Geometrical Shapes in Nepali Panche Baja

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Abstract

This qualitative research study investigates the existence of geometrical shapes within the traditional Nepali musical ensemble known as *panche baja*. Panche baja, comprising five primary instruments Nagara (Damaha), Dholaki, Tyamko, Narsingha, and Jhurma (Jhyali or Jhyamta)—is an essential part of Nepali cultural ceremonies, particularly marriages, bratabandha (sacred thread ceremonies), and various religious events. These occasions are significant in Nepalese society, often celebrated with communal participation and marked by traditional music. The Damai community, traditionally responsible for playing panche baja, has preserved these musical practices over generations. The objective of this study was to explore the mathematical aspects embedded in these instruments, specifically focusing on their geometrical features. Using direct observation and analysis, the researcher identified several geometric forms integrated into the structure of panche baja instruments, including circles, parabolas, hemispheres, cylinders, hollow cylinders, parallel lines, and intersecting lines. These shapes are not merely aesthetic but also contribute functionally to the sound quality and durability of the instruments.

The findings suggest that mathematical knowledge, particularly an intuitive understanding of geometry, is deeply woven into the traditional craftsmanship of Nepali musical instruments, even though it has been historically undocumented. This study emphasizes the interconnection between

traditional art, culture, and mathematics, highlighting the richness of indigenous knowledge systems. Understanding these connections can contribute to broader appreciation and preservation of Nepal's intangible cultural heritage.

Keywords: Panche baja, Geometrical Shapes, Nepali Culture, Musical Instruments, Marriage, Bratabandha, Damai Community, Traditional Knowledge.

Introduction

Nepal, a land of rich cultural diversity, is adorned with numerous traditional practices and rituals passed down through generations. Among these traditions, Panche Baja holds a significant place as a musical ensemble integral to Nepali festivals, especially weddings, bratabandha (sacred thread ceremonies), and other celebratory occasions. Panche Baja literally means "five musical instruments" in Nepali. It consists of the Damaha (or Nagara), Dholaki, Narsingha, Tyamko, and Jhurma (also called Jhyali or Jhyamta). Each instrument produces a distinct sound, contributing to a harmonious and energetic musical performance. For example, the Narsingha resembles a long trumpet, the Dholaki is a double-headed drum, the Tyamko is a small kettledrum, the Damaha is a large kettle drum, and the Jhurma are cymbals. Together, they create melodies that enhance social celebrations and religious rituals.

Music in Nepali society holds profound cultural significance. It transcends mere entertainment, fostering social cohesion, spiritual expression, and the preservation of collective memory. The Damai community, traditionally responsible for playing Panche Baja, has passed down this musical heritage through generations, making it an essential symbol of Nepali identity.

Fine arts in Nepal, especially music and sculpture, have long shared an interdependent relationship. Sculptural art seen in metals, stone, and wood often depicts musical instruments, indicating the deep-rooted presence of music in ancient Nepali traditions (Poudel, 2022). Scholars have shown how geometry is naturally embedded in cultural artifacts worldwide. Seidenberg (1961) discusses how geometric patterns permeate traditional architecture, textiles, and ritual practices. Similarly, Islamic art, Native American rituals, and Buddhist mandalas all incorporate intricate geometric forms, symbolizing cosmic and cultural order. Geometry, traditionally defined as the mathematical study of shapes, sizes, and spatial relationships, thus plays a critical role not only in science and architecture but also in the artistic expressions of various cultures.

Recent studies in ethnomusicology and material culture have explored the geometry of musical instruments. For instance, Sahfitri and Sari (2022) studied the Gordang musical tradition among the Mandailing people, showing how nine differently sized drums produce a range of tones, demonstrating an implicit use of mathematical and geometric principles. However, despite abundant examples from other cultures, limited research exists on the geometric analysis of traditional Nepali musical instruments, particularly Panche Baja. While geometry has been explored in Nepali art and architecture, its presence within musical instrument craftsmanship remains under-researched. This creates a significant gap in both ethnomusicology and cultural mathematics. The present study aims to explore and document the existence of geometric shapes in the construction and arrangement of Panche Baja instruments. By doing so, it seeks to highlight the underlying mathematical knowledge embedded in traditional Nepali music, bridging the disciplines of mathematics, culture, and

ethnomusicology. This research ultimately contributes to a deeper understanding of Nepal's intangible cultural heritage and its hidden mathematical dimensions.

