



Ethnomathematics Identification in West Sumatra Rantak Dance Performances

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Abstract

The diversity of traditional dance performances in Indonesia showcases the country's rich cultural heritage. The art of Rantak dance from West Sumatra, Indonesia, is one such cultural treasure that exhibits connections with ethnomathematics. This research aims to explore the relationship between culture and mathematics education in schools by identifying aspects of the Rantak dance. The research method employed was qualitative descriptive using an ethnographic approach. Data analysis techniques follow Miles and Huberman's approach, involving data reduction, data display, and drawing conclusions. The findings of this research reveal a significant correlation between the cultural art of Rantak dance from West Sumatra and mathematics. This connection is observed in the floor patterns that form geometric shapes such as triangles and circles. Additionally, the formation of straight lines at 180° is evident within the dance. The musical instruments accompanying the dance also feature mathematical elements, such as the cylindrical shape of the "gandang," resembling a solid geometric figure. This research underscores the cultural ties of the Rantak dance with mathematics and highlights its potential as a foundation for culturally-based mathematics education.

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1. Introduction

Traditional dance performances in Indonesia possess a profound and intricate cultural wealth, reflecting the ethnic diversity and long history of this country (Pratiwi & Mushlihuddin, 2021). One fascinating type of traditional dance that attracts attention is the Rantak dance, originating from West Sumatra. The Rantak dance is a heritage passed down from generation to generation, incorporating unique elements of ethnomathematics. Ethnomathematics is the study of how traditional societies utilize mathematics in various aspects of their daily lives, including their arts and culture.

West Sumatra is one of the provinces in Indonesia rich in cultural heritage, including traditional dance performances. Rantak dance is one form of dance art that is passed down through generations and plays an important role in the lives of the Minangkabau community. Besides being an artistic expression, Rantak dance also reflects the profound application of mathematics in its movements, rhythms, and symbolism used in the performance. Therefore, research on ethnomathematics in Rantak dance in West Sumatra holds significant value in understanding local culture and how the local community utilizes mathematics in their traditional art.

It is important to understand that ethnomathematics is not just about numbers and calculations, but also about patterns, symbols, and meanings inherent in mathematical practices within specific cultures. (Sa'adah et al., 2021). In the context of Rantak dance in West Sumatra, ethnomathematics encompasses the understanding of movement selection, rhythmic patterns, dancer arrangement, and symbols used in the performance. In this journal article, the researcher will discuss the identification of ethnomathematics in

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Rantak dance performances, delineating the mathematical elements contained within this dance, and exploring how the Minangkabau community applies them in their arts and culture.

Rantak dance is one form of traditional dance originating from the Minangkabau community, inhabiting the region of West Sumatra. The Minangkabau people possess a rich and unique cultural heritage, reflected in various aspects of their lives, including performing arts. Rantak dance plays a significant role in Minangkabau culture and is often performed in various traditional ceremonies, celebrations, and festivals. (Dharsono et al., 2022).

Rantak dance performances involve a group of dancers typically consisting of both women and men. This dance is dominated by elegant movements that express beauty and grace, often using scarves as attributes. Besides the movements, Rantak dance is also known for its strong rhythm, with the use of traditional musical instruments such as *talempong*, *gandang*, and drums as support.

However, behind the beauty of the movements and rhythms of Rantak dance lie intriguing ethnomathematical elements. The movements in this dance are not merely random but are tightly regulated by specific rules. Furthermore, the selection of musical instruments, rhythmic patterns, and arrangement of dancer groups also involve complex mathematical concepts.

This research holds significant importance in several aspects. First, it will help preserve and understand the cultural heritage of Rantak dance in West Sumatra, which continues to face challenges in maintaining its existence amidst changing times. Second, it will contribute to the field of ethnomathematics by revealing how the Minangkabau community applies mathematics in their traditional art. Third, this research will provide insights for arts learning and education, which can leverage knowledge of ethnomathematics in teaching traditional dance.



