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GEOMETRIC PATTERNS IN JAIPONG DANCE: AN ETHNOMATHEMATICS STUDY

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ABSTRACT
Jaipong dance is a traditional dance deeply rooted in the culture of West Java. However, not everyone is aware that Jaipong dance incorporates mathematical elements into its performance. Therefore, the aim of this research is to analyze mathematical concepts, particularly geometric patterns, within Jaipong dance. The research approach employed is ethnography, with data analysis including domain analysis, taxonomic analysis, and ethnographic analysis. Data was collected through three main methods: interviews, observations, and documentation. The research findings reveal the utilization of mathematical concepts in Jaipong dance. This includes counting from 1 to 8 to maintain the dance's rhythm and the use of geometric shapes in floor patterns. The floor patterns in Jaipong dance reflect the spatial arrangement used in the dance performance. Some of the floor patterns used in Jaipong dance encompass straight lines, diagonals, triangles, quadrilaterals, and pentagons. Thus, Jaipong dance not only blends artistic movements but also integrates mathematical and geometric concepts within its floor patterns. Geometry plays a significant role in creating visual aesthetics and regulating interactions among the dancers during Jaipong dance performances.
Keywords: Ethnomathematics, Jaipong Dance, Patterns, Geometry

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PRELIMINARY

Mathematics is one of the fundamental subjects that is compulsory to study from primary school to high school. One of the topics covered in mathematics is geometry, which deals with patterns, lines, points, angles, plane shapes, and spatial figures (Jainuddin et al., 2022). Geometry is a subject that introduces the relationship between points, lines, angles, and planes. Through the study of geometry, students develop logical thinking skills and sharpen their spatial intuition, which they can apply in their daily lives (Clements, 2003). Geometry is considered a challenging subject to learn (Cesaria et al., 2021) due to its abstract nature, making it difficult for students to grasp. Van Hiele identified stages of student thinking in understanding geometry, including recognition, analysis, ordering, deduction (Rafianti, 2016) Geometric patterns introduce concepts with artistic value that can be applied in everyday life, such as in architecture, visual arts, dance, and more. An example is the

application of geometric concepts in the architecture of the Gadang house, including flat shapes, the concept of geometric transformations such as translation (shift), rotation, and reflection (Susanti et al., 2023). However, teachers often struggle to explain geometry without concrete teaching aids.

One tangible medium for learning geometry is the art of dance. An example of such dance originating from West Java is Jaipong dance. Jaipong is a relatively new genre in the Sundanese dance tradition, incorporating elements from various traditional folk arts (Mulyana & Ramlan, 2012). Over time, Jaipong has thrived and spread to various regions in West Java, resulting in a diversity of regional styles. Jaipong dance is often performed for entertainment, such as at celebrations, wayang golek, and bajidoran performances (Nuriawati & Nalan, 2018). Jaipong dance draws from a range of traditional arts, including Ketuk Tilu, Pencak Silat, Topeng Banjet, and Kliningan Bajidoran. The structure of Jaipong dance consists of four segments: opening, pencugan, nibakeun, and minced (Regina et al., 2020). Jaipong dance has evolved into several different forms but is fundamentally categorized into three types: tari putri, tari putra, and tari pasangan (Amrullah, 2021).

In addition to its entertainment value, Jaipong dance can also serve as an educational medium, both in non-formal and formal education. In non-formal education, it is typically taught in dance studios, providing instruction in the art of Jaipong dance. In formal education, Jaipong dance is integrated into the school curriculum as a teaching material. Further examination reveals that Jaipong dance incorporates mathematical elements, which is known as ethnomathematics. Ethnomathematics is the study of mathematics as it manifests within the culture (ideas, activities, and cultural objects) that distinguishes a particular community or region (Fitriza et al., 2018). It can be defined as the mathematics practiced within cultural groups, such as national communities, ethnic groups, age-specific groups, and professional classes (Andriyani & Kuntarto, 2017). Ethnomathematics examines the mathematical practices that arise and develop within a society to address specific issues. Mathematical problems related to culture often surround the learning process of mathematics or other mathematical applications (Sroyer et al., 2018).