Literature Review

The intersection of geometry and musical instrument construction has been explored in several cultural contexts. Sahfitri and Sari (2022) examined the Gordang tradition of the Mandailing people, where nine differently sized drums are crafted with distinct diameters and heights to produce varied tones, reflecting an implicit understanding of mathematical and geometric principles. This study highlights how traditional artisans used geometric knowledge practically, even without formal mathematical education, to create musical harmony.

Although limited research has focused specifically on Nepalese instruments, Ballinger and Bajracharya (1960) conducted an early detailed study on Nepalese musical instruments. Their research documented the craftsmanship and caste-based divisions of musical production, noting how Newar artisans traditionally created both stringed and percussion instruments. However, their focus was primarily ethnographic rather than on the geometric structures of these instruments. This gap suggests a need for focused studies linking instrument design to geometric principles in Nepalese culture.

While direct studies on the geometry of musical instruments are scarce, abundant literature discusses the role of geometry in traditional art and architecture. Gangwa, Gaur, and Kaur (2017) explored how ancient civilizations, from Egypt to the Indus Valley, utilized geometry for religious and symbolic purposes rather than purely aesthetic reasons. Similarly, Poor, Nafisi, and Javed (2021) compared the use of geometry in Islamic and Gothic

architectures, emphasizing that geometric forms often serve as metaphors for divine order. Aromus (2018) further argued that geometry acts as a bridge between artistic creativity and scientific reasoning. His analysis of geometric tiling, particularly in Islamic art, illustrates how symmetrical patterns and structures embody both spiritual and aesthetic dimensions. Palestini (2014) also highlighted the natural origins of architectural geometry by examining shell-inspired geometric configurations, demonstrating humanity's long-standing fascination with natural and mathematical forms.

These studies collectively establish that geometry has deep cultural, philosophical, and practical significance across different civilizations. Yet, few extend this analysis to musical instruments, indicating an important research gap. Ethnomusicology has traditionally focused on the social, cultural, and ritual contexts of music. Ballinger and Bajracharya's (1960) ethnographic research provides insights into how musical practices in Nepal are deeply intertwined with caste, religion, and communal life. They detailed the roles of the Damai community in playing Panche Baja, reinforcing music's role in social structure. Globally, ethnomusicologists have emphasized how music reflects cultural identities and values.

However, the mathematical or structural analysis of instruments within ethnomusicology remains underexplored. This suggests an opportunity to bridge ethnomusicological perspectives with mathematical analysis, particularly in traditional Nepali musical traditions. From the review, it is evident that while the cultural and ritualistic significance of Nepali musical instruments has been documented (Ballinger & Bajracharya, 1960), and the role of geometry in traditional arts and architecture has been widely studied (Gangwa et al., 2017;

Poor et al., 2021; Aromus, 2018; Palestini, 2014), there is a significant gap regarding the study of geometric structures within traditional Nepali musical instruments like the Panche Baja. This research aims to address that gap by exploring the existence and role of geometric principles in the design and construction of Panche Baja instruments. It seeks to highlight how traditional craftsmanship in Nepal implicitly incorporated mathematical concepts, contributing to both the functionality and symbolic meaning of these cultural artifacts.

Research objective

To identify and analyze geometric shapes present in Nepali Panche Bajas.

Methodology

This study employed a qualitative research approach to identify and analyze the geometric shapes present in traditional Nepali Panche Baja instruments. A qualitative method was chosen because it allows for an in-depth exploration of cultural artifacts, emphasizing observation, interpretation, and contextual understanding rather than numerical analysis.

A comprehensive review of existing literature was first conducted to gather historical and cultural information about Panche Baja instruments. Sources included academic journals, books, and traditional documentation that discuss the construction, symbolism, and artistic aspects of these instruments. This review helped to establish a theoretical framework for understanding how geometry is embedded in Nepali musical culture. Primary data was collected through direct field observation. Various Panche Baja instruments such as the Damaha, Dholaki, Narsingha, Tyamko, and Jhurma were examined in different

local settings where they are traditionally made and played. Key physical features such as size, structure, and shape were carefully observed and recorded. Precise measurements of each instrument's dimensions (such as diameters, lengths, and curvatures) were taken using appropriate tools like measuring tapes, rulers, and calipers. The physical structures were then compared with standard 2D and 3D mathematical models, such as circles, cylinders, hemispheres, parabolas, and hollow cylinders. The goal was to match the real-world designs of instruments with idealized geometric forms.

