concepts but also deepens their appreciation of the cultural roots of mathematics. Similarly, art, architecture, and music provide intricate, culturally embedded examples that help students recognize and value the cultural foundations of mathematical knowledge.

Several studies (Gupta, 2009; Blamurugan, 2015; Sankaran et al., 2009) integrated ethnomathematics as a pedagogy and developed a method for teaching mathematics based on culturally entrenched practices. Gupta (2009) used folk mathematics and riddles to help upper-primary pupils understand diverse patterns and logical thinking in mathematics. Sankaran et al. (2009) found that ethnomathematical activities, such as constructing a bead necklace and tiling an area, can considerably increase kids' arithmetic skills. Balamurugan (2015) highlights the transformative potential of ethnomathematics in enhancing education by integrating multicultural perspectives into the mathematics curriculum. This approach connects mathematical concepts to students' cultural backgrounds, fostering a more inclusive and engaging learning environment. By recognizing the diverse cultural contexts from which mathematical ideas arise, ethnomathematics encourages students to see the relevance of mathematics in their daily lives and cultural practices. Ethnomathematics combines mathematical concepts with cultural practices to make learning more meaningful and engaging for students. This approach allows students to connect mathematical concepts to their daily lives, improving comprehension and recall.

Recent curriculum modifications, such as the National Curriculum Framework-NCF (2005), highlight the importance of improving children's mathematical skills. The goal of mathematics education is to build talents that allow children to rethink their relationship with the world, rather than just performing quantitative computations. The NCF (2005) also emphasizes the development of children's logical abilities as well as their ability to comprehend spatial concepts. It advocated that mathematics should gradually advance towards abstraction, even if it begins with real experiences and models. NCERT's mathematics books for grades 6-8 include prefaces and notes for instructors, emphasizing the need to develop a child's own framework of concepts for learning, confidence, and understanding the fundamentals. This would necessitate a separate classroom where students could discuss ideas, problem solutions, create new challenges, and discover not only their own ways of addressing difficulties, but also their own definitions in their native tongue. PPNFGTM (2006, p. 11) identified challenges in teaching mathematics, including student fear and failure, phobia, boring classroom settings, disappointing curriculum, and traditional methods. One recommendation is to help children understand the importance of mathematics in their daily lives. According to the position statement, it is customary in Indian villages for people who are not formally educated to employ various kinds of mental mathematics. It may be referred to as "folk algorithms".

### **Developing a conceptual understanding of mathematics among the students with Ethnomathematics.**

The development of conceptual understanding of mathematics through ethnomathematics in Indian schools involves integrating cultural practices and traditional knowledge into mathematics education. This approach not only enhances students' engagement but also fosters a deeper understanding of mathematical concepts by connecting them to the students' cultural backgrounds.

### **Implementation in Indian Schools Curriculum Integration**

Incorporating ethnomathematics into the curriculum allows educators to draw upon local traditions, folklore, and community practices to teach mathematical concepts. For instance, a recent initiative in India involved developing a device that leverages traditional knowledge and artificial intelligence to teach mathematics interactively. This device engages students through puzzles and simulations rooted in their cultural experiences, making learning more relatable and effective. (Joglekar, 2023)

### **Enhancing Understanding**

Research indicates that using ethnomathematical approaches can significantly improve students' mathematical abilities. By starting from culturally relevant contexts, educators can bridge the gap between formal mathematics and students' everyday experiences. This method encourages learners to see mathematics as a tool for understanding their world rather than an abstract set of rules. (D'Ambrosio, 2001)