Ethnomathematics in dance, such as Jaipong dance, includes the study of geometric patterns. Ethnomathematics in dance has been explored in previous research. Some earlier studies have delved into geometric patterns in dance, such as group theory and transformation geometry in Buyung dance (Andriani & Muchyidin, 2020), basic geometry in Banjar Baksa Kembang dance (Habibah et al., 2022), and plane figures in Gandrung Banyuwangi dance (Mukarromah & Darmawan, 2022). There are several studies discussing

ethnomathematics in Jaipong dance (Hartanti & Ramlah, 2021),(Renali & Astuti, 2023). In the research by Hartanti & Ramlah (2021), it is explained that the mathematical concept in Jaipong dance lies in the dancers' movements following the rhythm of the accompanying music and the accompanying gamelan instruments. Meanwhile, in the study by Renali & Astuti (2021), it is described that Jaipong dance involves mathematical concepts such as geometric transformations, including rotation, reflection, dilation, and translation.

Therefore, mathematics has a close connection with the art of dance because dance can serve as a concrete means of learning mathematics, enabling learners to develop creative thinking skills and practice critical and logical thinking. Thus, ethnomathematics in Jaipong dance is still relatively underexplored, and there has been no research on the geometric shapes present in Jaipong dance. Given these considerations, the objective of this research is to analyze the geometric patterns in Jaipong dance. The findings of this study can serve as valuable content for concrete geometry teaching materials for secondary and advanced students. Abstract geometric patterns can significantly influence students' thinking levels and their ability to visualize geometric patterns effectively.

METHODS

This study is a qualitative research with an ethnographic approach (Soepeno, 2019). Data analysis in this research includes domain analysis, taxonomic analysis, and ethnographic analysis. The data analysis process involves grouping the research data and organizing it according to the research problem and objectives. The research object in this study is the Student Activity Unit for the Arts at Universitas Buana Perjuangan Karawang (UBP Karawang). The dance club has a total of seven members who come from various study programs at UBP Karawang. The dance club is supervised by one person who also serves as a lecturer. Observation was conducted by observing Jaipong dance performances by the members of the UBP Karawang Arts Club. Interviews were conducted with the dance club advisor at UBP Karawang.

Data was collected through three methods: observation, interviews, and documentation. Data collection was conducted through direct observation at the dance club by observing, taking notes, and capturing necessary images. This was carried out during the dance club's practice sessions. Additionally, interviews were conducted with the dance club instructors and some members regarding their understanding of Jaipong dance and its application with mathematics.

The research process can be depicted in the following flowchart

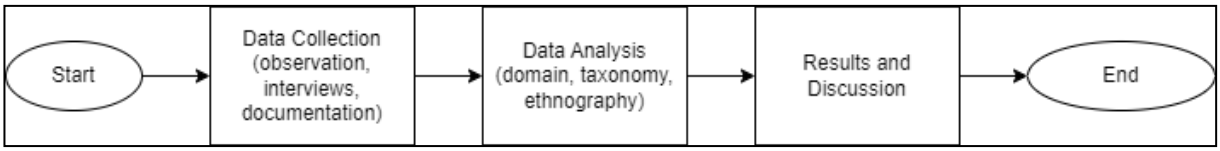


Figure 1. Research Procedure

Research procedure stages include:

1. Data Collection, three methods are employed for data collection: direct observation at the dance club, interviews with dance club instructors and members, and documentation through the capture of photos or other relevant materials.
2. Data Analysis, three types of analyses are conducted: (1) Domain Analysis: Involves collecting and categorizing acquired data; (2) Taxonomy Analysis: Identifies patterns and geometric forms from interviews, grouping them into relevant categories; (3) Ethnographic Analysis: Involves interpreting the cultural significance, in this case, of Jaipong dance, within the framework of mathematical concepts.
3. Results and Discussion, summarizes and explains the obtained results. These research steps encompass the collection, analysis, and discussion of data, providing a comprehensive approach to exploring the connection between Jaipong dance and mathematical concepts.

RESULT AND DISCUSSION

Jaipong dance is a traditional dance originating from West Java, Indonesia. This dance is characterized by its unique movements, costumes, and floor patterns. One intriguing aspect to explore is the use of geometry in the floor patterns of Jaipong dance. Geometry is an essential element not only in mathematics but also in performing arts, including Jaipong dance.

