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New ideas on geometrical design in Malay *mengkuang* weaving motifs

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ABSTRACT

The art of Malay *mengkuang* weaving motifs started from 100 years ago in the states of Malaysia particularly in. Thus, due to its past history, there are now 51 types of motifs gathered and more new ideas emerged. A study has been done on 16 motifs produced by the weavers in Bukit Tanah and Kota Bharu, Kelantan and analysis have been made upon the changes of ideas on the above-mentioned motifs. The data collection was through observation and analysis of the *mengkuang* weaving and also by interviewing the *mengkuang* weavers. The input obtained was then analyzed to understand the new ideas in Kelantan Geometrical design in *mengkuang* weaving. Four main areas of kelarai *mengkuang* were selected in order to analyze the geometrical designs in its essential value, but also for its substantial contribution, for the socio-economic development in the industry. Due to the above-mentioned condition, the main objective of this research is to identify the new ideas on Geometrical Design in Malay *mengkuang* weaving motifs. The analysis showed that the weavers have applied mathematical thinking in the design of *mengkuang* weaving. Hence, this research will contribute more information to the body of knowledge in *mengkuang* weaving and its relation to mathematical tools thus should be preserved for the benefits of the Malaysian heritage.

1. Introduction

Weaving is a traditional form of art inherited from our ancestors without any external foreign influences. Weaving involves the process of crisscrossing raw materials obtained from special selected plants to be formed into usable products. There are six types of weaving which are *mengkuang* leaves, *pandan* leaves, Wild Bornean Sago leaves, rattan core, coconut leaves and fern leaves weaving. The *mengkuang* weaving main item for this research, involves the same process of crisscrossing the dried processed *mengkuang* leaves in making mats and other handicrafts as a leisure time activity that also generates part time income for women in the east coast of Malaysia.

According to DeWalt and DeWalt (2011), the existence of motif of all types of weaving is shaped from the image repetitions and also noted from small designs. The shape is arranged structurally; where it follows the sequence that has been decided until it forms a pattern.

The production of each individual motif is also linked to the arrangement aspect of an object, whereby it involves arranging both organic and geometric shapes. This motif arrangement which has been done in repetitions would naturally involve other elements available in the design element like line, shape, value and color was explained in Ismail (Ismail, 2007). The repetition will also produce a new design called all over *pattern*.

Furthermore, the inspiration and creativity of the weavers can be seen by adding or subtracting the patterns to become a new *pattern*. Exposure to shapes also provides experiences that are keys to developing spatial thinking more broadly. This art is considered as a heritage craft that needs to be supported not only for its essential value, but also for its substantial contribution, for the socio-economic development in the industry (Melati, 2010). Due to the above mentioned condition, the main objective of this research is to identify the new ideas on Geometrical Design in Malay *mengkuang* weaving motifs. Today it is a dire need for the preservation of the cultural heritage of Malaysia to ensure that this valuable asset will be in the heart of every Malaysian.

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If you were to picture any type of repeating pattern, you would be able to picturing a pattern that classified one of only 17 district symmetry groups (Nelson et al., 2012). The symmetry group of the patterns includes is all isometries such as translations, rotations, reflections or glide reflection which map the pattern onto itself. However, the most popular representations of these symmetry groups were introduced by a Dutch graphic artist M.C. the tessellation concept. A "*periodic pattern*" or "*repeating pattern*" or "*kelarai*" on the other hand are created to make two-dimensional design to fill the plane are called wallpaper groups. Every periodic pattern or structure associated to it is called a *lattice* of points. The *lattice unit* is the set of all images of that when acted on by isometries. There are 5 five types of *lattice* such as parallelogram, rectangular, rhombic, square and hexagonal.