## **Social Justice and Empowerment**

Ethnomathematics also aligns with educational goals focused on social justice. By valuing diverse mathematical practices, this approach empowers students from various backgrounds, fostering inclusivity and respect for different ways of knowing and doing mathematics. It challenges the dominance of Eurocentric mathematical narratives and promotes a more equitable educational environment. The integration of ethnomathematics into Indian school curricula represents a significant shift towards recognizing the importance of traditional settings in mathematics education. By embracing diverse mathematical practices, educators can enhance students' conceptual understanding, making learning more meaningful and relevant to their lives. This method not only improves the educational experience but also helps to preserve traditions in the structure of contemporary education. (Rosa et al., 2016) Examples of ethnomathematics in Indian culture illustrate how traditional practices and local knowledge systems incorporate mathematical concepts. Here are some notable instances:

### **Jejahitan in Balinese Hindu Culture**

Jejahitan in Balinese Hindu culture is a unique and deeply meaningful practice that combines artistry, spirituality, and community. The term jejahitan, meaning “stitching,” refers to the intricate craft of assembling offerings by weaving together natural materials such as banana leaves, coconut leaves, flowers, and sometimes fruits, which are then used in a wide range of Balinese Hindu rituals and ceremonies (Ardika, 2006; Suardana & Wirawan, 2021). These offerings are not merely ornamental; they hold profound symbolic significance, with each element representing different aspects of the divine and the universe—banana leaves for fertility, coconut leaves for purity, and specific colors of flowers symbolizing major deities like Iswara, Brahma, Mahadeva, and Vishnu (Sutawa et al., 2019). The process of creating jejahitan is itself a spiritual act, embodying the principle of Tri Hita Karana, or the harmony between humans, nature, and the spiritual world (Suardana & Wirawan, 2021). Jejahitan plays a central role in religious events such as Galungan, Kuningan, and Nyepi, where families and communities come together to prepare elaborate offerings as a form of devotion and gratitude (Ardika, 2006). Beyond its religious function, jejahitan also serves as a form of artistic expression and a means of cultural transmission, as knowledge of its techniques is passed down from elders to younger generations, helping to preserve Balinese identity and values such as patience, precision, and creativity (Sutawa et al., 2019). However, the practice faces challenges in the modern era, as the fast pace of life, environmental concerns, and the availability of ready-made offerings threaten the traditional methods (Suardana & Wirawan, 2021). Despite these pressures, many Balinese continue to uphold the practice of jejahitan, recognizing it as an essential link to their cultural heritage and a vital expression of their spiritual connection to the divine. Ultimately, jejahitan is more than just a craft; it is a living symbol of Balinese Hindu culture, reflecting the community’s enduring commitment to beauty, faith, and harmony.

### **Traditional Crafts and Pottery**

In many Indian communities, artisans use traditional methods that involve mathematical reasoning. For example, potters often need to calculate the volume of clay required for specific pot sizes or the angles needed for throwing nets by fishermen to maximize their catch. These

practices embody practical applications of geometry and measurement that have been passed down through generations (Kapadia, 2016). Traditional crafts and pottery are deeply interwoven with the cultural fabric of societies worldwide, serving as tangible links to ancestral knowledge, artistic expression, and communal identity. These handmade creations—ranging from intricately woven textiles to skilfully crafted ceramics—not only fulfill practical needs but also embody the stories, beliefs, and values of the people who make them. Pottery, in particular, stands out as one of the oldest and most universal forms of craftsmanship, with regional styles and techniques reflecting the diversity of local materials, environmental conditions, and spiritual traditions. The making of pottery is often a communal process, fostering social cohesion and continuity as skills are passed down through generations, frequently through oral tradition and apprenticeship. In many cultures, pottery also plays a crucial role in empowering women and supporting local economies, reinforcing its significance beyond mere aesthetics or utility. However, the survival of these traditions faces mounting challenges from industrial mass production, globalization, resource depletion, and shifting social dynamics, which threaten both the economic viability and cultural transmission of craft knowledge. Recognizing the importance of traditional crafts and pottery as intangible cultural heritage, communities, organizations, and governments are increasingly working to revitalize these practices through education, fair-trade initiatives, and innovative approaches that blend tradition with contemporary design. By valuing and supporting these crafts, societies not only preserve their unique identities but also promote sustainable development and inspire future generations to appreciate the enduring beauty and significance of handmade heritage. (UNESCO, 2023; Rice, 2015; Kurin, 2004)

