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Research Article

Unravelling the mathematical tapestry: Exploring the ethnomathematics of the "Seroa" within the Lakiput culture in Sarawak

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ABSTRACT

This ethnomathematical study focuses on the intricate connections between mathematical principles and the rich palette of cultural craftsmanship, particularly Seroa, worn by the Lakiput people of Sarawak, Malaysia. Through a careful examination of geometric patterns, the study reveals the profound integration of mathematics and cultural identity inherent in the design and construction of this traditional craft. The study seeks to illuminate the unique mathematical language woven into the headdresses through a focused examination of material selection, proportion and ceremonial context. The collaboration with the Lakiput community not only enriches the research, but also contributes to a nuanced understanding of indigenous mathematical thought and promotes the preservation of cultural heritage in the intricate threads of tradition.

Keywords: Ethnomathematics, Lakiput, Seroa, mathematical concepts, geometric patterns, cultural heritage.

Introduction

Human civilisation cannot be separated from the development of culture and mathematics, and thus culture cannot be separated from the development of mathematical activity (Sari et al., 2022). Ethnomathematics is defined as the cultural anthropology of mathematics, i.e. the study of the relationship between mathematics and culture (Turmudi et al., 2016). It is a branch of mathematics that sheds light on the concept of mathematics and community culture by focusing on the knowledge of mathematical ideas, methods and procedures that people have built up in their culture (Sari et al., 2022; Wahyuni et al., 2023) and that they have used to solve difficulties in their surrounding. This branch of mathematics therefore recognises that mathematical knowledge is shaped not only by formal education, but also by a range of cultural, historical and social factors. Thus, ethnomathematics can be interpreted as a means of representing mathematical concepts in the context of cultural experiences, thereby deepening people's understanding of mathematics (Rosa and Orey, 2007; 2011) and providing learners and teachers with deeper insights into the relationship between mathematics and culture (Albanese and Parales, 2015). According to D'Ambrosio (1985), ethnomathematics describes the mathematical practises of identifiable cultural groups and the study of mathematical ideas found in each culture. Furthermore, he (D'Ambrosio, 1993) emphasised that understanding the mathematical knowledge developed by different ethnic groups involves recognising the different modes through which cultures realise their mathematical practises. Torres-Velasquez and Lobo (2004) emphasised the importance of studying mathematics by relating it to culture and experiences and integrating mathematics naturally into the cultural context. Rosa and Orey (2007; 2011) defined 'ethnos' as cultural groups characterised by their traditions, codes, symbols and myths in which the ideas, methods and

mathematical techniques of the cultural community can be interpreted analytically, geometrically, graphically or through other appropriate mathematical techniques and technologies (Rosa and Orey, 2015) and ultimately develop students' literacy skills during the enquiry process.

The application of mathematical concepts to everyday activities such as weaving and house building, revealing the mathematical knowledge inherent in these cultural practises, can be found in Turmudi et al. (2016) and Hariastuti et al. (2019). Suffina and Yahutazi (2020) found a strong connection between mathematics, agriculture and cultural heritage in the daily lives of the Melanau community in Sarawak. Furthermore, Suffina et al. (2022) found that Melanau Mukah society uses numbers to characterise their social ranks using qualitative methods, ethnographic techniques and key methods. Umbara et al. (2021) make a further contribution by examining the use of ethnomathematics in the language system of the Cigugur community in their daily activities. Inspired by the work of Turmudi et al. (2016), Hariastuti et al. (2019) and Suffina and Yahutazi (2020), we explore the intricate relationship between the concept of mathematics and Seroa, a weaving craft in the Lakiput Sarawak culture.

Background of the Study

Sarawak, known as Bumi Kenyalang and nestled in the Borneo Islands, is one of the states in Malaysia that harbours a rich diversity of more than 40 indigenous ethnic groups. Among them, the Lakiput ethnic group, also known as Kiput or 'Lepo Pu'un', which means "early tribe" or "original race"," occupies a special place. The Lakiput, who belong to the Orang Ulu community, are a significant ethnic minority in Sarawak with a population of about 2000 people (as of 2013). The Lakiput community lives mainly along the scenic coastline of Sungai Baram, Kuala Tutoh and Lubok Nibong in Miri, Sarawak (Sarawak Facts and Figures 2013, n.d.) and has linguistic similarities with the Jati Miriek language spoken by the Kedayan, Narum and Bakong ethnic groups. They also maintain a close socio-cultural connection with the Brunei community living in Belait and Kiudang, Brunei Darussalam. The Lakiput ethnic group has its roots in a centuries-old history originating in the central part of the island of Borneo. They were among the first settlers to migrate and establish communities on the banks of the Baram River, see Figure 1. According to the oral traditions of the elders, the Lakiput community, once associated with the Sultanate of Brunei, was at the forefront of the migration to Sarawak. Similar to other Orang Ulu communities, the Lakiput live in longhouses along the Baram River, the second largest river in Sarawak. Originally they practised paganism or animism, but in the 1920s there was a religious shift and many converted to Christianity or Islam. The Christian Lakiput communities continue their traditional longhouse life, while those who have embraced Islam favour traditional Malay villages, with a significant population in Kampung Benawa. With agriculture, rice farming, river fishing and traditional handicrafts, the Lakiput ethnic group contributes significantly to Sarawak's economic landscape, selling their products in the town of Marudi. To this day, many young members of the Lakiput community, who are well educated and skilled, work as civil servants and in the private sectors (particularly in oil and gas sector) in major cities such as Miri and Bintulu as well as overseas such as Brunei Darussalam. During the reign of Rajah James Brooke, leaders of the Lakiput ethnic group played a crucial role as liaisons for the affairs of the Orang Ulu of Sarawak. Respected figures such as Jok Pengiran, Tinggang Jok, Manak Dapat, Penghulu Lejau and Orang Kaya Temenggung Lawai Melayong made a name for themselves as government officials, especially in the Marudi district, utilising their extensive knowledge of Baram acquired over generations.