The collected observational and measurement data were analyzed to interpret the significance of geometric shapes in Panche Baja. Emphasis was placed on understanding how geometric principles influence the craftsmanship, functionality, and symbolic meaning of each instrument. The interpretation also explored how geometric designs contribute to the acoustic and aesthetic qualities of Panche Baja instruments. This methodology directly aligns with the research objective by systematically identifying and analyzing the geometric shapes present in Nepali Panche Baja, thus bridging cultural tradition with mathematical understanding.

Result and Discussion

The study of geometrical shapes in Nepali Panche Baja instruments reveals a rich tapestry of craftsmanship deeply intertwined with cultural significance. Through meticulous observation and precise measurement, several distinct geometric shapes were identified across various instruments. These

findings are discussed below, with references to corresponding figures and connections to the cultural context highlighted in the literature review.

Identification of geometrical shapes in Dholaki

Figure 1.1 Dholaki

The Dholaki is a cylindrical drum traditionally hung from the neck or shoulder. The smaller head (*pothi*) is struck by hand, while the larger head (*bhale*) is beaten with a stick (*gajo*). Local traditions dictate its playing style, with variations in strokes and dampening techniques.

Observed Geometric Shapes:

- Cylinder
- Circle
- Parallel Lines
- Concentric Circles

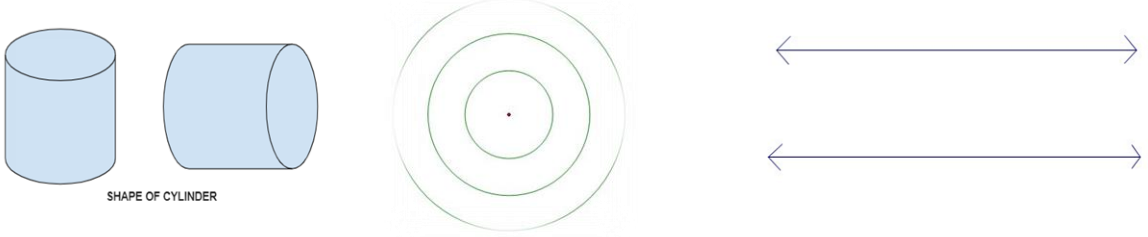


Figure 1.2 Shapes existed in Dholaki

Identification of geometrical shapes in Narsinga

Figure 1.2 Narsinga

The Narsinga, a conical trumpet, features a gradual curvature resembling a crescent moon. It is constructed from copper sheets with brass rings.

Observed Geometric Shapes:

- Parabolic Curve
- Circle
- Conical Bore

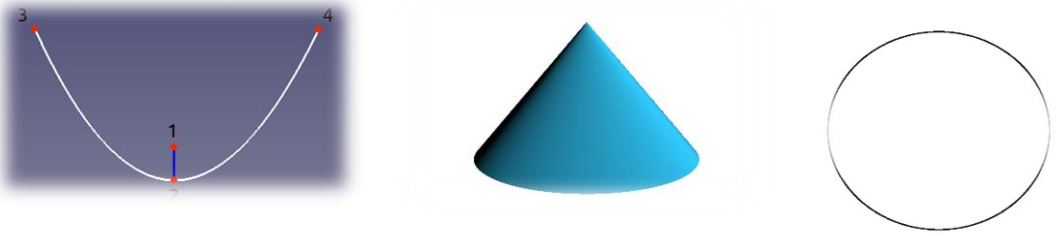


Figure 1.4 Shapes existed in Narsinga

The parabolic and conical structures of the Narsinga amplify sound while symbolizing spiritual ascent, connecting to the themes of divinity discussed in the literature.