### **Games and Folklore**

Traditional games in Indian communities serve not merely as pastimes but as culturally rich, informal learning environments where mathematical concepts such as counting, probability, strategy, and spatial reasoning are embedded within the gameplay. Games like Pachisi and Chaupar—precursors to modern board games such as Ludo—require players to navigate cross-shaped boards based on the outcomes of cowrie shell throws or dice rolls. These actions introduce players to the fundamental principles of probability, combinatorial thinking, and chance events. The strategic movement of pieces, anticipation of opponents' actions, and decision-making processes in these games foster cognitive skills like pattern recognition and logical reasoning (Madhavan, 2013). Furthermore, as Prabakaran (2024) emphasizes, these games are deeply intertwined with cultural narratives and folklore, such as the role of a dice game in the Mahabharata, illustrating how mathematical play intersects with storytelling and cultural heritage. Through such traditional games, community members—often without formal mathematical training—develop intuitive understandings of mathematical principles, reinforcing the idea that mathematical learning can emerge organically from cultural practices (Madhavan, 2013; Prabakaran, 2024). These games thus exemplify the role of ethnomathematics in everyday life, where mathematical thinking is embedded within the social and cultural fabric of a community.

### **Agricultural Practices**

Indigenous tribes in India have historically relied on astronomical observations, including lunar phases and star constellations, to guide essential farming activities. These practices are deeply embedded in their cultural and spiritual beliefs, reflecting a harmonious relationship between human activity and the natural world. These examples underscore the significance of ethnomathematical concepts in traditional agricultural systems. By aligning farming practices with lunar cycles and other natural rhythms, these communities have developed sustainable methods that optimize crop production and resource management.

### **Architectural Design**

Traditional Indian architecture often incorporates intricate geometric designs and symmetry, reflecting a deep understanding of mathematics in design principles. Structures like temples exhibit complex patterns that can be analyzed mathematically, showcasing how cultural identity is expressed through spatial organization (Sharma, 2018). Traditional Indian architecture often incorporates intricate geometric designs and symmetry, reflecting a deep understanding of mathematics in design principles. Structures like temples exhibit complex patterns that can be analyzed mathematically, showcasing how cultural identity is expressed through spatial organization.

### **Ethnomathematics in Indian textile**

Ethnomathematics in Indian textile showcases the rich interplay between cultural practices and mathematical concepts. Here are some notable examples:

#### **Woven Textiles**

Indian textiles, particularly handwoven fabrics like Kanchipuram silk (Fig. 1), Banarasi brocade (Fig. 2), and Ikat (Fig. 3), often feature intricate patterns that embody mathematical principles such as geometry, symmetry, and tessellation. These patterns are not just aesthetic choices but reflect a deep understanding of spatial relationships, measurements, and precision in design. (Raghavan, 2015; Mishra, 2017)



Figure 1: Kanchipuram sarees, Source: Artisan



Figure 2: Banarasi Brocade, Source: Artisan



Figure 3: Ikat Pochampali, Source: Artisan

### Geometric Patterns

The designs in Indian textiles frequently incorporate geometric shapes such as circles, triangles, diamonds, and squares, arranged symmetrically across the fabric. For instance, in Ikat weaving, repetitive motifs like diamonds or chevrons are meticulously planned and dyed to align perfectly when woven, illustrating an intuitive grasp of patterns, symmetry, and repetition (Raghavan, 2015). The double Ikat technique, as practiced in regions like Pochampally and Patan, showcases an even more complex understanding, where both the warp and weft threads are dyed in a way that their intersections form precise geometric patterns—a process requiring advanced mathematical calculation and spatial awareness. (Gillow & Barnard, 1991)

### Tiling and Angles

The artisans also apply concepts of tiling—arranging shapes without gaps or overlaps—akin to mathematical tessellations. For example, the floral and lattice patterns found in Banarasi brocade sarees demonstrate tessellation principles, where small motifs are repeated across the fabric to create seamless designs (Mishra, 2017). Similarly, in Kanchipuram silk sarees, temple border motifs like the gopuram are designed with careful consideration of angles and proportion to achieve a balanced and harmonious appearance (Raman, 2020).