2. Literature review

Ismail (1997) stated that motifs are also classified as on theme, while patterns are visual elements arranged in such a manner that they cover the same area as that of motif form. The most appropriate description for pattern is motif arrangement. When motifs are arranged in single unit repeats it can be called as a spot repeats. Motifs that are arranged in rows are called stripe repeats. A motif is something that is related to pattern in design. The different of basic unit will get from the arrangement of the basic unit, cell or original pattern (model) is repeated and it is referred to as a motif (Otto, 2002).

According to Ismail (1997) the geometrical shape in weaving is divided to three categories like original geometrical design, natural geometrical design and arrangement of the geometrical design. The original geometrical designs have existed for many years. In these motifs, combination of lines can produce geometrical shapes without a particular shape. The simple shape and in geometrical *'mengkuang'* weaving design was first known as 'gadas'. According to Ismail (1997) that is a normal weaving or weaving without motifs. Hajah Rokiah Haji Mahmud stated that the Malays produced weaving products based on natural environment. Such natural characteristics consist of 2 main shapes namely the plant characteristics and animal characteristics. Such characteristics are image stemmed from observation of certain plants and parts of animals, insects and so on and translated into geometrical shape. Some of plant characteristics are *tampok jantung motif* based on the shape of the center part of a tree or flesh of a young (Serian Motives published by Kraftangan).

The geometrical arrangement design is a combination of natural geometrical design in producing an abstract. Some of the examples of geometrical arrangement design are known as *belah ketupat* Motif, *buntut siput* Motif, *pucuk rebung* Motif, *kisar mengiri* Motif, *sisik kelah* Motif (Ismail, 1997). There are changes geometrical design in motif according to time changes. Motif that has been produced is a development of geometrical shape with plus and minus operation shape geometrical for producing new motifs (design). Table 1 and Fig. 1 below show which have similarities between the mentioned shapes and mathematical ideas and flowchart of symmetry group respectively.

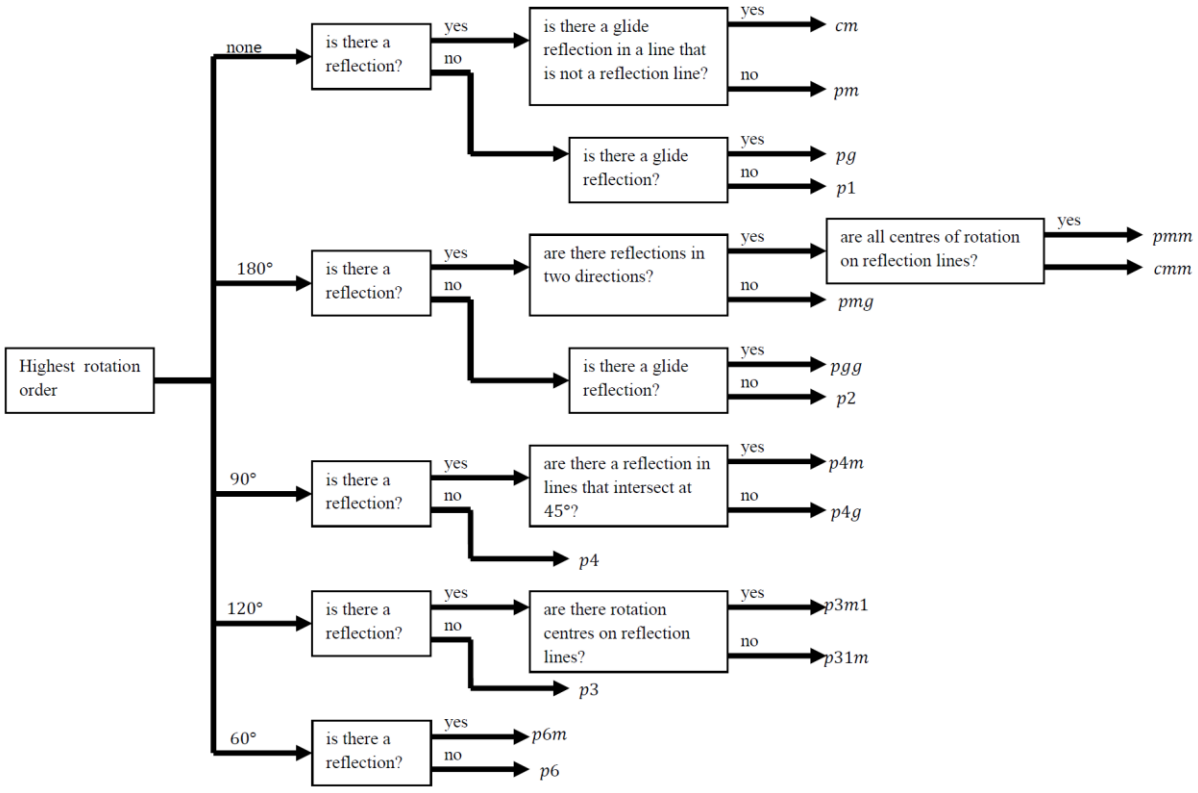
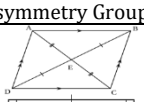
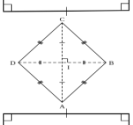
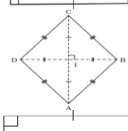
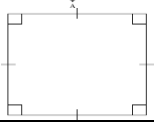