This research was conducted within the Student Activity Unit for the Arts at UBP Karawang, specifically focusing on dance, with members comprising female students from various study programs. The data for this study were obtained through observations and interviews with the advisor of the Arts UKM, Dr. Anggy Giri Prawiyogi, M.Pd., M.Sn., serving as the primary informant.

Figure 2. Documentation with the Interviewee

The interview results can be seen in the following table:

Table 1. Interview Results with the Expert

Number	Question	Answer
1	What do you know about Jaipong dance?	Jaipong is a traditional dance that is distinctive to the West Java region.
2	What makes Jaipong dance unique compared to other dances?	The uniqueness of Jaipong dance lies in its fluid and synchronized body
3	How many types of Jaipong dance are there today?	There is only one type of Jaipong dance; the variation lies in the song titles. However, Jaipong dance can be categorized as Jaipong Pakem and Jaipong Kreasi (modified).
4	What are some basic movements you are familiar with?	Ukel, mincit, and sonteng are examples of basic movements in Jaipong dance.
5	Does the music and rhythm in Jaipong dance influence the dance movements?	Yes, the music and tempo significantly affect the movements in Jaipong dance.
6	Are there differences between Jaipong dance for males and females? Please specify!	The difference lies in the fact that male Jaipong dance movements are more robust, while female Jaipong dance movements are more fluid.

Number	Question	Answer
7	Are there mathematical concepts in Jaipong dance movements? Please specify!	Yes, there are mathematical concepts, such as counting from 1 to 8 and floor patterns that form mathematical geometric shapes, for example, triangles, rectangles, and trapezoids.

Based on Table 1, it can be concluded that Jaipong dance is a traditional dance originating from West Java. Jaipong dance can be categorized into two types: Jaipong Pakem and Jaipong Kreasi. The difference lies in the dance movements; Jaipong Pakem uses traditional, well-defined movements or basic Jaipong steps, while Jaipong Kreasi incorporates modified dance movements. Both types of Jaipong can be performed individually or in groups.

Several basic movements in Jaipong dance include ukel, mincit, sonteng, and others. Ukel involves rotating the wrist to create a curved position (ukel) (Makki et al., 2017). On the other hand, mincit is a transition between various dance movements and is performed by dancers after they have executed the Ngala movement.

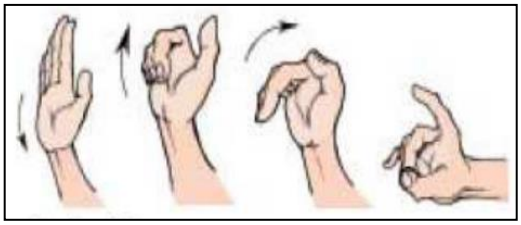


Figure 3. Ukel Movement
(Source: Supriatna & Negara, 2010)

Furthermore, the interview results also indicate that there are mathematical concepts in Jaipong dance, specifically involving the concept of counting from 1 to 8 to mark the rhythm of Jaipong dance movements and the geometric concept in floor patterns. The counting concept is used to indicate the beats of the dance's rhythm during Jaipong dance practice to synchronize the tempo of Jaipong dance movements. Typically, the counting can range from 1 to 4 or 1 to 8, depending on the specific dance movements being performed. These counting beats are repeated until the dance movement is completed. However, during a performance, these counting beats are replaced by the rhythm of the music.

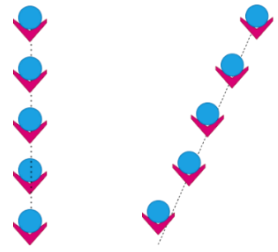
The floor patterns in dancing determine the positions of the dancers and constantly change to match the choreography of Jaipong dance. Some common floor patterns used in Jaipong dance include straight lines, diagonals, triangles, rectangles, pentagons, and other

geometric shapes. This research is in line with the findings reported by Sagala & Hasanah (2023), which indicate the presence of geometric plane figures that are intrinsically related to the architectural structure of the State Museum of North Sumatra. This can be interpreted as the implementation of ethnomathematics principles.