These practices demonstrate how traditional Indian textile artisans apply mathematical reasoning intuitively in their craft, transforming complex mathematical concepts into cultural artifacts of beauty and utility. The geometric intricacy seen in these textiles not only serves an aesthetic purpose but also reflects centuries-old knowledge systems that merge art, culture, and mathematics seamlessly (Sen, 2021).

## Embroidery Techniques

Traditional embroidery styles such as Phulkari (Fig. 4) from Punjab and Chikan Kari (Fig. 5) from Lucknow involve complex stitching techniques that reflect mathematical thinking.

- Symmetry and Repetition: Phulkari, characterized by its vibrant floral patterns, often employs symmetrical designs that require an intuitive understanding of balance and proportion (Kumar & Sharma, 2020).
- Counting and Measurement: The intricate nature of Chikan Kari involves precise counting of stitches and measurements to ensure uniformity across designs, showcasing practical applications of arithmetic and geometry (Singh, 2019).



Figure 4: Phulkari, Source: Artisan



Figure 5: Chiken kari, Source: Artisan

### Block Printing

The art of block printing in regions like Rajasthan (Fig. 6) involves mathematical concepts in its execution.



Figure 6: Rajasthani Block Printing, Source: Artisan

- Pattern Design: Artisans create repeating patterns using carved wooden blocks, necessitating knowledge of symmetry, rotation, and reflection to ensure that designs align correctly when printed on fabric (Sharma, 2018).

- **Spatial Arrangement:** The placement of blocks requires an understanding of spatial relationships to maintain consistency across large pieces of fabric (Jain & Gupta, 2020).

### **Tie-Dye Techniques (Bandhani)**

The traditional tie-dye technique known as Bandhani (Fig. 7) involves knotting sections of fabric before dyeing, resulting in unique patterns.

- **Geometric Shapes:** The knots create circular or star-like patterns that reflect geometric properties. Understanding how to manipulate fabric to achieve desired outcomes demonstrates practical geometry in action. (Verma, 2019)



Figure 7: Bandhani (Tie dye techniques) , Source: Artisan

### **Issues and challenges in the implementation of the Ethnomathematics approach in the classroom.**

The implementation of ethnomathematics in Indian classrooms presents several issues and challenges that educators must navigate to effectively integrate cultural perspectives into mathematics education.

#### **Curriculum Integration**

One of the main problems is that current curricula don't provide clear instructions on how to include ethnomathematical concepts efficiently. Without specialized frameworks or support, teachers frequently struggle to figure out how to combine classical mathematics with cultural themes. (Bishop, 1997)

#### **Teacher Preparation**

A large number of teachers may lack sufficient training in ethnomathematics, which makes it challenging to incorporate cultural knowledge into their lessons. Redesigning curricula to

incorporate ethnomathematics approaches is imperative for teacher training programs to guarantee that teachers get the requisite knowledge and abilities (Rosa & Orey, 2016).

### **Assessment Procedures**

In an ethnomathematical environment, it is frequently unclear how to evaluate students' comprehension. When cultural components are incorporated into mathematics classes, traditional assessment techniques might not be sufficient to fully capture students' learning (López et al., 2017).

### **Cultural Sensitivity**

Applying ethnomathematics necessitates a thorough comprehension of the social and historical backgrounds of diverse mathematical methods. It might be difficult in a multicultural classroom setting for educators to tackle these subjects with care and knowledge of the varied backgrounds of their students (Bishop, 1997).

