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Frieze Pattern in Malay Traditional Dance: Zapin Tenglu Pak Akob

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Abstract
The purpose of this study is to investigate the existence of Frieze Pattern in malay traditional dance, namely Zapin Tenglu Pak Akob. This zapin dance has a rather agile, rough and also quite aggressive movement which explained why this dance is more suitable to be danced by men than women. By observing the formation of the dance, there exists several mathematical ideas such as the subject of geometry, geometry transformation, and the counts and measurements produced by the dancers while performing the Zapin Tenglu dance. Every formation that satisfies the presence of Frieze Pattern will be classified into each type of Frieze group. This research is considered as a qualitative study. All the data that was needed for this research paper was obtained from thorough observation and documentations. Based on the final result obtained from this research, it can be concluded that the dance formation in Zapin Tenglu Pak Akob dance is somewhat similar to the pattern of the Frieze group. Also, the classification of pattern into 7 different Frieze group is made in order to identify which types of Frieze group were existed the most in the Zapin Tenglu Pak Akob dance.
Keywords: Frieze Pattern; Zapin Tenglu Pak Akob; traditional dance; geometry; symmetrical

1. Introduction

Generally, Zapin Tenglu is one of the zapin in Johor. Zapin Tenglu can be divided into three types, namely Zapin Tenglu Mak Usu, Zapin Tenglu Pak Akob, and also Zapin Tenglu Pak Othman. This research is mainly focus on Zapin Tenglu Pak Akob.

According to Jabatan Kebudayaan dan Kesenian Negeri Johor [1], Zapin Tenglu Pak Akob is one of the zapin dances found in Mersing and was created in 1963. It was founded by the late Yaakob bin Amir Hamzah or better known as Pak Akob. The late Yaakob bin Amir Hamzah or Pak Akob began to study and deepen the knowledge of zapin dance since he was 18 years old. To learn the movement of this zapin dance, he learned it from an Arab Sheikh named Sheikh Ali.

This dance is quite different compared to other types of zapin dances including Zapin Tenglu Mak Usu due to its own unique characteristics and identity. This zapin dance has a rather agile, rough and also quite aggressive movement, hence this dance is more suitable to be danced by men than women.

By observing the formation of the dance, several mathematical ideas such as the subject of geometry, geometry transformation, and the counts and measurements could be produced by the dancers while performing the Zapin Tenglu Pak Akob dance. From the observation made within Zapin dance, mainly focusing on Zapin Tenglu Pak Akob, there exist the correlation of geometrical concept in mathematics which will make people more aware the beauty of symmetrical axes could develop a beautiful formation of dance which were classified as Frieze Pattern.

A frieze pattern is a repeated pattern of an infinite strip and it can also be referred to as a border pattern [2]. The word "frieze" comes from architecture, where a frieze refers to an architectural sculpture or design just below a roofline or ceiling.

2. Literature Review

2.1. Ethnomathematics: Relation Between Mathematics and Malay Culture

Referring to Rohrer et al. [3], the person who was responsible in developing and establishing the term Ethnomathematics is Ewald Fettweis (1881-1967). In fact, he was the first researcher to acknowledge ethnomathematics in his analysis and to describe it in his lectures, which has brought a disciplinary status for ethnomathematics. Fettweis's theory of ethnomathematics began in 1930, much sooner than Ubiratan D'Ambrosio's results of the same term.

Ethnomathematics refers to mathematical concepts that develop and are used in the life of a traditional community. Mohamad Zain [4] describes ethnomathematics as a taught, enunciated, used, and written notion of mathematics in the Malay language based on Malay values. In reality, the Malay community has been aware of the term "mathematic," "*ilmu hisab*," or "*kira-kira*" since the beginning of the Hindu-Buddha period. Western experts have labelled the Malay population as incapable of assessing the precision of mathematics. However, it is difficult to assume that Malays' mathematical ideas are only based on their thorough observations of nature. In this regard, ethnomathematics is useful for analysing traditional people's mathematical concepts, which were originally employed in the study of Anthropology.