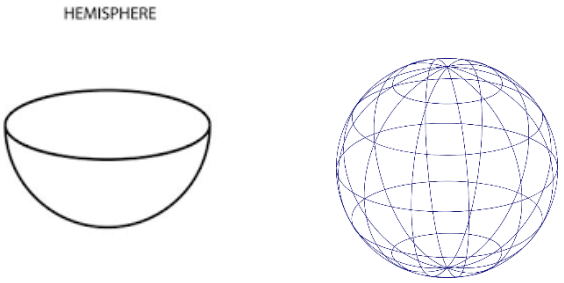
Identification of geometrical shapes in Damaha

Figure 1.5 Damaha

The Damaha, a bass drum, is suspended in front of the player and played with sticks. It has ceremonial significance, requiring ritual purification during its making.

Observed Geometric Shapes:

- Hemisphere
- Lines of Spherical Geometry



- *Figure 1.6* Shapes existed in Damaha

The hemispherical body enhances deep bass tones, while culturally symbolizing the heavens and the earth, resonating with Nepali beliefs about cosmic harmony.

Identification of geometrical shapes in Jhurma

Figure 1.7 Jhurma (Jhyali, Jhyamta)

Jhurma is Nepali classical musical instrument, used as Panche baja. It is round shaped disk made by various metal like brass, bronze and so on and looks like cymbal. This instrument is very popular in marriage ceremony but is is popular also in Kirat community of Nepal. It has two sizes; small and large. Small sized Jhurma is made with diameter 9 cm whereas large sized Jhurma is made with 11 cm diameter. Mathematical shapes existed in Jhurma

- Circle
- Hemi sphere
- Concentric circle
- Congruent shapes

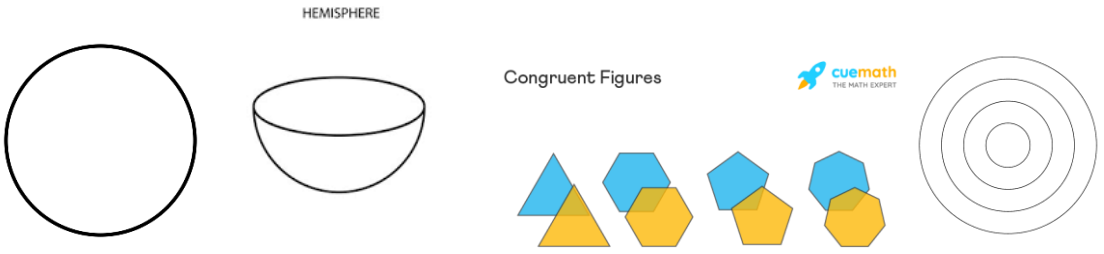


Figure 1.8 Mathematical shapes existed in Jhyali

Identification of geometrical shapes in Tyamko

Figure 1.9 Tyamko

Tyamko is variously made of wood, copper or earthenware according to regional taste, these wooden kettledrums a western Nepali tradition. Although a more secondary instrument in the ensemble the damai note it as the primordial instrument in their mythology.

Mathematical shapes existed in Tyamko

- Hemi-sphere
- Circle
- Lines of elliptical geometry

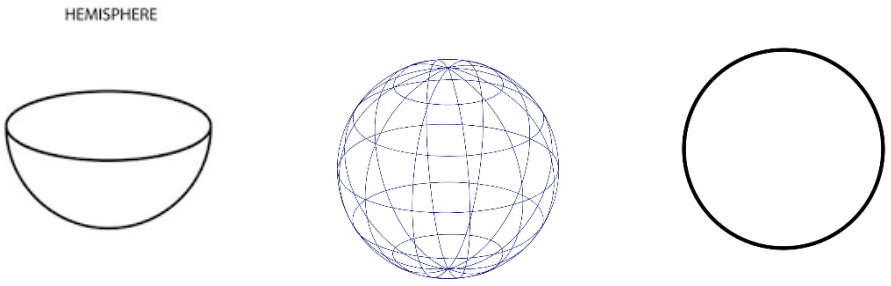


Figure 1.10 Mathematical shapes in Tyamko

The shapes of the instruments in the Panche baja not only serve functional purposes in producing music but also carry deep cultural and symbolic meanings within Nepali society. They represent unity, continuity, adaptability, spiritual growth, and aspiration, encapsulating the essence of Nepali traditions and values through their distinctive forms. Dholaki, a cylindrical drum, symbolizes rhythm and harmony within Nepali communities. Its shape, reminiscent of a sturdy pillar, signifies strength and unity. Jhyali, a pair of cymbals shaped like circular plates, represents the cyclic nature of life and the interconnectedness of all beings. Its round shape reflects the eternal and continuous flow of time and traditions and so on.