### **Availability of Resources**

It might be difficult to find relevant materials that accurately depict the variety of mathematical practices seen in different cultures. A range of resources that highlight ethnomathematical ideas that are applicable to the lives of their pupils are required of teachers (Rosa & Orey, 2016). Balancing Goals: Teachers must strike a balance between promoting cultural awareness and the development of quantitative skills. While adhering to academic standards, they must design learning settings that promote communication and cooperation between students from diverse backgrounds (López et al., 2017). The opportunities for enhancing ethnomathematics skills among the students in the classroom.

Integrating ethnomathematics into Indian classrooms presents several growth opportunities that can enhance students' learning experiences and outcomes. Here are some key opportunities:

### **Cultural Relevance**

Ethnomathematics enhances the learning experience by making mathematical concepts more meaningful and engaging through the lens of students' cultural identities and lived experiences. It acknowledges that mathematical thinking and practices are not universal in a detached sense but are deeply embedded in cultural contexts. By connecting mathematical concepts to students' cultural heritage, local practices, and community knowledge, ethnomathematics fosters a sense of belonging and identity in the learning process. For instance, incorporating patterns in traditional weaving, measurement techniques used in indigenous architecture, or numeracy skills inherent in local trade and markets demonstrates the practical utility of mathematics in everyday life. This culturally responsive approach not only enriches students' understanding of mathematical principles but also validates and honors the knowledge systems of their communities. As a result, students are more likely to engage with and retain mathematical ideas, as they see the relevance of mathematics beyond abstract symbols and formulas. They understand that mathematical reasoning has been an integral part of their cultural heritage, used for problem-solving and decision-making long before it was

formalized in academic curricula (Bishop, 1988; D'Ambrosio, 2001). In this way, ethnomathematics bridges the gap between school mathematics and real-world applications, creating a more inclusive and empowering learning environment.

### **Enhanced Student Engagement**

Teachers play a crucial role in making mathematics more engaging and accessible by connecting abstract mathematical concepts to students' personal experiences, cultural practices, and community knowledge. When teachers acknowledge and incorporate students' cultural backgrounds into their instructional practices, they create a learning environment where students feel seen, heard, and valued. This cultural responsiveness fosters a sense of belonging and relevance, which in turn boosts students' interest and motivation in the subject. By drawing upon familiar cultural contexts—such as patterns in local textiles, counting methods in traditional markets, or measurement systems used in agriculture—teachers help students see how mathematical ideas are not isolated or foreign concepts but are deeply embedded in their daily lives. When students recognize that mathematical challenges can mirror real-life scenarios, they are familiar with, they are more likely to engage actively and meaningfully with the subject. For example, solving problems related to community trade, crafting, or festivals can spark curiosity and show students the practical importance of mathematics.

This culturally grounded approach transforms the classroom into a space where students feel empowered to explore mathematical ideas through the lens of their own identities and experiences. It also fosters a positive attitude toward learning mathematics, as students see it as a tool for understanding and navigating the world around them, rather than as an abstract or irrelevant discipline (Zaslavsky, 1996; Clements, 2007). Ultimately, by valuing and integrating students' cultural knowledge, teachers create a more inclusive and motivating learning environment that promotes deep understanding and long-term retention of mathematical concepts.

### **Critical Thinking Development**

Ethnomathematics not only broadens students' understanding of mathematics but also serves as a powerful tool for cultivating critical thinking skills. By exposing students to diverse mathematical practices and problem-solving strategies used in different cultures, ethnomathematics challenges the dominant narrative that mathematics is a fixed and universal body of knowledge. It encourages learners to question the assumptions and values embedded within mathematical systems, asking, for example, why certain methods are prioritized over others in formal education or how cultural contexts influence mathematical approaches.