In this discussion, we will delve further into how geometry is used in the floor patterns of Jaipong dance. The floor patterns in Jaipong dance represent the spatial layout used in the dance performance. These floor patterns play a crucial role in determining dance movements and interactions among the dancers. They possess distinct geometric elements that form the basis of the dance's aesthetics.

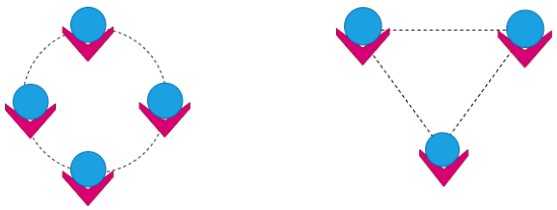
In Jaipong dance, the dance floor becomes a canvas where the dancers move. Dancers use this space to move forward, backward, spin, or leap. This space is also used for communication between the dancers. The floor patterns create a connection between space and movement, with geometry playing a role in orchestrating interactions among the dancers in a group.

Some of the floor patterns used in Jaipong dance include straight lines, diagonals, triangles, rectangles, pentagons, and other geometric shapes. The first floor pattern consists of lines, which can be either straight or diagonal. In this position, the dancers line up to form a straight line. In the case of a straight line, the dancers use it to adjust their formation on the stage. Dancers also need to maintain the distance between each other, indicating how far apart each dancer's position should be from one another. This is illustrated in the following Figure 4:



(a) (b)

Figure 4. (a) Straight Line Floor Pattern; (b) Diagonal Line Floor Pattern



(a) (b)

Figure 5. (a) Circle Floor Pattern; (b) Triangular Floor Pattern

One of the dance movements frequently observed is the dancers' circular motion within a circle pattern, as seen in Figure 5. (a). This circular pattern creates a sense of harmony and balance in the performance. In mathematics, a circle is defined as a set of points in a two-dimensional plane equidistant from a specific point known as the circle's center (Hidayad, 2014; Liptak & Scholtzova, 2021). The distance from the center to each point is referred to as the radius. Furthermore, Figure 5 (b) represents a triangular floor pattern. The dancer positioned at the center of the triangle becomes the focal point of attention, as their dance movements may differ from those of the dancers at the triangle's corners, who play a role in responding to or supporting the central dancer's movements. The triangular pattern used can be either an equilateral triangle or an isosceles triangle. A triangle is a two-dimensional shape with three sides.

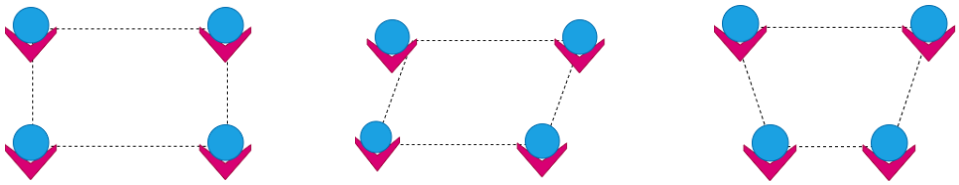


Figure 6. (a) Rectangular Floor Pattern; (b) Parallelogram Floor Pattern; Trapezoidal Floor Pattern

One of the commonly used floor patterns in Jaipong dance is the quadrilateral pattern. There are many forms of quadrilaterals, such as squares, rectangles, rhombuses, kites, parallelograms, and trapezoids (Asnawati & Caswita, 2018). Figure 6 (a) represents the rectangular floor pattern, in which dancers form a formation resembling a rectangle on the floor. Typically, the dancers stand side by side, creating two long sides and two short sides in the rectangular formation. The rectangular formation has strong symmetry elements with parallel and equal-length sides. In this context, the parallel sides of this geometric shape are used to guide the dancers' movements, while the corners may be used for interaction or directing the movements.