Figure 1: Distribution of the Lakiput in Sarawak, Malaysia.

Methods

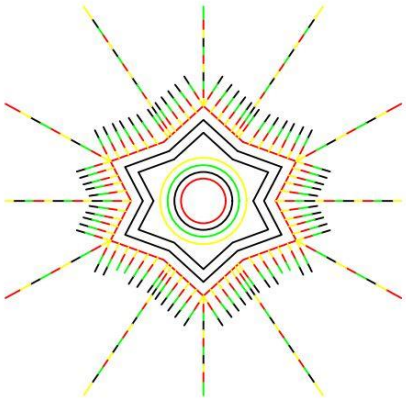
An exploratory and descriptive qualitative approach was used in this research. The researcher attempts to find the mathematical elements of Kiput Seroa within the Lakiput culture in Sarawak. The choice of handicraft as a medium is due to the fact that it is easier to find. The researcher then described and analysed the mathematical factors to understand the relevant geometric concepts. The obtained results of the mathematical elements can be used to understand the required geometric concepts. Data is collected through observation, interview and documentation during the field trip. The researcher made observations by recording and documenting the handicraft products based on the ethnomathematics of the society. The researcher also interviewed the subjects to explore ethnomathematical data about the handicraft products. The interview used in this study was semi-structured. The documentation results in this study were photographs of the Seroa, which included geometric concepts and their general physical conditions. At the same time, the ethnographic approach is an empirical and theoretical approach that aims to obtain a description and in-depth analysis of the culture based on intensive fieldwork. The data were reviewed and validated to investigate the ethnomathematical component found in the craft patterns.

Results and Discussions

Seroa is a special kind of handicraft made by the Lakiput community that keeps this heritage alive. It is known for its intricate designs, vibrant colours and organic materials. The craft is characterised by a process that involves various steps, including the selection of natural materials such as leaves, fibres and dyes and the skilful weaving of these materials into intricate patterns and designs. The art of weaving is a fundamental technique in the production of Seroa, requiring precision and attention to detail to ensure the desired aesthetic. After weaving, the weavers may add embellishments such as beads, shells or feathers to enhance the overall design and complement the natural materials used for the craft. Finally, the woven cloths are dyed with natural dyes from local plants to create vibrant and eye-catching patterns. The functional and decorative aspects of the Kiput Seroa make them a valuable cultural artefact within the Lakiput community. They are used as hats, accessories and household items such as baskets or mats and serve as a representation of Lakiput beliefs, traditions and way of life. The completion of the Seroa craft and the analysis of the characteristics of the Seroa patterns are shown in Figure 2 and Table 1 respectively.

Figure 2: The Completion of The Seroa Craft

Table 1: Analysis of the characteristics of Seroa patterns.

	Characteristics: i) The motif is reflected with vertical lines. ii) The original and the image are congruent. iii) It is a mirror-inverted image of an object above a line. iv) The inverted image is like in a mirror.

If the motif with the center point $A(0,0)$ reflects the vertical line or y-axis, the coordinate of the second motif can also be identified by the concept of reflection. If the point $A(x, y)$ is reflected on the $y = h$, then the coordinate of the reflection is $A'(x, y - 2h)$ and the notation can be written as follows:

$$A(x, y) \rightarrow A'(x, y - 2h).$$

Conclusion

The results show that ethnomathematics is widespread among the Lakiputians. The analysis shows that the patterns in the Seroa craftsmanship are clearly characterised by the principles of transformational geometry, especially through the use of reflection. This finding not only improves our understanding of the intricacies of Seroa craftsmanship, but also has wider implications, particularly in the Realistic Mathematics Education (RME). This study holds great promise in helping students understand geometry concepts. By linking the abstract nature of mathematical activities to tangible elements of local culture, such as the transformative geometry in the Seroa patterns, students can make more concrete connections. This facilitates a deeper understanding of geometric principles and makes the subject more accessible and interesting. Furthermore, this realisation has also shown that the foundations of the Lakiput people are essentially based on mathematics. This is in line with the relationship between maths and culture in this study, which can be a starting point for further preservation of the Lakiput cultural heritage.

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