Exploring Some Mathematical Pattern in Zapin Pat Lipat and Zapin Tenglu Pak Akob

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Abstract

This research explores the mathematical patterns inherent in the traditional Malaysian dances which are Zapin Pat Lipat and Zapin Tenglu Pak Akob, through the perspective of ethnomathematics. Ethnomathematics bridges the gap between mathematical concepts and cultural practices, uncovering the mathematical structures embedded in traditional arts. Previous studies highlighted the presence of frieze patterns and geometric elements in these dances. The study identifies frieze patterns in Zapin Pat Lipat using symmetry operations and group theory. In Zapin Tenglu Pak Akob, the focus is on geometric properties like shapes, angles, and spatial relationships by using principles of Euclidean geometry and symmetry. Additionally, the choreographic sequences are represented with matrices to capture the dance dynamics. This research not only deepens the understanding of the mathematical aspects of Zapin dances but also aids in cultural preservation and education. By uncovering the hidden mathematics in these traditional dances, the study enhances the appreciation of cultural heritage and shows how mathematics can be applied in cultural contexts.

Keywords: Ethnomathematics; Zapin Pat Lipat; Zapin Tenglu Pak Akob; Frieze Patterns; Geometric Analysis; Matrix Representation

1. Introduction

Mathematics is an expansive field encompassing diverse applications and theoretical foundations, including the fascinating study of ethnomathematics. Referring to Wan Muhammad Fauzan et al. in [1], ethnomathematics is an area of studies in mathematics that was created based on the culture and ethos of an ethnic. Besides, D'Ambrosio in [2] introduced ethnomathematics as a technological art of knowing, educating, illustrating, learning, dealing, and handling human lives in a certain way that fits society. By studying ethnomathematics, researchers delve into the mathematical reasoning, symbols, and structures inherent in traditional rituals, arts, and dances, providing a holistic understanding of mathematical knowledge across different cultures.

The Zapin dance is one of the traditions that can be used as an alternative to learning mathematics. There are several types of Zapin, and each type differs in movement and dance style. In this research, two types of Zapin which are Zapin Tenglu Pak Akob and Zapin Pat Lipat will be discussed.

2. Literature Review

2.1. A Relation Between Mathematics and Malay Culture

Ethnomathematics is a term that encompasses various interpretations, with researchers offering their own understandings based on their perspectives. Among them are the definition by Wan Muhammad Fauzan et al. [1] which expresses ethnomathematics as the mathematics that was created based on culture and the value system of an ethnic. This definition is intricately linked to the manifestations outlined in the earlier statement by D'Ambrosio in 1985. He emphasized the idea that culture expresses itself through various elements such as jargons, codes, myths, symbols, utopias, and ways of reasoning

and inferring. Accompanying these cultural manifestations are practices like ciphering and counting, measuring, classifying, ordering, inferring, modelling, and so on, all of which constitute the essence of ethnomathematics [3]. This interconnection is fundamental to defining ethnomathematics.

2.2. The Origin of Zapin
Zapin is one of the four not regional, original Malay dances, alongside Joget, Inang, and Asli dance [1]. It originated in the Middle East, brought by Arabs involved in trade with Malaysia, and its rich culture has deeply influenced Malaysian musical evolution. The Zapin contains the Oud, a form of lute brought to Malaysia by the Arabs and known as a Gambus in Malaysia [4]. The Zapin dance is distinguished from other genres by a distinct rhythmic pattern played by the Marwas (drums). The tempo of this dance varies from moderate to rapid. The Zapin Melayu is an adaptation of the original Zapin Arab, which came through during the Malacca trade times, and has undergone adaptations and assimilations of the two cultures, both religiously and culturally [5].