Next, Figure 6 (b) represents the parallelogram floor pattern. This floor pattern involves two parallel sides and two other sides that are also parallel but shorter, creating a dynamic shape on the floor. The parallelogram's property, which may have different angles, can create diagonal or transversal movements from one side to the other. This conveys a sense of distance and interaction between the dancers, presenting an interesting visual dynamic in the dance performance. Meanwhile, Figure 6 (c) illustrates the trapezoid floor pattern. The trapezoid floor pattern in Jaipong dance refers to the formation of dancers creating a trapezoid shape on the stage floor. A trapezoid is a quadrilateral shape with two

parallel sides (opposite sides) and two other sides that are not parallel. Additionally, the angles in a trapezoid may have various measurements, not necessarily right angles. Therefore, the trapezoid floor pattern in Jaipong dance is used to create inclined movements, depicting imbalance and non-symmetry. This floor pattern allows the dancers to move diagonally or obliquely, adding an interesting dynamic and greater flexibility to the performance.

Figure 7. Pentagon Floor Pattern

One two-dimensional shape used for floor patterns is the pentagon, as seen in Figure 7. In this pentagon floor pattern, a minimum of 5 dancers is required on each of its sides. These sides may serve as guides for the dancers' movements, such as walking or spinning along the pentagon's sides. Dancers can combine the pentagon formation with other geometric shapes, such as hexagons or circles, to create intriguing movement variations and more complex visual dynamics. In mathematical terms, a pentagon is a well-known geometric shape. A pentagon is a polygon with five sides of varying lengths and five angles. The pentagon exhibits several types of symmetry, including 72-degree rotational symmetry, which means that its shape remains the same if rotated by 72 degrees five times (Sparavigna & Baldi, 2017).

Based on the research findings, it is obtained that the mathematical concepts in this study include the concepts of counting from 1 to 4 or 1 to 8 for the rhythm beats in dance movements. Additionally, there are also concepts related to lines and geometric shapes in the floor patterns used by the dancers. These results align with previous research findings that in tradisional dance, there are mathematical concepts, particularly in geometry (Mukarromah & Darmawan, 2022; Renali & Astuti, 2023). The results of this research hold the potential for the development of an art-based learning approach that can incorporate mathematical concepts, especially geometry. Its implementation in the educational model at schools has the potential to enhance interest and creativity in learning mathematics. Additionally, this research can serve as an effective means to introduce traditional culture, such as Jaipong dance, while integrating an understanding of mathematical concepts, thus

increasing appreciation for cultural richness and the relevance of mathematics in everyday life.

Although this research provides valuable insights, it is important to acknowledge certain limitations that may impact the interpretation and generalization of findings. The research's focus on Jaipong dance within the cultural context of West Java may limit the generalization of these findings to other traditional dances. Furthermore, the ethnographic approach used tends to be subjective, potentially affecting the objectivity of the findings. Some aspects of mathematical concepts, particularly those related to visual aesthetics in dance, may be challenging to quantify objectively, limiting the level of quantitative analysis that can be conducted. Nevertheless, this research contributes to understanding the relationship between traditional dance and mathematical concepts.

CONCLUSION

Jaipong dance is a traditional dance originating from West Java and can be classified into two types, Jaipong Pakem and Jaipong Kreasi. This dance incorporates several basic movements, such as "ukel," "mincit," and "sonteng." Jaipong dance also involves the use of mathematical concepts, such as counting from 1 to 8 to regulate the rhythm of Jaipong dance and geometric concepts in floor patterns. The floor patterns in Jaipong dance reflect the spatial layout used in the dance performance. These patterns play a vital role in determining dance movements, interactions among the dancers, and creating a unique aesthetic impression in the dance. Various floor patterns used in Jaipong dance include straight lines, diagonals, triangles, rectangles, pentagons, and other geometric shapes. In the realm of mathematics, geometric shapes possess specific properties and characteristics, including the number of angles, lengths of sides, and symmetry. Therefore, Jaipong dance not only combines artistic movements but also integrates mathematical and geometric concepts in its floor patterns. Geometry plays a crucial role in creating visual aesthetics and organizing interactions among the dancers in Jaipong dance performances.

Suggestions for further research include exploring other mathematical concepts beyond geometric plane figures. The development of a learning model that integrates mathematical concepts and dance, particularly Jaipong dance, is also proposed as a contribution to innovative education. Sociocultural aspects and the active perspectives of Jaipong dancers and instructors can be a focus to deepen understanding of the relationship between traditional dance and mathematical concepts in the context of Jaipong dance.

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