Fig. 1: Flowchart of symmetry group

Table 1: Types of symmetry group

Type of Symmetry Group	Generators	*Lattice*	Description for the symmetry Group
p1	Translation	Parallelogram	
p2	Translation Rotation	Parallelogram	
p3 (pm)	Reflection Translation	Rectangle	
p4 (pg)	Glide Reflection Translation	Rectangle	
p5 (*cm*)	Reflection Glide Translation	Rhombus	
p6 (*pmm*)	Reflection	Rectangle	
p7 (*pmg*)	Reflection Glide Reflection	Rectangle	
p8 (*pgg*)	Glide Reflection Half Turn Rotation Translation	Rectangle	
p9 (*cmm*)	Reflection Rotation	Rhombus	
p10 (*p4*)	Rotation Translation	Square	
p11 (*p4m*)	Rotation Translation Reflection Glide Reflection	Square	

3. Method

In the research objective, it stated the need to identify the new ideas on Kelantan Geometrical Design in Malay *mengkuang* weaving motifs, hence qualitative study was chosen. We have selected 6 *mengkuang* weavers in Kota Bharu and Bukit Tanah Pasir Puteh Kelantan. The data collection was through observation and analysis of the *mengkuang* weaving and also by interviewing the *mengkuang* weavers. The input obtained was then analysed to understand the new ideas in Kelantan Geometrical design in *mengkuang* weaving. An analysis of the new ideas on geometrical design in few motifs of *mengkuang* weaving was made.

4. Results and discussion

An analysis of the 6 motifs, out of 51 *mengkuang* weaving motifs was made. The selected motifs were analysed to identify new ideas of the geometrical designs. Interviews with the *mengkuang* weavers were carried out to gain information about *mengkuang* motifs. Finally, conclusions were made based on the analysis.

Four main areas of *kelarai mengkuang* were selected in order to analyse the geometrical designs in *mengkuang* weaving motifs. The four main areas are based on flora, fauna, abstract and people's names. New ideas were developed in each category. In the category of flora the *Kelarai Bunga Cempaka* has been developed to *Kelarai Berakar*. *Kelarai Bunga Cina* too has been adjusted to *Kelarai Bunga Bemban*. *Kelarai Bunga Api* has been changed to *Kelarai Bunga Durian*. *Kelarai Bunga Teratai* too has gone through the same process to *Kelarai Bunga Melor*. Under the category of abstract the *Kelarai Berakar* has been enlarged to *Kelarai Gelung Paku*. *Kelarai Belah Ketupat* too has been transformed to *Kelarai Berhati*. In fauna category few squares have been deleted from *Kelarai Kepala Lalat* to get *Kelarai Mata Ketitir*. Lastly from the category of people's name *Kelarai Cik Kedah Berakar* has been enlarged to *Kelarai Cik Kedah Bersila*.