2.2.1 The Origin of Zapin Pat Lipat
According to Warisan Zapin Flora Jaya in [6], Zapin Pat Lipat is a variety of zapin dance in the Muar area that originated in Parit Bugis, Parit Yusof, and has now spread to Parit No. 2, Parit Yusof Darat (Sungai Balang subdistrict). Imam Nasir bin Mahmud Sulaiman is the Zapin Pat Lipat's third generation heir. He was a religious teacher in the village and had taught Md Amin bin Ma'osom this dance. This zapin was initially performed to the accompaniment of Arabic songs such as Sollualallahhadisofi and Yaa Badi'usami. However, this zapin, on the other hand, includes the accompaniment of Malay songs such as Terang Bulan, Inang Baru, Lancang Kuning, and Mawar Putih. Md Amin has also formed the 'Zapin Sri Serumpun' group.

2.2.2 The Origin of Zapin Tenglu Pak Akob
Zapin Tenglu Pak Akob was formed by the late Yaakob bin Amir Hamzah, also known as Pak Akob. Pak Akob, the late Yaakob bin Amir Hamzah, began studying and deepening his understanding of zapin dancing when he was 18 years old. He learned the movement of the zapin dance from an Arab Sheikh named Sheikh Ali. In 1963, Zapin Tenglu Pak Akob was founded. In truth, the zapin dance originated in Mersing, Johor. Zapin Tenglu Pak Akob is a dance that is distinct from other forms of zapin dances, such as Zapin Tenglu Mak Usu. This is because this zapin has its own characteristics and identity. Among its unique features are, this zapin dance has a rather agile, rough and also quite aggressive movement. Due to the aggressiveness and agile nature of this zapin dance, this dance is more suitable to be danced by men than women.

2.3. Frieze Pattern
Frieze pattern is defined as one with symmetry "in one direction" and friezes itself are designs found directly beneath the rim of a roof, window, or other structure [7]. In dance, this pattern can be referred to the repetitive and rhythmic sequences of movements or motifs performed by dancers, often arranged in a linear or continuous fashion. It can manifest in various forms, including simple repetitive gestures, synchronized footwork, or coordinated arm movements. Here are the 7 frieze patterns in footwork form [7]:
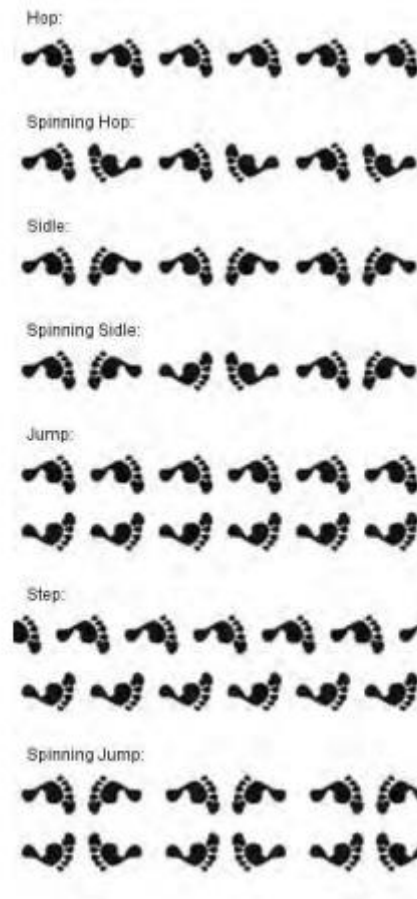
Figure 1 Frieze patterns for feet

3. Methodology

To identify Frieze patterns in Zapin Pat Lipat, a relevant YouTube video of a Zapin Pat Lipat performance will be selected for analysis. The chosen video will be carefully selected based on its clarity, quality, and suitability for pattern recognition. The video will be analyzed to identify repeated motifs, movements, and patterns. Mathematical techniques, including symmetry operations and group theory, will be applied to classify and analyze the identified patterns.
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4. Results and discussion