2.2. Zapin Traditional Dance: The History of Zapin Dance

The origin of zapin was recognized from Zapin Arab Emirates and exchanged names with the name of Zapin Malay in its creation [2]. Music equipment such as the string instrument *Al-Ud* was replaced with Lute, while Tambur was substituted by Marwas. Zapin Malay dance is a gesture that consists of variety or interest. In Malay, traces and direction of zapin indicate cultural acculturation and the Arabs have approached Malay society's life [2]. For centuries, the existence of the Arab nation has continuously experienced solidarity with local communities, including Zapin as an art form that eventually institutionalized and became an essential part of the society.

In the sixth years of the prophet, Zapin was estimated to have existed as Prophet Muhammad SAW asked Ja'far to be the caretakers for Saidina Hamzah's daughter who wanted to join the Prophet SAW shift to Madinah [2]. Immediately, Ja'far was delighted and danced by raising his feet and swung his legs repetitively as a sign of enthusiasm over the Prophet's decision. Based on the Ja'far leg movement, which was also attended by Ali, the spontaneous movements have been established in Arab society as a sign of love and enthusiasm in event. This leg gesture then has become a practice when there were activities at the time that ultimately became an attraction for the community. It was also known that the term *Al-Zafn* implies Zapin [4]. This occurs when the truce with the infidels of *Mecca* (Makkah) begins to emerge.

2.2.1. The Origin of Zapin Tenglu

Generally, Zapin Tenglu is one of the zapin in the state of Johor. Zapin Tenglu can be divided into three types, namely Zapin Tenglu Mak Usu, Zapin Tenglu Pak Akob, and also Zapin Tenglu Pak Othman. However, there are two types of Zapin Tenglu that are better known or popular, namely Zapin Tenglu Mak Usu and Zapin Tenglu Pak Akob. This is because these two zapin dances have their own style that is easier and unique in its steps.

According to *Jabatan Kebudayaan dan Kesenian Negeri Johor* [5], Zapin Tenglu Mak Usu is one of the zapin dances found in Mersing. This Zapin was influenced by the movement from Zapin Pekan (Pahang) and Zapin Banjar (Banjarmasin, Indonesia). According to the heir of the founder to this dance, Habsah Mohamad (see **Figure 1**) who comes from Kampung Tenglu, Jalan Haji Omar, Mersing, this dance was learned from a dance teacher who came from Banjarmasin when she was 14 years old. This Zapin Tenglu Mak Usu dance step was inspired by the movements or behavior of women who play or walk on the beach. Therefore, when this zapin dance is danced, this dance step requires the dancer to dance as if straddling. This move is inspired based on the actions of a person while walking in a watery and wet coastal area. The uniqueness of this dance was the dancers will need to roll their left hand's sleeve and paddle their right hand while moving the shoulder occasionally.

While for Zapin Tenglu Pak Akob, it was founded by the late Yaakob bin Amir Hamzah or better

known as Pak Akob. The late Yaakob bin Amir Hamzah or Pak Akob (see **Figure 2**) began to study and deepen the knowledge of zapin dance since he was 18 years old. To learn the movement of this zapin dance, he learned it from an Arab Sheikh named Sheikh Ali. Zapin Tenglu Pak Akob was created in 1963. In fact, this zapin dance also originates from Mersing, Johor. Zapin Tenglu Pak Akob is a dance that is quite different and unique compared to other types of zapin dances including 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.

Figure 1 Habsah Binti Mohamad or as known as Mak Usu founder of Zapin Tenglu Mak Usu

Figure 2 The late Yaakob Bin Amir Hamzah, known as Pak Akob founder of Zapin Tenglu Pak Akob.