Some specific and common shapes in panche baja: The Nepali Panche baja, a traditional musical ensemble, showcases an intriguing blend of geometry in its instruments, each embodying symbolic and practical significance within Nepali culture.

Cylindrical Shapes: Instruments like the Dholaki (cylindrical drum) features cylindrical forms. These shapes not only aid in producing resonant sounds but also symbolize unity and strength within Nepali communities. The cylindrical shape suggests stability and continuity, reflecting the enduring cultural traditions upheld through music.

Circular and Spherical Shapes: The Jhyali (cymbals) is example of instruments with circular or spherical shapes. The circular form of the Jhyali represents the cyclic nature of life and the interconnectedness of all things. It symbolizes harmony and balance, essential qualities in both music and community life. The Damphu, with its spherical shape, signifies adaptability and

versatility, traits that are crucial in maintaining cultural traditions amidst changing times.

Spiral Shape: The Narsiha (conch shell trumpet) is characterized by its spiral shape. The spiral symbolizes growth, evolution, and the journey of life. In Nepali culture, the sound of the Narsiha holds spiritual significance, often used in religious ceremonies and festivals to invoke divine blessings and connect with higher realms.

These geometric forms in the Panche baja instruments not only serve practical functions in producing music but also convey deeper cultural meanings and values. They reflect the interconnectedness of Nepali traditions with nature, spirituality, and community harmony. The geometry of these instruments thus becomes a visual and auditory representation of the rich cultural tapestry of Nepal, resonating through both musical performances and ceremonial occasions.

Conclusion

The Nepali *Panche Baja* ensemble vividly illustrates the intricate connection between geometry, cultural symbolism, and musical expression. Each instrument, carefully crafted with specific geometric forms, serves not only an acoustic function but also conveys profound cultural meanings deeply rooted in Nepali society. Cylindrical shapes, such as those in the Dholaki and Karnal, symbolize strength, endurance, and community solidarity. Circular and spherical forms, seen in the Jhyali and Damphu, represent harmony, interconnectedness, and adaptability essential traits in both life and music. The

spiral structure of the Narsiha reflects spiritual growth and the continuous journey toward higher ideals, resonating through religious and cultural practices.

These geometric features collectively enhance the sound quality of the instruments while embodying values that define Nepali identity. Thus, the Panche Baja instruments, through both form and function, weave a rich tapestry of tradition, spirituality, and communal harmony, connecting generations across time and space. While this study highlights key geometric features and their cultural significance in Panche Baja instruments, it is limited by its reliance on observational analysis and secondary cultural interpretations. Precise mathematical measurements (e.g., exact dimensions, proportions) were not extensively calculated, which could offer deeper insights into the craftsmanship.

For future research, a comparative mathematical study involving detailed measurements, material analysis, and sound frequency studies of Panche Baja instruments could provide a more comprehensive understanding. Additionally, exploring regional variations in instrument shapes and their symbolic meanings across different Nepali communities would further enrich the cultural and scientific appreciation of Panche Baja.

References

Aromus. (2018). Shapes of design: Traditional geometry, symmetry and representation. Journal of Design Studies.

Ballinger, L., & Bajracharya, D. (1960). Nepalese musical instruments. Ethnomusicology,4(1), 1–9.

Gangwa, B. S., Gaur, A., & Kaur, A. (2017). Significance of geometrical forms in architectural design. International Journal of Research in Engineering and Technology.

Palestini, C. (2014). Geometric shapes that generate architectural forms. Journal of Architecture and Urbanism.

Poudel, P. P. (2022). Musical instruments in Nepali sculpture. Journal of Fine Arts Campus, 4(1), 1-11.

Poor, D., Nafisi, S., & Javed, K. (2021). Philosophy, geometry, and purposes in Islamic and Gothic architecture as two religious-based styles. International Journal of Architecture and Urban Development.

Sahfitri, J., & Sari, D. N. (2022). Draft mathematics used for exploring the existence of mathematics in culture, especially in art, one of which is in traditional music tools.

Seidenberg, A. (1961). The ritual origin of geometry. Archive for history of exact sciences, 1, 488-527.