4.1. Seven Types of Frieze Pattern

Frieze patterns, characterized by their repetitive motifs, are essential elements of many decorative designs and cultural expressions. These patterns are created through the repetition of a fundamental motif or pictorial element in one direction [8]. Identifying a specific Frieze Pattern among the seven types can be challenging. However, the following flow chart (Figure 2), which was adapted from Kartika et al. [9], could be useful for categorizing the patterns:
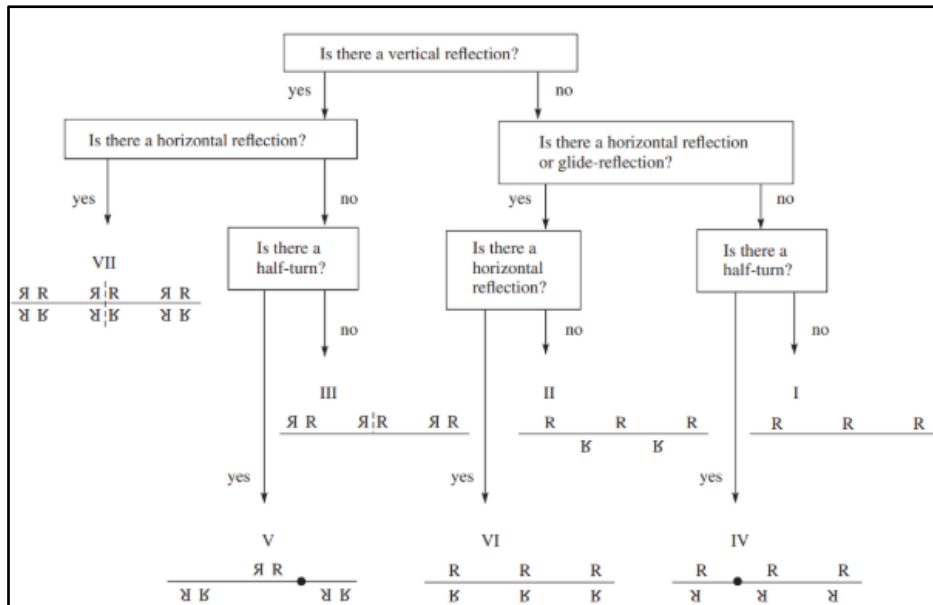
Figure 2 Flowchart on classification for each type of Frieze Pattern

4.1.1. Type 11 or hop

The simplest type of Frieze Pattern is called Type 11 that contains only translational symmetry [8]. In this pattern, the motif repeats indefinitely in a single direction without any reflection or rotation.

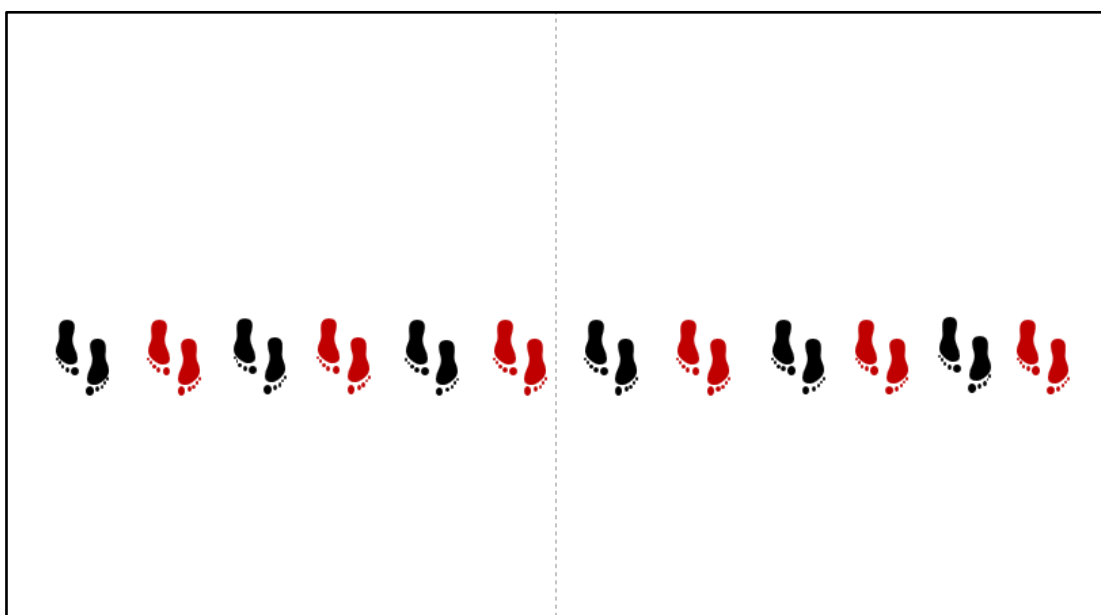**Figure 3** Translation symmetry in dance formation