Figure 1. Rantak Dance of West Sumatera

The research on ethnomathematics has been extensively studied by most authors, such as: Ethnomathematics Exploration: Offering Dance Performance (*Makan Sirih*) Ethnic Malay Deli North Sumatra (Hasibuan & Br Ginting, 2021). Ethnomathematics in the Making of Layered Cake (Mahendra & Hasanah, 2023). Exploration of Ethnomathematics in the Processing of Bandrek Production. (Apendi & Salamah, 2023). Ethnomathematics Exploration of Museum Gedung Arca (State Museum of North Sumatra) (Safriyanti & Yahfizham, 2023). Ethnomathematics Exploration at The State Museum of North Sumatra (Sagala & Hasanah, 2023). Ethnomathematics in the Alas Tribe Culture in Southeast Aceh Regency (Aflah & Andhany, 2022). Identifying Ethnomathematics: Motifs in Woven Songket Fabrics of Langkat Malay from North Sumatra (Sawita & Ginting, 2022). Ethnomathematics in the Process of Tempeh Making (Harahap & Rakhmawati, 2022). Exploration of Ethnomathematics in the Process of Tofu Making in Sayurimatinggi Village, Simalungun Regency, as a Source for Mathematics Learning (Febriyanti & Afri, 2023). Ethnomathematics-Based Mathematics Learning Activities in Labuhan Batu Pesisir Beach Malay Communities (Deby & Yahfizham, 2023). Ethnomathematics: Exploration of Geometric Transformations in the Interior Ornaments of *Balairung Istana* Maimun as a Source for Learning Mathematics (Adawiyah & Hasanah, 2022). Hence, the author took the initiative to conduct research and identify Ethnomathematics in Rantak Dance Performances in West Sumatra to examine the extent of the relationship between mathematics and culture.

Through this research, the researcher hopes to provide deeper insights into how the Minangkabau community utilizes mathematics in their traditional art, particularly in the context of Rantak dance. Additionally, the researcher also aims for this study to enhance our understanding of the complexity of local culture and the importance of preserving traditional cultural heritage amidst modern developments.

With the aforementioned background, the author aims to conduct research on Rantak dance in West Sumatra. This is to delve further into the mathematical concepts present in Rantak Dance of West Sumatra.

2. Methods

This research employs a qualitative approach with direct observation and in-depth interviews as methods. The author directly observes Rantak dance performances and notes the movements, rhythmic patterns, and other mathematical aspects contained in the performance. Additionally, the researcher engages in discussions with dancers, instructors, and other stakeholders within the Rantak dance community to gain deeper insights into the use of mathematics in this artistic practice.

Data analysis techniques follow Miles and Huberman's approach, including data reduction, data display, and drawing conclusions (Ulya & Rahayu, 2017). Data reduction is carried out to select parts of the Rantak Dance process in West Sumatra that are related to mathematical concepts. Data presentation is conducted to gain an overview of the overall results of the mathematical concepts found in the art of Rantak Dance in West Sumatra. Conclusions are then drawn regarding ethnomathematics in the dance.

3. Results & Discussions

3.1. The principles of Rantak Dance concepts

This research reveals that the movements in Rantak dance are tightly regulated with mathematical principles (Candrasari et al., 2023). The dancers' movements are not based solely on chance or improvisation, but rather follow complex rules. These rules encompass the use of symmetry, patterns, and precise coordination. Rantak dancers must understand these mathematical principles to execute movements accurately.

Symmetry, for example, is a mathematical principle underlying many movements in Rantak dance. Movements of the right hand are often followed by similar movements of the left hand, creating a sense of symmetry. Additionally, dancers often follow movement patterns that reflect principles of geometric mathematics. These mathematical principles not only make Rantak dance movements visually appealing but also ensure that the movements themselves meet certain quality standards.

The placement of dancers in Rantak dance performances reflects the application of mathematics, especially in geometric aspects. Formations of dancers, such as circles, squares, or other patterns, are deliberately chosen (Amri & Santia, 2023). The patterns are formed as follows.:

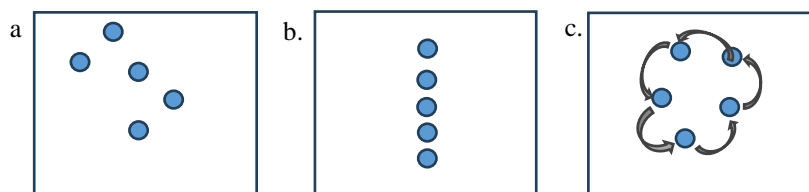


Figure 2. (a) takes the form of a triangle; (b) takes the form of a straight line; (c) takes the form of a circle

The patterns formed above can be seen to have a relationship with mathematics such as:

- a) The floor pattern forms a triangle. A triangle is one of the plane figures that has three interconnected sides. The dancers form two triangles; therefore, the floor area and perimeter of the triangle can be calculated as follows:
 - Area $\triangle = \frac{1}{2} * base * height$
 - Circumference $\triangle =$ the sum of the lengths of all its sides
- b) The floor pattern consists of vertical straight lines. A straight line has an angle of 180° , so it can be said that the dancers form a 180-degree angle.
- c) The floor pattern forms a circle. A circle is one of the plane figures that only has one side and does not have any vertices. The dancers form a circle, so the formulas for the area and circumference of a circle can be found as follows:

- Area $\bigcirc = \pi r^2$
- Circumference $\bigcirc = 2\pi r$

Among the patterns of Rantak dance from West Sumatra shown above, it is evident that there are mathematical elements present. Therefore, Rantak dance can be utilized as a learning medium in the classroom.

