ETHNOMATHEMATICS OF CHINESE BATIK SINGKAWANG DRAGON & PHOENIX MOTIFS AND THEIR LESSONS IN MATH CLASS

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Abstract

This research aims to analyze the Dragon and Phoenix motifs in Singkawang Chinese Batik from an ethnomathematics perspective. Ethnomathematics examines the relationship between mathematics and culture, and batik, as a traditional work of art, has many mathematical elements. The Dragon and Phoenix motifs in Singkawang Chinese Batik, which are influenced by Chinese symbolism and mythology, contain mathematical concepts such as symmetry, repeating patterns, and fractals. This research uses a descriptive qualitative approach by analyzing the mathematical elements contained in these motifs. The research results show that these two motifs reflect geometric regularity, which is closely related to the concepts of symmetry and fractals, and represent balance and harmony, both aesthetically and philosophically, which reflects Chinese culture. It is hoped that this research can enrich the literature on ethnomathematics and become a reference in developing local culture-based mathematics learning methods.

Keywords *Ethnomathematics, Chinese Batik, Dragon, Phoenix*

A. Introduction

Ethnomathematics is a science that studies the relationship between mathematics and culture in people's lives. This concept highlights that mathematics is not only present in formal and abstract forms but is also found in various aspects of life, including arts, crafts and local traditions (Rawani & Fitra, 2022; Sari et al., 2021). Through an ethnomathematics approach, we see how mathematics is used in a cultural context, making it more relevant and close to people's daily lives. One manifestation of art that is rich in mathematical and cultural elements is batik, which, in various regions of Indonesia, has distinctive motifs that reflect local values (Arwanto, 2017). In Singkawang, a city known for its cultural diversity, batik has a strong influence from ethnic Chinese. The dragon and phoenix motifs in Singkawang Chinese Batik are an exciting example of how cultural and symbolic elements can be translated into a visual form that also contains mathematical concepts.

Batik is one of Indonesia's cultural heritages, and it is not only known locally but also recognized globally. Each batik motif has its meaning and philosophy, which is closely related to the cultural identity of the local community (Fauzi & Ma'arif, 2024; Iskandar & Kustiyah,

2016). One form of batik that reflects a combination of cultural values and mathematical concepts is Singkawang Chinese Batik. This batik has a strong influence from ethnic Chinese culture, which dominates the population in Singkawang, a city in West Kalimantan. In Singkawang Chinese Batik, the dragon and phoenix motifs are the two most iconic designs, not only because of their beauty but also because they are rich in symbolic meaning and cultural solid values between ethnic Chinese and local communities (Iskandar & Kustiyah, 2016). The use of these two motifs reflects how Chinese cultural influences are accepted, adapted and preserved.

The dragon and phoenix motifs in Singkawang Chinese Batik come from Chinese culture, which is rich in mythology and symbolism. These two motifs have become an essential part of Chinese cultural heritage and are integrated into various forms of art, including batik (Arwanto, 2017; Iskandar & Kustiyah, 2016; Pawestri, 2017). Dragon and phoenix motifs in Chinese culture have meaning as symbols of power, luck, wisdom and balance. The dragon symbolizes strength and sovereignty, while the phoenix represents grace and awakening (Angkawijaya et al., 2019; Fauzi & Ma'arif, 2024; Jiwo & Budi, 2015). Apart from philosophical and symbolic meaning, these motifs also contain mathematical elements, such as symmetry, repeating patterns, rotations and geometric transformations, which allow us to analyze them from an ethnomathematics point of view. This shows that works of art such as batik are not just aesthetic results but can also be objects of in-depth mathematical study.

Singkawang Chinese batik, with its rich patterned dragon and phoenix motifs, provides a concrete example of how culture can be integrated into mathematics learning, making the material more exciting and meaningful for students (Angkawijaya et al., 2019; Jiwo & Budi, 2015; Pandanwangi et al., 2019; Jiwo & Budi, 2015; Pandanwangi et al., 2019; al., 2023). Even though the ethnomathematics approach has much potential, more research is still needed that explicitly examines the mathematical elements in traditional batik motifs, especially those related to Chinese culture. Therefore, it is essential to carry out this research to analyze further the mathematical concepts present in the dragon and phoenix motifs in Singkawang Chinese Batik. By examining in depth the mathematical patterns contained in these motifs, this research will enrich our understanding of the relationship between batik art and mathematics, as well as contribute to the development of teaching materials based on local culture. The purpose of writing this article is to analyze the dragon and phoenix motifs in Singkawang Chinese Batik from an ethnomathematics perspective, with the hope of enriching academic literature and contributing to the development of more contextual and relevant mathematics learning methods.