2.3. Frieze Pattern

2.3.1. Geometry and Symmetry

According to Elya Roza et al. [2], a geometric motif or pattern represents abstract, non- representational forms like lines, circles, ellipses, triangles, polygons and rectangles. It is the objects which are replicated in distinctive order. Whereas the definition of symmetry is when we flip, slide or transform, it will form exactly like one another. There are 4 ways to move a motif in the pattern or transformations or symmetry operations to another location. Translation, reflection, rotation and glide reflection are the four modes.

In another research, Villarroel et al. [6] claims that few geometrical and symmetrical studies of designs have been done, where few geometrical and symmetrical ideas are explored. The research of the property retained on each element in an object, such as rotation, reflection or inversion, is a geometrical or symmetrical study. The table shown below indicates certain basic operations of symmetry and theirconforming elements of symmetry [7]:

Symmetry Operation	Geometrical Representation	Symmetry Element
Rotation	Line (axis)	Rotation axis
Inversion	Point (center)	Center of inversion
Reflection	Plane	Mirror plane

Translation	Vector	Translation vector

Table 1 Basic Symmetry Operation

2.3.2. Frieze Pattern and Its Types

A frieze pattern is a repeated pattern of an infinite strip and it can also be referred to as a border pattern [2]. The word "frieze" comes from architecture, where a frieze refers to an architectural sculpture or design just below a roofline or ceiling. By referring to the properties of symmetry, there are seven different types of Frieze pattern [8] as in **Table 2**:

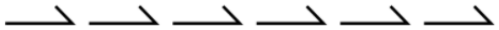
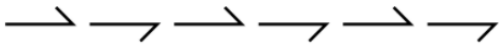
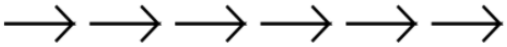
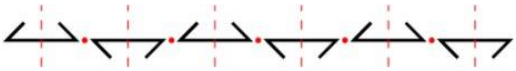
Type	Pattern	Summarized
11		Translation (T)
1g		Glide Reflections (G)
12		Rotation (R)
m1		Vertical Reflection (V)
1m		Horizontal Reflection (H)
mg		Rotation & Vertical Reflection (RV)
mm		Alternate Horizontal & Vertical Reflection (HV)

Table 2 Seven Types of Frieze Pattern

3. Methodology

3.1. Proposed Method

The type of research that has been used in this research is qualitative research. According to K. Hammarberg et. al. [9], qualitative approaches are used to answer questions regarding experience, meaning, and viewpoint, usually from the participant's point of view. Porter and Bhattacharya in [10] stated that qualitative approaches were used to highlight possible issues in conducting a proposed trial of elective single embryo transfer. For example, where small-group conversations allowed staff to express their own resistance, leading to a modified strategy.

3.1.1. Population and Sample

The target or research subjects are a group of male dancers from Yayasan Warisan Johor [11] as the choreographer and dancers for Zapin Tenglu Pak Akob dance. This male group was chosen as the research target because the movement of the dancers can be seen clearly from the top view of the dance video and easy to recognise every pattern that are match and similar to the Frieze Pattern.

3.1.2. Research Design

In qualitative research, there are three major stages according to Sugiyuno [12]: the description stage or orientation phase, the reduction stage, and the selection stage. In this research, the researcher need to observe the dance video of Zapin Tenglu Pak Akob and list down all possible formation that exists Frieze Pattern. Later on, each dance formation was classified into its Frieze Group. The least and the most amount of dance formation exist in each Frieze Group were determined.

3.2. Tools and Platforms

Qualitative research instruments are data collection tools. The instrument of qualitative research is the researcher himself, who cannot be substituted by others. The researcher gathered data verbally and supplemented it with his or her eyesight, hearing, and appreciation towards the zapin dance. The tools that have been used by the researcher in this research proposal are solely the laptop, Microsoft Word and Microsoft Power Point software.