These formations not only create visually appealing aesthetics but also adhere to profound geometric principles. This research proves that Rantak dance is a result of the fusion of art and mathematics, where arranging dancers in precise formations is the key to creating a captivating visual display.

The traditional musical instruments used in Rantak dance, such as talempong, gandang, and drums, serve not only as musical accompaniments but also as significant ethnomathematical elements in this performance. Additionally, the accompanying musical instruments of the dance are closely related to mathematics. For instance, the shapes of these musical instruments resemble cylinders, as shown in the image below.



Figure 3. (a) Gandang; (b) cylindrical in shape

From the above image, it can be observed that one of the traditional musical instruments accompanying Rantak dance from West Sumatra is cylindrical in shape, allowing for the calculation of its volume and surface area as follows:

- Volume $\text{Cylinder} = \pi r^2 t$
- Surface Area $\text{Cylinder} = 2\pi r t + 2\pi r^2$

Not only does the shape of these musical instruments produce complex rhythmic patterns, but dancers must also understand rhythm mathematics to synchronize with the music. This requires a deep understanding of rhythm calculations, timing, and precise coordination.

Furthermore, rhythm arrangement also considers profound mathematical principles. Proper rhythm is key to maintaining choreography and dancer movements in line with the music. This research reveals that the selection of musical instruments and rhythm in Rantak dance is not only based on preferences but also considers essential mathematical aspects in the performance.

In addition to the ethnomathematical aspect, Rantak dance also serves as a cultural symbol and identity for the Minangkabau community. The mathematical principles applied in Rantak dance not only embody high artistic quality but also strengthen cultural identity. The Minangkabau community regards Rantak dance as an integral part of their cultural heritage. This dance is not just a performing art but also a manifestation of rich cultural values and local identity (Mangkin et al., 2021).

In the modern world dominated by technology, preserving cultural heritage becomes increasingly crucial. The use of audio and visual recordings, digital documentation, and other media can assist in conserving Rantak dance. Technology can aid in creating accurate and easily accessible archives to ensure that knowledge about ethnomathematics in Rantak dance remains available for future generations.

3.2. Ethnomathematics in Rantak Dance

Ethnomathematics is an interdisciplinary field of study that combines ethnography (understanding culture and society) with mathematics. Ethnomathematics focuses on understanding how mathematics and mathematical concepts are reflected in culture, traditions, and the daily lives of people. Its goal is to explain

and explore the various ways in which mathematical knowledge is applied in specific cultural and social contexts.

Ethnomathematics does not merely view mathematics as a standalone entity but seeks to understand how mathematics integrates into human activities and thinking within specific cultural and contextual settings. This field responds to the understanding that mathematics is not only a universal phenomenon that emerges in all cultures in the same way but is also influenced by specific cultural factors (Dewi et al., 2019).

In practice, ethnomathematics involves in-depth research into how people in various cultures understand and apply mathematical concepts in their daily lives. This may include observations of how a society measures, counts, and organizes things, as well as how mathematical concepts are used in activities such as agriculture, trade, art, and religious rituals.

One common example often used in ethnomathematics studies is traditional measurement systems used in specific cultures, which may differ from the more commonly adopted metric system. Ethnomathematics also examines concepts such as comparison, proportion, geometry, and other mathematical principles reflected in the everyday practices of specific communities (Lestari, 2019).

Rantak dance, as an integral part of Minangkabau culture, demonstrates how mathematics permeates every aspect of this performance. Research results indicate that movements in Rantak dance are tightly regulated by specific rules. These movements are not merely random but are governed by mathematical principles. Rantak dancers must follow movement patterns that reflect symmetry and mathematical patterns. The movements of the dancers' hands are often symmetrical, where the movement of the right hand is followed by a similar movement of the left hand. This research reveals that every step in Rantak dance is chosen not only based on aesthetics alone but also based on deep mathematical regularity.

Furthermore, the arrangement of dancers in Rantak dance performances reflects the application of mathematics in geometric aspects. The placement of dancers in circle formations, squares, or other patterns is concrete evidence of how geometric principles are integral to this dance. These formations create visual balance that captivates the audience's eyes. It also illustrates how the arrangement of dancers in Rantak dance serves not only as a mere artistic performance but also as a manifestation of the application of mathematics in cultural arts (Apriliyani & Mulyatna, 2021).