Thus, it is hoped that this research will dig deeper into the relationship between art, culture and mathematics, as well as integrate this knowledge into education to strengthen appreciation for local wisdom and cultural heritage.

B. Hypothesis Development

Analysis carried out on the dragon and phoenix motifs in Singkawang Chinese Batik found that mathematical concepts were contained in them. These mathematical concepts include the concepts of symmetry, repetition, fractals and geometric transformations. The analysis results can be explained as follows:

Figure 1. Singkawang Chinese Dragon and Phoenix Batik Motif

- Dragon Motif
  - The dragon in Singkawang Chinese Batik shows a repeating pattern of regular triangular or rhombus-shaped scales along its body.

Figure 2. Triangle or Rhombus Shaped Pattern

- The pattern of axial symmetry is visible along the dragon's body, especially in the distribution of scales and the balanced shape of the dragon's body on both sides of the central axis.

Figure 3. Axial Symmetry Pattern in Dragons

- There is a pattern that resembles a fractal on the dragon's tail, where the curve of the tail depicts a repetition of shapes on various scales that are similar to the overall structure of the body.

Figure 4. Fractal Patterns in Dragons

- Phoenix Motif
  - In the phoenix motif, there is clear reflective symmetry between the right and left wings, creating visual balance.
  - The feathers on the phoenix's tail form a regularly repeating elliptical pattern, demonstrating the concept of repeating geometric patterns.
  - The structure of the phoenix tail shows a repeating fractal pattern at each level of feather size that resembles each other, showing that there is geometric regularity in the motif.

Figure 5. Symmetrical, Elliptical and Fractal Patterns on the Phoenix

- Relationship with Mathematical Concepts

  The dragon and phoenix motifs in Singkawang Chinese batik are closely related to mathematical concepts. Symmetry, repeating patterns, fractals and geometry are essential elements that make this motif not only aesthetically beautiful but also orderly and meaningful. This use of mathematical principles creates vital visual harmony and emphasizes the importance of order in traditional art. This combination of culture and mathematics shows that Singkawang Chinese batik art is not only a cultural product but also a representation of the order of the universe, which is realized through deep mathematical patterns.

C. Research Method

Qualitative descriptive research using ethnographic methods was used to understand the mathematical elements contained in the batik motifs of cultural products used by the Singkawang Chinese community, especially the dragon and phoenix motifs. Data was obtained from documentation and through literature related to batik, dragon and phoenix symbolism, and batik products with dragon and phoenix motifs, which contain ethnomathematics.

The data analysis technique used in this research is a descriptive analysis technique to identify and explain the mathematical elements in the motif, such as symmetry, repeating patterns, geometry and fractals. Each mathematical pattern is analyzed based on the visual characteristics of the dragon and phoenix motifs. The results of the analysis are explained descriptively, connecting the mathematical elements and cultural meaning of the motif, thus providing a comprehensive understanding of the relationship between mathematics and culture in batik.

D. Discussion

From the analysis results, it appears that the dragon and phoenix motifs in Singkawang Chinese Batik contain many mathematical elements that are closely related to the concepts of symmetry, repeating patterns and fractals. Further discussion regarding these concepts is as follows:

1. The Meaning and Symbolism of the Dragon and Phoenix in Chinese Culture
   a. Dragons symbolize strength, courage and majesty in Chinese culture. Dragons are considered the rulers of water, including oceans, rivers and clouds. The Dragon symbol on Singkawang Chinese batik depicts vital energy and vitality. In the context of Singkawang culture which Chinese influence, this symbol represents strength and wisdom.

b. Phoenix, or Fenghuang, symbolizes harmony, beauty and good luck. The Phoenix is a symbol of rebirth and is considered the spiritual counterpart of the Dragon. In Singkawang Chinese batik, the Phoenix is often paired with the Dragon to depict the balance of the universe—which, in a gender context, is defined as a balance between men (Dragon) and women (Phoenix).