Figure 4 Translation symmetry in floor pattern

4.1.2. Type 1g or Step

In Frieze Translation plus Glide Reflection (TG) (p1g1), translation and glide reflection are combined. The elements are translated along one direction and then reflected about a horizontal axis [8]. This combination results in a pattern where each motif is translated and then mirrored in a glide reflection. The followings are the example of Frieze Pattern Type 1g or Step:

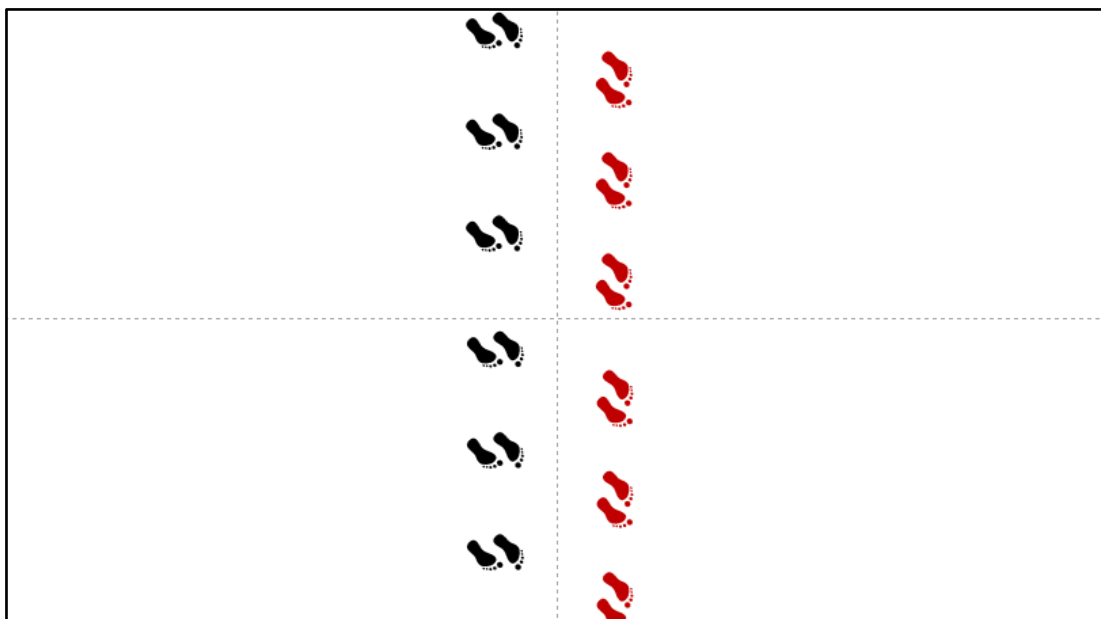**Figure 5** Translation and glide reflection in dance formation

Figure 6 Translation and glide reflection in floor pattern

4.1.3. Type 12 or Spinning Hop

Frieze Translation and 180° Rotation (TR) (p112) exhibits translation and 180° rotation [8]. In this pattern, the elements are translated along one direction and then rotated by 180 degrees. As a result, each motif is both translated and rotated to create the pattern.

Figure 7 Translation and rotation in dance formation

Figure 8 Translation and rotation in floor pattern

Conclusion

The classification for every possible frieze pattern that exists in the Zapin Pat Lipat into its type has been done. From this classification, it is clearly seen that the dance formation in Zapin Pat Lipat does not fully satisfy the existence of every type of Frieze Pattern since there are two types that do not appear. The formation of the dance is repetitive, which finally brings out 62 dance formations in the Zapin Pat Lipat dance by the observation method.

Acknowledgement

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