3.2.1. Observation

According to Bungin [13], observation is a person's capacity to employ observation via the five senses' function and is being help by other senses. The observation method is used as a form of facts that are on the field in a scientific manner in order to obtain solid data. In this research, researchers were not involved in the activity and just observe the steps, movements and positions of every dancer in Zapin Tenglu Pak Akob dance. The researcher observed the dance by watching the video of the Zapin Tenglu Pak Akob dance.

3.2.2. Interview

Interview session involves two people, which are the researchers and the representatives of the dancers in order to exchange information and ideas through questions and replies so that the significance of certain issues can be understood [12]. The interview is a semi-structured interview, means that it consists of several essential questions that assist to outline the topics to be investigated while also allowing the interviewer or interviewee to stray in order to pursue a concept or response in greater depth. One of the questions that were been asked was the background of the Zapin Tenglu dance and its significances.

3.3. Frieze Pattern: Seven Frieze Group

Translation, reflection, rotations, and glide reflection are the four isometries. From the four isometries, the seven types of Frieze Pattern is obtained. It might be difficult to identify a certain frieze pattern as one of the seven patterns. The flow chart below (see **Figure 3**), modified from Washburn et. al [14], may help in classifying the patterns:

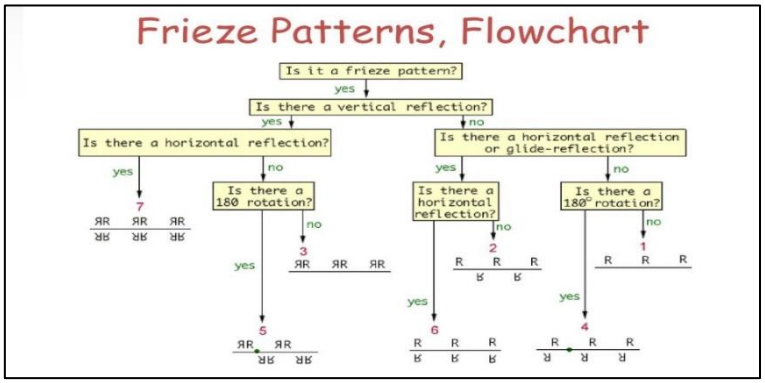


Figure 3 Flowchart on classification for each type of Frieze Pattern

Noted that in **Figure 3** shows a brief information on classifying every observable pattern into its own Frieze Group. The first thing to ensure whether the pattern can be classified into its Frieze Group is by determining whether the observable pattern is a Frieze Pattern or not. Then, examine whether the observable pattern consist any vertical reflection. After examining the existence of vertical reflection, find out whether the observable pattern have horizontal reflection or glide reflection. Last but not least,

check whether the 180° rotation exist. After considering all these conditions, the seven group of Frieze Pattern were obtained.

4. Results and discussion

By definition, Frieze Pattern is a model that is repeated in one direction on a two-dimensional surface [15]. In order to be considered as a Frieze Pattern, symmetrical translation is a must have. As shown in **Figure 4**, all dancers were aligned in a straight horizontal line which also shows the existence of translation among the dancers. It can be shown precisely in **Figure 5**:

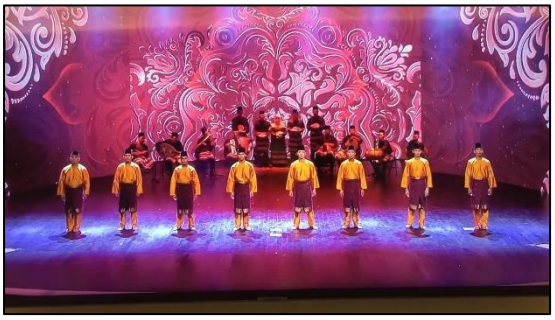


Figure 4 Entrance of the dancers in straight horizontal line

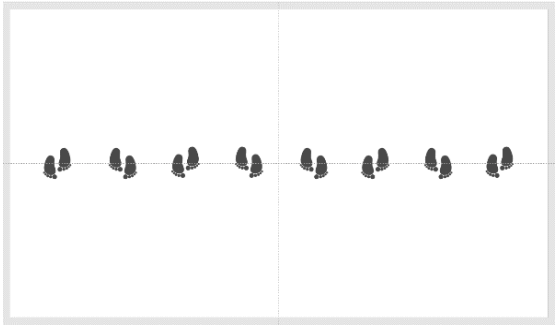


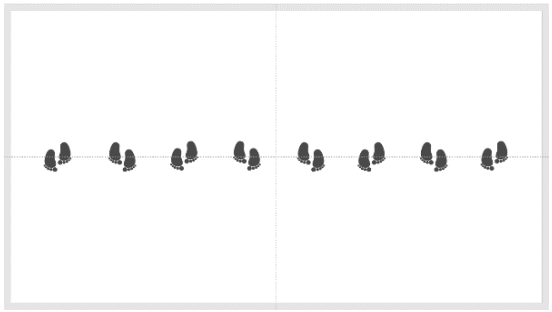
Figure 5 Floor Pattern of **Figure 4**

Figure 5 above shows that every dancer was standing in one horizontal line. Since the pattern of the dancers are repetitive along the straight line, on 2-dimensional surface, it is clearly can be classified as a Frieze Pattern. The design can be either in a horizontal line or vertical line as long as it is repetitive.

4.1. Type 11 or Hop

The first type of Frieze Pattern is called Type 11. For this design, it only contains translation symmetry. A Mathematician named John Conway [16] has created names that relate every frieze pattern with footsteps. For this design, Conway named it as Hop. **Figure 6** shows one of the examples that consists only translation symmetry in the Zapin Tenglu Pak Akob dance:

(a)

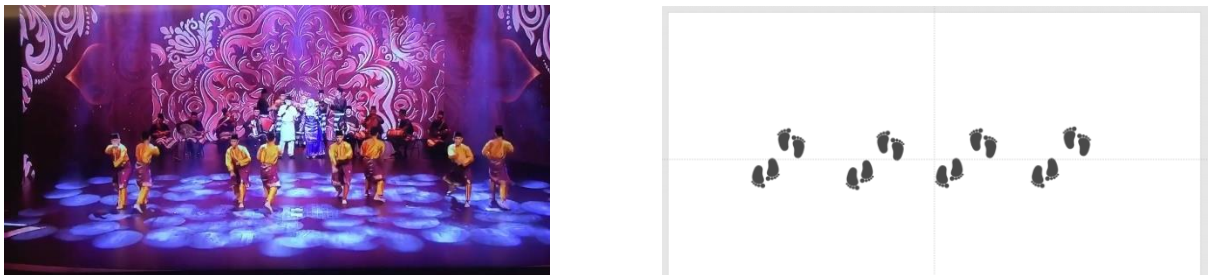


(b)

Figure 6 Translation symmetry in dance formation & its floor

4.2. Type 1g or Step

Next one is called Type 1g. This type of Frieze Pattern contains translation and glide reflection symmetries. According to Conway [16], this type of Frieze Pattern is called as Step. This pattern is unique as the design looks like a walking step. For this design, the center of the stage is used as the mirror area to show the reflection axes between the dancers. As mentioned before, the translation symmetry can be either vertically or horizontally. The following is one of the examples of Frieze Pattern Type 1g or Step (see **Figure 7**):