This reflective engagement fosters critical thinking by prompting students to analyze, compare, and evaluate various mathematical practices across cultures. For instance, they might explore how measurement systems differ globally, how traditional knowledge systems solve complex problems without formal algebra, or how indigenous communities use patterns and symmetries in ways that differ from textbook geometry. Through such inquiries, students learn to appreciate the diversity of mathematical thought and its cultural significance, moving beyond rote learning to deeper conceptual understanding.

Moreover, this critical perspective empowers students to question the socio-political dimensions of mathematics, such as its role in colonization, social stratification, or technological development. They begin to see mathematics not merely as a set of abstract rules but as a human endeavor shaped by history, culture, and power relations (Sullivan, 2000; Skovsmose, 2011). In this way, ethnomathematics transforms mathematics education into a dynamic space for critical reflection, enabling students to become more thoughtful, analytical, and socially aware learners.

### **Multidisciplinary Education**

The integration of ethnomathematics into the curriculum promotes a rich, multidisciplinary learning environment that bridges mathematics with subjects such as social studies, history, culture, and the arts. This cross-disciplinary approach breaks down the artificial barriers that often exist between academic subjects, demonstrating to students that knowledge is not compartmentalized but interconnected and holistic. Through ethnomathematics, students explore how mathematical concepts and practices emerge from and interact with diverse aspects of human life, including societal structures, historical developments, cultural traditions, and artistic expressions. For instance, students might investigate how traditional architecture reflects geometric principles, how indigenous measurement systems are intertwined with local agriculture, or how patterns in folk art and textiles reveal concepts of symmetry, proportion, and transformation. These connections not only make mathematics more meaningful but also deepen students' appreciation for the rich tapestry of human knowledge and creativity.

By seeing mathematics as part of a larger, interconnected system of understanding, students develop a more comprehensive perspective on the world around them. They begin to appreciate how mathematical thinking contributes to cultural heritage, economic practices, and artistic expression. This approach fosters curiosity, creativity, and critical inquiry, encouraging students to explore how different disciplines inform and enrich each other. It also equips them with the skills and mindset needed to navigate complex, real-world challenges that require multidisciplinary solutions (Bishop, 1991; Clements, 2007). In this way, ethnomathematics serves as a powerful bridge between mathematics and the broader human experience, creating a more engaging and inclusive curriculum for all learners.

### **Student Empowerment**

Ethnomathematics plays a transformative role in student empowerment by affirming and validating the cultural knowledge and lived experiences that students bring to the classroom. By recognizing that mathematical thinking is deeply embedded in the cultural practices, traditions, and problem-solving strategies of their own communities, students gain a sense of ownership over their learning. This validation fosters confidence, as students realize that their ways of understanding and applying mathematics are not only legitimate but also valuable. Rather than perceiving mathematics as a distant, abstract discipline, students come to see it as something relevant, accessible, and part of their identity. This perspective encourages a sense of agency, where students are not just passive recipients of knowledge but active participants in the construction of mathematical understanding (Zaslavsky, 1996; D'Ambrosio, 2001).

Furthermore, the inclusion of students' cultural backgrounds in the mathematics classroom can inspire a sense of pride and self-esteem. When students see their cultural heritage reflected

in academic content—whether through exploring traditional games, crafts, architecture, or storytelling—they develop a stronger connection to both their culture and their academic learning. This connection reinforces the idea that their cultural knowledge is not something to be left outside the classroom but a valuable resource that can enrich and inform the learning process. As a result, students feel more motivated and confident to engage with mathematical content, seeing themselves as capable learners and problem-solvers. Ethnomathematics, therefore, not only strengthens mathematical understanding but also nurtures positive self-identity and cultural pride, fostering a more inclusive and empowering educational experience.