2. Application of Mathematical Concepts in Motifs
   a. Symmetry in Dragon and Phoenix Motifs
      - In the Dragon motif, axial symmetry is visible in the body and scales. The Dragon's body is arranged in balance around its body axis, with a symmetrical distribution of scales. This pattern not only enhances the aesthetics, but also provides a sense of harmonious movement and strength.
      - In the Phoenix motif, axial symmetry is evident in its broad, open wings. This symmetry depicts balance and harmony, which is at the heart of Phoenix's symbolism. The Phoenix's left and right-wing designs are perfectly symmetrical, creating the illusion of perfect balance in visual art.

   b. Geometric Patterns in Design
      - Elliptical patterns are found on Phoenix feathers, especially on the wings and tail. This elliptical shape is repeated periodically to create the impression of smooth and elegant movement, which is one of the characteristics of Phoenix.
      - There is a dragon motif, and the spiral and curved lines on the body reflect complex geometric patterns, showing dynamic movement. This pattern also creates the illusion of majesty and power.

   c. Fractals in Dragon and Phoenix Tail Details
      - Fractals are patterns that repeat at various scales, and in this batik motif, fractals are visible in the details of the Dragon and Phoenix tails. On the Dragon, the details of the scales and tail show repetition of smaller and smaller patterns, creating the impression of very complex natural movement. It reflects fractals often found in nature.
      - On the Phoenix's tail, the layered feathers show a fractal pattern with repeating details that get smaller at the tip of the tail. This structure gives the impression of graceful and harmonious flying movements.

3. Dragon and Phoenix Interaction as Symbols of Harmony
   a. In Singkawang Chinese batik, the depiction of the Dragon and Phoenix simultaneously depicts the balance of Yin and Yang. The Dragon, with its masculine and robust energy, is symbolized as the Yang element, while the Phoenix, which is feminine and graceful, represents Yin. The two create perfect harmony when combined, like a balance between strength and gentleness or between man and woman.
   b. Dragon and phoenix motifs are often placed side by side in batik as a representation of the universal balance desired in life. The use of bold colours and complex designs shows the harmony between these two elements in Chinese culture.

4. Aesthetic and Philosophical Values in Batik Motifs
   a. The use of Dragon and Phoenix motifs in Singkawang Chinese batik is not just decoration but is full of philosophical and spiritual values. The symbolic power of the Dragon and Phoenix reinforces the meaning of balance, good luck and harmony in Chinese society.

b. The Dragon carries the meaning of protection and strength, while the Phoenix carries a message of transformation and rebirth. The combination of the two becomes a powerful symbol in the representation of life, which is full of dynamics but remains harmonious.

E. Conclusion

Based on an analysis of the dragon and phoenix motifs in Singkawang Chinese Batik, it was concluded that both motifs contain significant mathematical elements, such as symmetry, fractals and repeating geometric patterns. The Dragon motif displays strong axial symmetry, fractal patterns on the tail, and regular triangular or rhombic-shaped scales. On the other hand, the Phoenix motif shows reflective symmetry on its wings and a repeating elliptical pattern on the tail feathers that reflects geometric regularity.

Philosophically, the Dragon and Phoenix motif symbolizes the balance of Yin and Yang, with the Dragon as a symbol of strength and the Phoenix as a symbol of harmony and good luck. The combination of the two creates harmony in batik designs, which also reflects deep Chinese cultural values, such as wisdom, rebirth and balance in life. Aesthetically, the combination of symmetry, geometry and fractal patterns in the Dragon and phoenix motif not only presents a beautiful design but also provides symbolic depth. Every detail in this motif reflects the broader meaning of strength, luck, balance and harmony in life.

F. Recommendation

1. Development of Ethnomathematics Research: Further research can deepen the ethnomathematics analysis of batik motifs from various other cultures to find more complex and in-depth mathematical patterns.
2. Use of Digital Technology: In order to preserve traditional motifs such as the Dragon and Phoenix, it is recommended that digital technology be used to catalog and visualize the mathematical patterns discovered. This can facilitate the preservation and promotion of Singkawang Chinese batik on a global scale.
3. Strengthening Cultural Education: It is essential to increase public awareness of the philosophical and mathematical values contained in batik by integrating ethnomathematics studies into arts and culture education.
4. Product Development: Batik with Dragon and Phoenix motifs can be further developed as a contemporary fashion and art product that combines elements of

tradition with modern design without losing the underlying philosophical and mathematical values.

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