4.1. Flora motifs

4.1.1. Evolution of Idea on Kelarai Bunga Cempaka to Kelarai Berakar

The *Kelarai Bunga Cempaka* was found in 1957. The *Kelarai Berakar* was inspired by the *Kelarai Bunga Cempaka* because of the similarities in the square shape.

Fig. 2 shows *Kelarai Bunga Cempaka* contains reflections, translations and rotations. The centers of the rotations lie on the reflection axes. The lattice is a square.

Fig. 3 shows that *Kelarai Berakar* contains reflections axes at 90 degree angle, glide-reflection, translations and half-turn rotations. The centers of the rotations lie on the reflection axes. The lattice is a square. The basic design found are *Kelarai Bunga Cempaka* which was originally emerged from *Kelarai Motif Flora.* The evolution from these two types of *kelarai* extremely non-ordinary where ideas could develop despite their motifs. The basic designs could clearly be seen between these two types of *kelarai*.

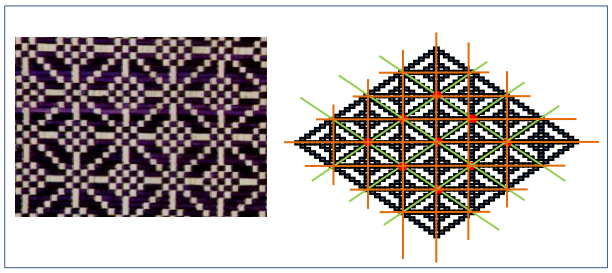


Fig. 2: *Kelarai Bunga Cempaka*

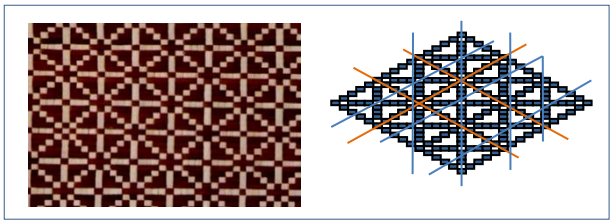


Fig. 3: *Kelarai Berakar*

The basic shape can clearly be seen between the two types of *kelarai* include the different size of square. Here the square is in the smallest size. Whereas the size of the square on the *kelarai Bunga Cempaka* is bigger (involves 15x15 total numbers of the boxes) compared to the size of *kelarai Berakar* which is smaller (involves 11x11 total numbers of boxes). This indicates that 8 rows and 8 columns are deleted to produce *kelarai Berakar*.

Based on Fig. 4, it is found that these 8 rows and 8 columns are deleted which involve 28 square boxes. This is represented by the yellow boxes. For completing the *kelarai* 4 units squares boxes are added (red coloured) as shown in Fig. 5.

