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Ethnomathematical Exploration on Malaysian Malay Songket Cloth

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Abstract:
Ethnomathematics serves as a bridge between formal mathematics and local culture, thereby helping students connect mathematics with real-life situations. This study focuses on revealing ethnomathematical concepts found in Malaysian Malay songket cloth that are not limited to geometric elements. Therefore, this research aims to explore the ethnomathematics embedded in Malaysian Malay songket fabric. The research was conducted in Kuala Lumpur, Malaysia, specifically at souvenir markets on Jalan Masjid India, the World Malay Ethnology Museum, the Orang Asli Arts and Crafts Museum, and the National Textile Museum. Data collection techniques included interviews with songket sellers and museum staff, observations, and documentation using observation and documentation sheets. The study employed a qualitative research method with an ethnographic approach, and data analysis was carried out using the Miles and Huberman model. The results show that Malaysian Malay songket cloth, which consists of six patterns, contains ethnomathematical elements. These include the hierarchical meaning in the cloth-making process, which aligns with the hierarchy of material in mathematics learning. Furthermore, Malay cakes reflect the application of function concepts and the determination of coordinate points, while the patterns and motifs of the cloth contain various geometric shapes (parallelograms, rectangles, squares, and triangles), line concepts, number patterns, and reflection concepts. The implication of this study is that the findings can serve as an alternative source of contextual and meaningful mathematics learning that is closely related to students' everyday lives.

Abstrak:
Etnomatematika menjadi jembatan antara matematika formal dan budaya lokal, sehingga membantu siswa mengaitkan matematika dengan kehidupan nyata. Penelitian ini berfokus pada pengungkapan konsep etnomatematika dalam kain songket Melayu Malaysia yang tidak hanya terbatas pada unsur geometri. Sehingga penelitian ini bertujuan untuk mengeksplorasi etnomatematika yang terdapat pada kain songket Melayu Malaysia. Penelitian berlokasi di Kuala Lumpur, Malaysia yaitu pasar penjualan souvenir di Jalan Masjid India Muzium Etnologi Dunia Melayu dan Muzium Seni Kraf Orang Asli, dan Muzium Textile Nasional. Teknik pengumpulan data yaitu wawancara terhadap penjual songket serta petugas musium, observasi dan dokumentasi menggunakan Lembar Observasi dan Dokumentasi. Metode yang digunakan adalah metode penelitian kualitatif dengan pendekatan etnografi. Teknik

pengumpulan data yaitu wawancara terhadap penjual songket serta petugas musium, observasi dan dokumentasi menggunakan lembar observasi dan dokumentasi. Teknis analisis data menggunakan Miles dan Huberman. Hasil penelitian ini menemukan bahwa kain songket Melayu Malaysia yang terdiri dari 6 corak mengandung etnomatematika, seperti pada pembuatan kain yang mengandung makna hirarki proses yang selaras dengan hirarki materi dalam pembelajaran matematika. Kemudian, Kek Melayu mengandung penerapan konsep fungsi dan penentuan koordinat titik, serta pola dan motif kain mengandung beberapa bentuk geometri (yaitu jajargenjang, persegi panjang, persegi, segitiga), konsep garis, konsep pola bilangan, serta konsep refleksi. Adapun implikasi penelitian ini adalah hasil temuan dapat menjadi alternatif sumber belajar matematika yang konstekstual, bermakna dan dekat dengan kehidupan siswa.

Keywords:
Exploration, Ethnomathematics, Malaysian Malay Songket Cloth

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INTRODUCTION

Mathematics learning still faces various challenges in achieving desired learning outcomes. Widayati (2022), the rapid development of technology and information must be adapted and responded to wisely in learning (Nuramin & Karawang, 2025; Syafdaningsih, Suparman, & Herlina, 2020), demands of 21st century skills such as creativity and critical thinking skills (Salma & Yasin, 2024), and selection of appropriate learning strategies (Intan, Kuntarto, & Sholeh, 2022). To address the various learning challenges, an appropriate strategy is required. One solution is implementing student centered learning, which provides opportunities for students to explore and apply the contexts and situations they encounter in the real world. Piaget argued that a child's mind develops as a result of his or her constructive interactions with the environment (Aras & Buhaerah, 2020). Likewise, Ausubel's theory, which carries meaning, states that learning is the result of meaningful assimilation, namely connecting the knowledge obtained with previously existing knowledge (Basyir, Dinana, & Devi, 2022). Students' mathematical abilities are still relatively low (Indrawati, 2019; Khoirudin, Styawati, & Nursyahida, 2017). They often struggle to connect mathematical concepts to real world situations. Likewise, students' conceptual understanding is rarely developed, with procedural approaches still being prioritized. Active learning participation is also poorly facilitated in learning. As a result, learning motivation is low, conceptual understanding is weak, and problem-solving skills are suboptimal (Afandi, Akhyar, & Suryani, 2019).