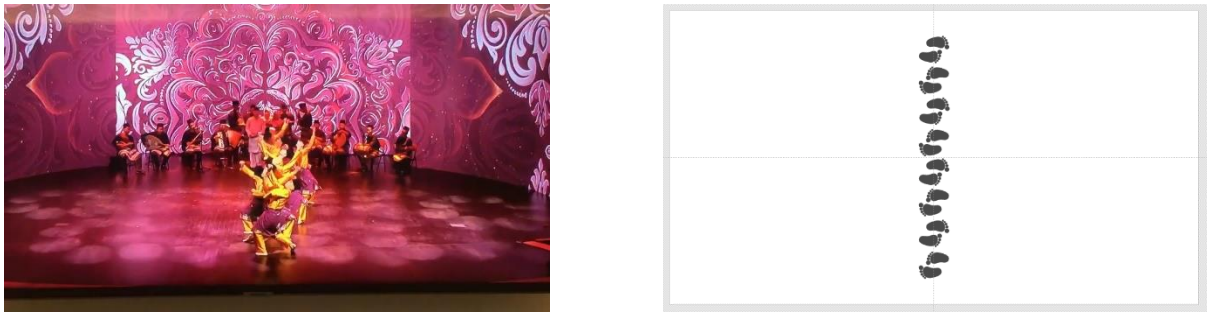


(a) **(b)**

Figure 7 Translation and glide reflection in dance formation & its floor pattern

4.3. Type 12 or Spinning Hop

The third type of Frieze Pattern is called Type 12. For this pattern, it contains translation and 180° rotation (a half turn) symmetries. Conway [16] named this third Frieze Pattern as Spinning Hop. In this case, the center of the stage is considered as the mirror area and also center of rotation. Previously, Hop is a design that only symmetrical translated. Example that can be seen clearly in this zapin dance is as shown in **Figure 8**:

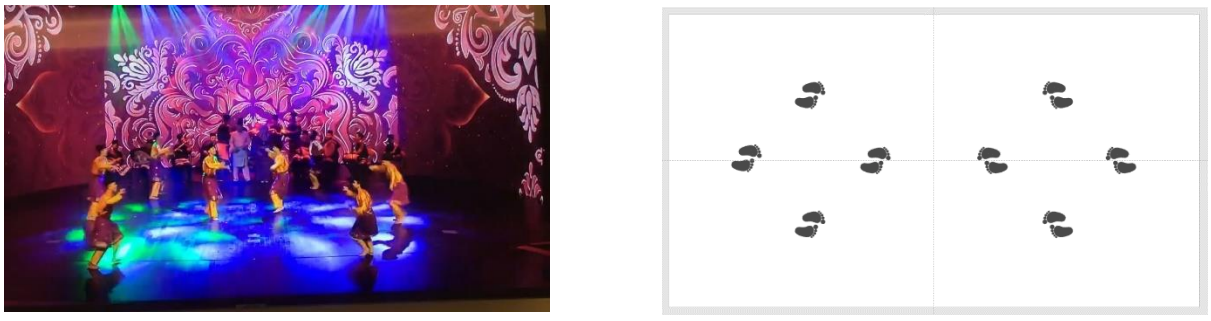


(a) **(b)**

Figure 8 Translation and 180° rotation symmetries in dance formation & its floor pattern

4.4. Type m1 or Sidle

Type number four is called as Type m1. This type of Frieze Pattern consists of translation and vertical reflection symmetries. The middle of the stage also is used as the mirror area to show the reflection axes of the dancers. As for this type, Conway [16] named it as Sidle. The following (refer **Figure 9**) is one of the observable patterns of this type of Frieze Pattern:



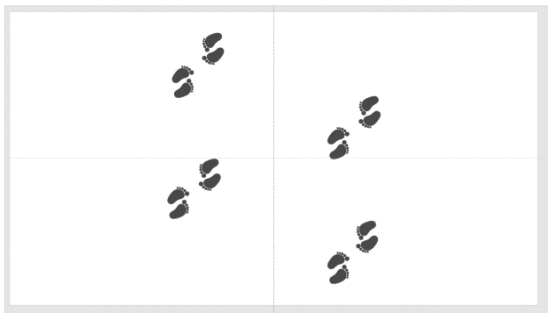
(a) **(b)**

Figure 9 Translation and vertical reflection symmetries in dance formation & its floor pattern