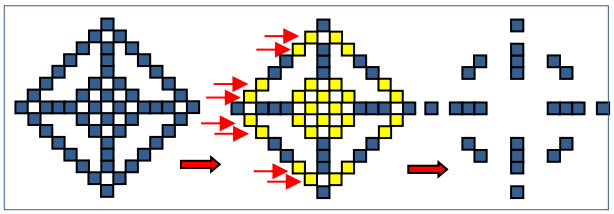


Fig. 4: Evolution of *Kelarai Bunga Cempaka*

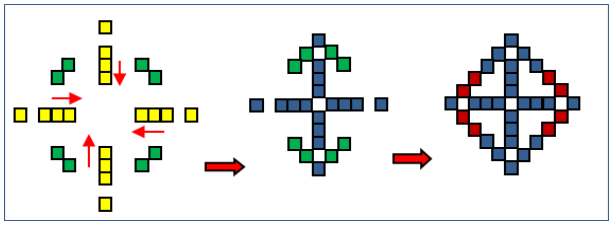


Fig. 5: Evolution of *Kelarai Berakar*

4.1.2. Evolution of idea on Kelarai Bunga Melur to Kelarai Bunga Cengkih Beranak

The *Kelarai Bunga Melur is* produced in parallel with the production of *Kelarai Bunga Cengkih Beranak*. This motive sparks from the *combination of Kelarai Bunga Cengkih Beranak* and Kelarai *Bunga Cengkih.* In Fig. 6 below, *Kelarai Bunga Melur* contains reflections axes at 90 degree angle, glide-reflection, translations and half-turn rotations. The centers of the rotations lie on the reflection axes. The lattice is a square. On the other hand, *kelarai Bunga Cengkih* contains reflections axes at 90 degree angle, glide-reflection, translations and half-turn rotations. The centers of the rotations lie on the reflection axes. The lattice is a square.

The basic shapes that are clearly seen on both *kelarai* are small size square arrangements which are also arranged to 4 different parts. Each square is arranged from 9 small boxes. In the middle of *kelarai Bunga Melur*, there is only one box whereas 4 more boxes are added to *kelarai Bunga Cengkih*.

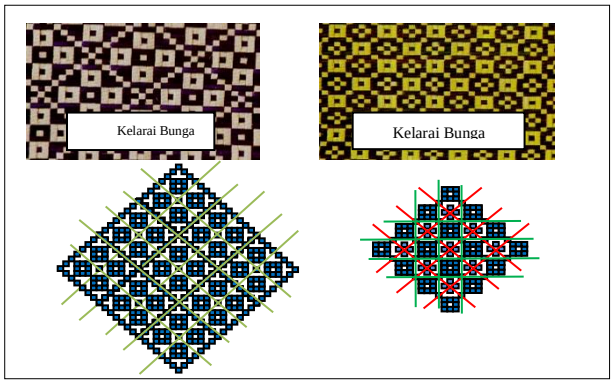


Fig. 6: *Kelarai Bunga Melur* and *Kelarai Bunga Cengkih*

Based on observation, the yellow cubes are deleted. In the center of *kelarai* are added 3 cubes to produced *kelarai Bunga Cengkih* as shown in Fig. 7.

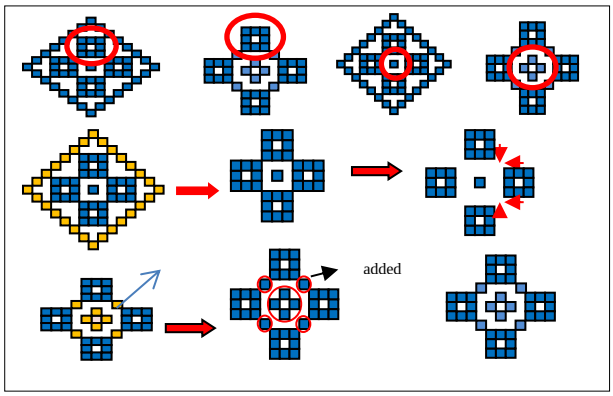


Fig. 7: Evolution of *Kelarai Bunga Melur* to *Kelarai Bunga Cengkih*

4.1.3. The evolution of idea from Kelarai Beremban to Kelarai Bunga Cina

The *bunga beremban* motif was developed from the *bunga cina* motif as shown in Fig. 8.