Furthermore, the selection of musical instruments and the arrangement of rhythm in Rantak dance also utilize mathematical principles. Traditional musical instruments such as *talempong*, *gandang*, and drums are used in this performance. These musical instruments produce complex rhythmic patterns, and dancers must synchronize with the music rhythm precisely. This requires a deep understanding of rhythm calculation and timing. This research proves that mathematics is not only applied in the dancers' movements but also in the musical elements that support the performance.

These findings indicate that ethnomathematics in Rantak dance is a reality that plays a significant role in Minangkabau culture. It reflects that mathematics is an unavoidable element in various aspects of Minangkabau community life. In Rantak dance, mathematics is not just a measuring tool but also an element that deepens the meaning and aesthetics of this performance.

Furthermore, this research reveals that knowledge of ethnomathematics in Rantak dance is often passed down orally from generation to generation. This indicates that oral tradition plays a crucial role in preserving this knowledge. Knowledge of ethnomathematics in Rantak dance is often unwritten and embedded in direct experience. Therefore, it is important to consider how this oral tradition can be preserved and continued in the face of modern challenges (Hasan & Budiarto, 2022).

In addition to the ethnomathematical value in Rantak dance, this research also highlights the cultural and identity values in traditional art. Rantak dance is concrete evidence of how traditional art can strengthen social bonds and cultural values in Minangkabau society. This dance is not just entertainment but also a cultural symbol and local identity. The importance of preserving this art is not only in the context of art itself but also in preserving cultural identity and local history.

Overall, this research emphasizes how ethnomathematics in Rantak dance from West Sumatra is tangible evidence of how mathematics is an integral element in the daily lives of the Minangkabau community. The ethics of Rantak dance not only reflect the application of mathematics in movements and rhythms but also how mathematics is an inseparable part of culture and local identity. Through a deeper understanding of ethnomathematics in Rantak dance, researcher can better appreciate the cultural and mathematical richness inherent in this traditional art. Furthermore, this research provides a foundation for

efforts to preserve cultural heritage and develop richer art education in the context of Minangkabau society. (Saputra et al., 2022).

3.3. Digital Documentation of Rantak Dance

Digital documentation is a key component in preserving Rantak dance. These documents involve collecting, storing, and organizing information about Rantak dance, including its ethnomathematical aspects (Saputra et al., 2022). Digital documentation includes written documents, images, audio recordings, and videos that explain and illustrate various aspects of Rantak dance. The utilization of digital documentation provides advantages in accessibility and ease of use. This information can be easily shared and accessed by anyone interested in learning Rantak dance. These documents can also be updated and improved over time to remain relevant and accurate.

Moreover, digital documentation enables collaboration among researchers, preservers, and other stakeholders who wish to contribute to the preservation of cultural heritage. This creates a collaborative resource that can be continuously enriched and expanded by various parties interested in Rantak dance and its ethnomathematical aspects.

The development of social media and digital education has provided a broader platform to introduce Rantak dance and its ethnomathematical aspects to a wider audience. Videos, photos, articles, and educational content shared through platforms such as YouTube, Instagram, and educational websites have made Rantak dance more accessible and popular worldwide.

Although there are challenges, technology provides invaluable opportunities in preserving cultural heritage such as Rantak dance. With the right approach, technology can help maintain the authenticity, accessibility, and sustainability of knowledge about ethnomathematics in this dance. This opens the door for future generations to continue appreciating and celebrating this valuable cultural heritage, ensuring that Rantak dance from West Sumatra and other traditional arts continue to thrive and evolve in the endless journey of history.

4. Conclusion

This research has demonstrated the central role of ethnomathematics in the Rantak dance performance in West Sumatra. The findings reveal a strong relationship between mathematics and this cultural art form, as well as the deeper impact of ethnomathematics on Minangkabau society. The conclusions drawn from this research present various aspects that need to be understood and appreciated.

In this study, several mathematical elements were found, including two-dimensional and three-dimensional spatial structures in the musical rhythm, calculations of timing, and numerical patterns in each interval of the Rantak dance from West Sumatra. This research makes a significant contribution to our understanding of the role of mathematics in local culture and traditional art. In an ever-evolving era, the preservation of cultural arts and local traditions is becoming increasingly urgent. The application of technology in cultural heritage preservation poses both challenges and opportunities.

With knowledge of ethnomathematics in Rantak dance, researcher can see that mathematics is not just a dry science but also an enriching element of culture and art. In the context of Rantak dance, mathematics is a language that expresses stories, values, and identities. Therefore, Rantak dance from West Sumatra is tangible evidence of how ethnomathematics enlivens culture.

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