### **Teacher Professional Development**

Integrating ethnomathematics into the classroom fosters meaningful opportunities for teacher professional growth. By engaging with the cultural dimensions of mathematics, educators are encouraged to rethink traditional pedagogical approaches and develop more inclusive, responsive, and contextually relevant teaching strategies. This shift moves educators beyond a one-size-fits-all model of instruction and challenges them to design learning experiences that reflect the diverse cultural backgrounds and real-world contexts of their students. As a result, teachers deepen their understanding of how mathematical knowledge is shaped by culture and history, prompting them to incorporate storytelling, hands-on activities, culturally significant problem-solving tasks, and real-life applications into their teaching practices (Lavy & Waxman, 2010; Sullivan, 2000).

Moreover, the exploration of ethnomathematics pushes educators to continuously adapt and refine their instructional strategies, fostering a growth mindset in their professional journey. Teachers are empowered to become reflective practitioners, critically examining their own assumptions about mathematics and embracing a more holistic perspective that values multiple ways of knowing. This process enhances their ability to create equitable learning environments where students from all backgrounds feel included and supported. By broadening their pedagogical toolkit through ethnomathematics, educators are better prepared to meet the needs of diverse learners, address cultural differences with sensitivity, and inspire students to connect mathematical concepts with their lived experiences. In doing so, teachers themselves become lifelong learners, contributing to a more dynamic, culturally aware, and socially just mathematics education landscape.

### **Promoting Inclusivity**

Ethnomathematics plays a vital role in fostering inclusivity within the classroom by recognizing and integrating the diverse mathematical knowledge and practices that exist across India's rich cultural landscape. From the intricate patterns found in tribal art and weaving traditions to the mathematical reasoning embedded in agricultural practices, trade systems, and architecture, each community contributes unique insights to the broader understanding of mathematics. By incorporating these diverse cultural perspectives into teaching, educators create a learning environment where all students feel seen, valued, and respected. This sense of representation allows students from different backgrounds to connect more deeply with mathematical concepts, as they recognize how their own cultural knowledge and lived experiences contribute meaningfully to the subject. Consequently, students are more likely to engage with

the material and feel a sense of belonging in the mathematics classroom (Bishop, 1991; D'Ambrosio, 2001).

Moreover, an inclusive approach to mathematics education—grounded in ethnomathematics—can help dismantle stereotypes and biases that often exist within traditional curricula. By showcasing the mathematical contributions of various cultural groups, students are encouraged to appreciate the diversity of mathematical thought and problem-solving approaches. This helps cultivate mutual respect, empathy, and understanding among students from different backgrounds. It challenges the misconception that mathematical knowledge is limited to a single dominant culture or way of thinking and instead promotes the idea that mathematics is a universal human endeavor with multiple valid perspectives. Such an approach not only enhances classroom dynamics but also lays the foundation for a more equitable and socially just learning environment, where all students feel empowered to participate fully and collaboratively in their mathematical journeys (Zaslavsky, 1996; Nunes, 2002).

### **Conclusion**

One important way to close the gap between traditional mathematical education and the distinctive cultural heritage of the Indian people is through the study of ethnomathematics in the educational setting of that country. Teachers can create a more welcoming and inclusive learning atmosphere where students' identities are valued and celebrated by implementing mathematical strategies that are culturally relevant into the curriculum. Through analysis and appreciation of the mathematical ideas ingrained in their cultural traditions, this method fosters critical thinking skills in addition to increasing student engagement and comprehension. Despite the limitations of applying ethnomathematics, which include curriculum integration, teacher preparation, and resource availability, the potential benefits are enormous. Ethnomathematics empowers students by connecting their learning experiences to their cultural backgrounds, making mathematics more relevant and meaningful. Furthermore, it encourages a multidisciplinary approach to teaching, which enhances the curriculum and builds a sense of belonging in pupils from diverse backgrounds. As India's educational techniques evolve, adopting ethnomathematics could play an important role in making mathematics instruction more culturally relevant and effective. By recognizing the mathematical knowledge embedded in local traditions and practices, educators can not only improve academic achievements but also help to preserve cultural legacy in an increasingly globalized society. Thus, incorporating ethnomathematics is an important step toward creating an inclusive educational environment that values all students' unique identities.

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