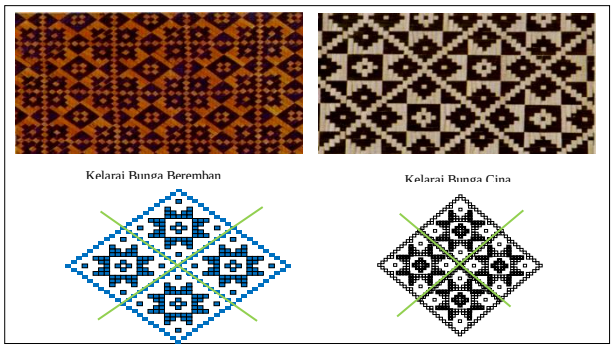


Fig. 8: *Kelarai Bunga Beremban* and *Kelarai Bunga Cina*

Kelarai Bunga Cina and *kelarai Bunga Bembam* are inspired by the flowers of plants and trees. The general feature of *Kelarai Bunga Cina* and *Kelarai Bunga Beremban* is the shape of square and polygon. Under their creativity, the Kelantan weavers have made an amendment to design a new *kelarai* by adding a column with 4 cubes or row with 4 cubes on the left and the right side of the polygon. The effect of adding these rows and columns are the size will become bigger from the original size of *Kelarai Bunga Bemban*. At the centre a cube is added to the

left and right to the original cubes and add one layer to the *kelarai Bunga Bemban* as shown in Fig. 9.

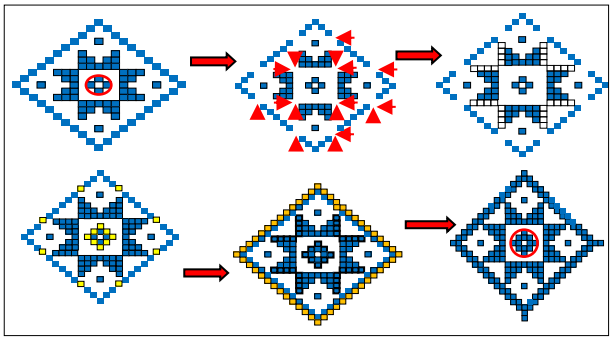


Fig. 9: Evolution of *Kelarai Bunga Beremban* and *Kelarai Bunga Cina*

Table 2 shwos the summary of the production of *kelarai* which apply mathematical instruments.

4.2. Fauna motifs

4.2.1. Evolution of idea on Kelarai Kepala Lalat to Kelarai Mata Ketitir

The *Kelarai kepala lalat* was produced when Handicraft Development Centre took over.

The original features of *kelarai kepala Lalat* is square fence (Fig. 10). The *kelarai mata ketitir* is produced by deleting the third row and fifth row (can be seen in stage 1). Then, move then first row and second row in a downward mode. Finally, move the seventh row and eighth row in an upward mode as shown in Fig. 11.

Table 2: Summary of production of *kelarai* in flora motifs

Name of Kelarai	Generators	Lattice	Type of Group Symmetry	Transformation Process	Name of Kelarai	Generators	Lattice	Type of Group Symmetry
Kelarai Cempaka	-Glide reflection -Half turn rotation -Translation	Square	p11	-Deleting row 6, 7, 9, 10	Kelarai Berakar	-Glide reflection -Half turn rotation	Rhombus	p11
Kelarai Melur	-Glide reflection -Rotation -Translation	Square	p11	-Adding 4 cubes to vertices and center -Deleting 8x8	Kelarai Cengkih Beranak	-Glide reflection -Rotation -Translation	Square	p11
Kelarai Beremban	-Glide reflection -Rotation -Translation	Square	p11	-Enlargement process -Adding new row and column between row 8 and 9 and also 13 and 14.	Kelarai Bunga Cina	-Glide reflection -Rotation -Translation	Square	p11

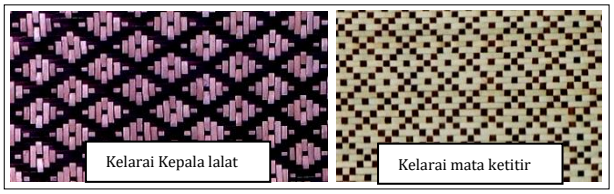


Fig. 10: *Kelarai Kepala Lalat* and *Kelarai Mata Ketitir*

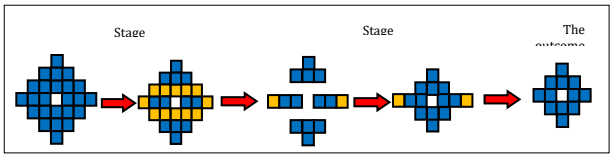


Fig. 11: Evolution of Kelarai Kepala Lalat and Kelarai Mata Ketitir

Table 3 shows the summary of the production of *kelarai* which apply mathematical instruments.