4.5. Type mg or Spinning Sidle

The fifth type of Frieze Pattern is called Type mg. In this pattern, it contains translation, glide reflection and 180° rotation (a half turn) symmetries. For this pattern, Conway [16] named it as Spinning Sidle. There is only one formation in the dance that has this type of Frieze Pattern, which is shown in **Figure 10**:

(a)



(b)

Figure 10 Translation, glide reflection and 180° rotation in dance formation & its floor pattern

4.6. Type 1m or Jump

The sixth type of Frieze Pattern is called Type 1m. This pattern consists of translation and horizontal reflection symmetries. Conway [16] has named this pattern as Jump. **Figure 11** shows one of the dance formations that consist this type of Frieze Pattern:

(a)

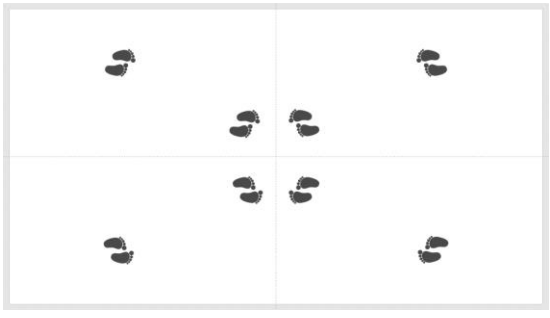
(b)

Figure 11 Translation and horizontal reflection in dance formation & its floor pattern

4.7. Type mm or Spinning Jump

The last type of Frieze Pattern is called Type mm. This pattern contains all symmetries, which are translation, horizontal and vertical reflection, also rotation. According to Conway [16], this frieze pattern is named as Spinning Jump. There exists only two dance formation that can be classify as Type mm or Spinning Hop, one of them is shown in **Figure 12**:

(a)



(b)

Figure 12 Translation, horizontal and vertical reflection and rotation in dance formation & its floor pattern

Conclusion

This research project aims to observe the existence of Frieze Pattern in Malay Traditional Dance, which is Zapin Tenglu Pak Akob. This finding starts with observing the video of Zapin Tenglu Pak Akob dance. The dance was delivered beautifully by eight male dancers from Yayasan Warisan Johor. The movement of the dancers for this dance were agile and fast, yet still managed to create beautiful

symmetrical shape or formation throughout the whole dance.

Since the dance consist lots of symmetrical shapes and patterns, the first objective which is to observe the existence of Frieze Pattern in the Zapin Tenglu Pak Akob was accomplished. After succeeded in proving the existence of Frieze Pattern in Zapin Tenglu Pak Akob dance, the study continued with constructing the floor pattern of every pattern or formation that have the Frieze Pattern element in it. As mentioned before, every Frieze Pattern must have its symmetrical translation in order to recognize as a Frieze Pattern. For this objective, it was actually ended with 27 formations or floor pattern of the Zapin Tenglu Pak Akob dance. Since the movement of the dancers were repetitive, then every repetitive pattern will be considered as one floor pattern only.

Follow up next was classifying every floor pattern or formation into every types of Frieze Pattern. Surprisingly, every formation or floor patterns in the Zapin Tenglu Pak Akob dance consists every element or types of Frieze Pattern. It complies all seven types or design of Frieze Pattern which are Type 11 or Hop, Type 1g or Step, Type 12 or Spinning Hop, Type m1 or Sidle, Type mg or Spinning Sidle, Type 1m or Jump and Type mm or Spinning Jump. Thus, the second objective which is to construct and classify every floor pattern into its group of Frieze Pattern were accomplished.

Last but not least is to identify how many types or groups of Frieze Pattern existed in this zapin dance. As mentioned above, all seven types of Frieze Pattern existed in Zapin Tenglu Pak Akob dance. Additionally, it is known that Frieze Pattern Type 1g or Step and Type 12 or Spinning Hop exists the most in this Zapin Tenglu Pak Akob dance. The least type of Frieze Pattern that exist in this zapin dance is Type mg or Spinning Sidle.

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