4.3. Abstract motifs

4.3.1. The evolution of idea from Kelarai Berakar to Kelarai Gelung Paku

The *Gelung paku* motive is very much identical with Root Motive (Fig. 12) but with different number of boxes whereby a boxes on the left, right, up and down have been deleted. These can be seen in the Fig. 13.

Table 3: Summary of production of *kelarai* in fauna motifs

Name of Kelarai	Generators	Lattice	Type of Group Symmetry	Transformation Process	Name of Kelarai	Generators	Lattice	Type of Group Symmetry
Kelarai Kepala Lalat	-Translation	Paralleogram	p1	-Deleting row 3, 5 column 1, 7	Kelarai Mata Ketitir	-Translation	Parallelogram	p1

Kelarai Berakar is inspired by the roots of plants and trees. The general feature of *Kelarai Berakar* is the shape of rhombus and square. The rhombus has four sides of the same length with two parallel sides, two opposite interior angles of 90 degree and four symmetrical lines. The square shape has four equal sides. The diagonals are congruent with a perpendicular bisector and have four right angles. Under their creativity the Kelantanese weavers have made an amendment to the design by deleting two squares at the left and the right side of the rhombus. The effect of deleting these squares are the size will become smaller from the original size of *Kelarai Berakar*. They name it as *Kelarai Gelung Paku* because of the size is as small as the head of a nail as shown in Fig. 13.

4.3.2. The evolution of idea from Kelarai Belah Ketupat to Kelarai Berhati

Kelarai Belah Ketupat is a motif based on local delicacy wrapped in woven *palas* leaves. *Kelarai*

Belah Ketupat consists of the arrangement of rhombus that fit perfectly together. The rhombus has four sides of the same length, two parallel sides, two opposite interior angles of 90 degree and four symmetrical lines. The idea that strike into the weavers to meet the demand of their customers are by changing the inside motifs of the rhombus from small rhombus to a polygon. The polygon is a plane figure that is bounded by a finite chain of straight line segments closing in a loop to form a closed polygonal chain. The polygon is similar like to the shape of the heart and they named it as *Kelarai Berhati*.

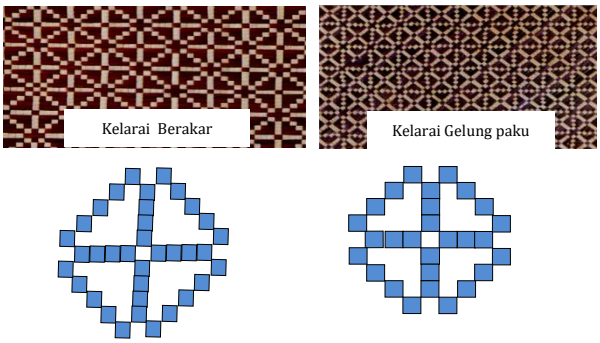


Fig. 12: *Kelarai Berakar* and *Kelarai Gelung Paku*

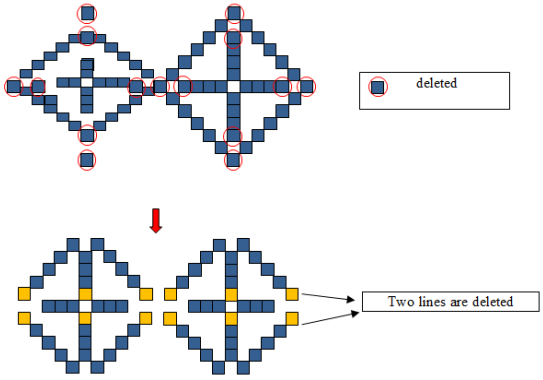


Fig. 13: Evolution of *Kelarai Berakar* and *Kelarai Gelung Paku*

The general feature of *Kelarai Berakar* is the shape of rows of vertical and horizontal box. In square box a row of horizontal lines is arranged from the top left and right corner. Changes between *Kelarai Mok Mek* and *kelarai sisk kelah* are on *kelarai sisik kelah* without fence in Fig. 14. This includes the square box and the make the *kelarai* look simpler.

Fig. 15 and Fig. 16 show the evolution of *kelarai Mak Mek* and *kelarai Sisik Kelah*.

4.4. People's name motifs

4.4.1. The evolution of idea from Kelarai Mak Mek to Kelarai Sisik Kelah

Table 4 shows the summary of the production of *kelarai* which apply mathematical instruments.

Fig. 14: *Kelarai Mak Mek* and *Kelarai Sisik Kelah*

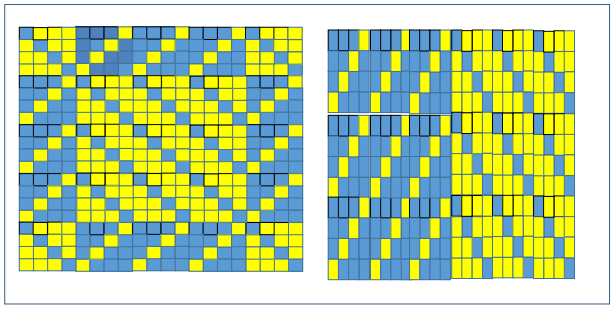


Fig. 15: Evolution of *Kelarai Mak Mek* and *Kelarai Sisik Kelah*

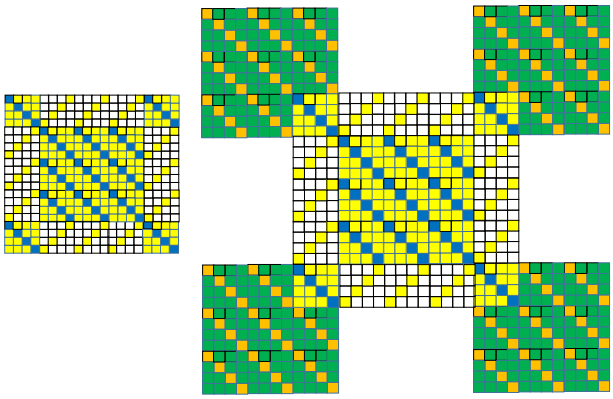


Fig. 16: Evolution of *Kelarai Mak Mek* and *Kelarai Sisik Kelah*

Table 4: Summary of production of *kelarai* in People's Name Motifs

Name of Kelarai	Generators	Lattice	Type of Group Symmetry	Transformation Process	Name of Kelarai	Generators	Lattice	Type of Group Symmetry
Kelarai Mak Mek	-Glide reflection -Half turn rotation -Translation	Square	p11		Kelarai Sisik Kelah	-Glide reflection -Half turn Rotation -Translation	Square	p11

5. Conclusion

New ideas that exist in the mind of the weavers show that they have the knowledge and the intelligence in mathematical thinking and creativity. The development of these kelarai will lead to the heritage.

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Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

References

DeWalt KM and DeWalt BR (2011). Participant observation: A guide for fieldworkers. Rowman Altamira, Lanham, Maryland, USA.

Ismail I (2007). Warisan motif and corak etnik Sabah. Universiti Malaysia Sabah, Sabah, Malaysia.

Ismail SZ (1997). The traditional Malay handicraft design. Dewan Bahasa dan Pustaka, Kuala Lumpur, Malaysia.

Melati MA (2010). Mengangkasa warisan seni kraf Negara. Bernama Government Agency, Malaysia.

Nelson A, Newman H, and Shipley M (2012). 17 plane symmetry groups. Available online at: docplayer.net/26207036-17-plane-symmetry-groups.html

Otto GO (2002). Art fundamental theory and practice. McGraw Hill, New York, USA.