Ideally, mathematics learning should not merely produce procedural skills such as performing calculations or manipulating mathematical symbols to solve problems. Good mathematics learning should facilitate students' learning needs, providing appropriate challenges and appropriate feedback. This will foster strong conceptual understanding, critical thinking, problem-solving, communication, decision-making, and critical reasoning skills. This is where the importance of local context (situation) and student experiences in enriching the mathematics learning process lies. Because ethnomathematics is an alternative to be a bridge between real mathematical practices in students' lives and formal mathematics (Anwar & Ramadhani, 2025); (Sandi, 2025); (Yanti, 2025). When students can encounter mathematics in cultural practices, their motivation and in depth understanding are expected to increase significantly. Learning mathematics using a culture that students already know will spark the belief that mathematics is close and real in life, making students more focused because they realize the importance of mathematics, and will also be directly involved in the analysis of the mathematics they are studying. The importance of local context and student experiences has led to the emergence of cultural context as a widely studied theme, linked to and applied in mathematics learning (Indrawati, 2019; Khoirudin, Styawati, & Nursyahida, 2017). Subsequently, the term ethnomathematics has emerged as a trending issue in mathematics education research. Numerous studies related to this have been conducted. However, most ethnomathematics research still focuses on the geometric elements present in the cultural objects studied. The mathematical concepts discovered are not yet in-depth. Therefore, this study seeks to uncover the mathematical concepts found in Malaysian Malay songket cloth, the cultural object being studied. The concepts expressed go beyond geometric shapes (Ain, Lingga, Sakila, & Yoanda, 2025); (Aras & Buhaerah, 2020); (Rizky & Nasution, 2024). To provide direction for this research, this study aims to find answers to the following questions: (1) What are the motifs of Malaysian Malay songket cloth? (2) What ethnomathematic elements or concepts are contained in Malaysian Malay songket cloth?

METHODS

This research is a qualitative study using an ethnographic approach. In this study, the object of study is art, specifically an ethnomathematical exploration of Malay songket cloth from Malaysia. Data collection techniques included observation, interviews, and documentation. Data collection tools in the form of observation guidelines, interview guidelines, and documentation guidelines have been compiled and validated by experts. Observations and documentation were carried out by directly observing and documenting these observations, namely in several locations, namely the souvenir sales market on Jalan Mosque India, the Malay World Ethnology Museum and Orang Asli Craft Arts Museum, and the National Textile Museum. Meanwhile, interviews were conducted with several Malaysian Malay songket sellers on Jalan Masjid India, as well as an officer at the State Textile Museum.

RESULTS AND DISCUSSION

There are three elements in Malaysian Malay songket cloth that contain ethnomathematics: (1) the stages in making Malaysian Malay songket, (2) a weaving tool called Kek Melayu, and (3) the patterns or motifs of the cloth. Ethnomathematics serves as a bridge between cultural preservation, local wisdom, and technological advancement through science. In mathematics learning, it facilitates the processes of abstraction, idealization, and generalization of mathematical concepts (Mutakin, Tola, & Hayat, 2023). Abstraction involves transforming objects from the external world into mental constructs (Ismiyati, 2023), while idealization refers to interpreting the properties of these abstracted objects. Cultural facts, both tangible (artifacts) and intangible (mentifaks), contain elements of mathematical logic that can be abstracted and idealized into school mathematics understanding, thereby moving learners from informal mathematical knowledge derived from their surroundings to formal mathematics in educational settings. By engaging with ethnomathematical elements, students are able to see the relevance of mathematics in daily life, recognize patterns, relationships, and structures within cultural objects, and develop critical thinking and problem-solving skills.

After examining Malaysian songket, both in terms of its production process and patterns, the ethnomathematical elements contained within it can be described as follows.

1. The Songket Weaving Process Follows Specific Stages

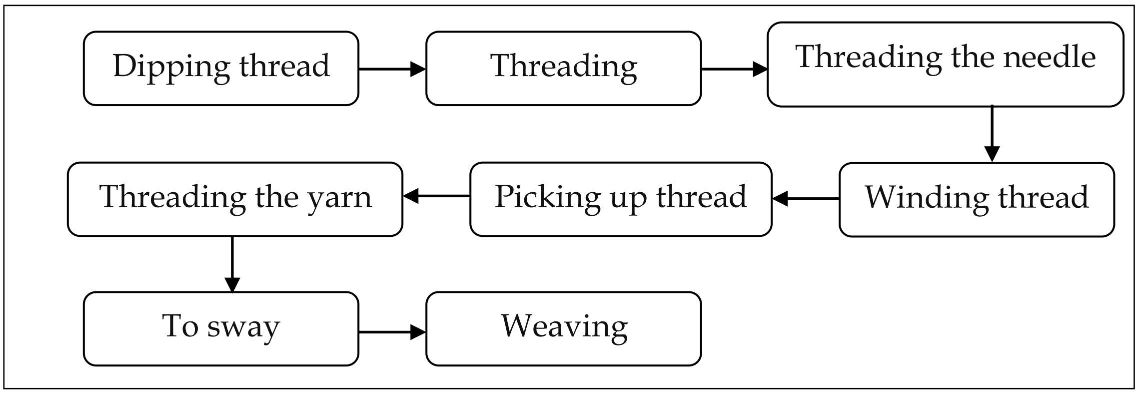


Figure 1. Stages of making Malaysian Malay Songket

This process must be followed in sequence; if the steps are not followed, a beautiful songket will not be created. The relationship between the stages of making Malaysian Malay songket and mathematics is the characteristic of mathematics, namely its strict hierarchy of material. Mathematical materials have levels or sequences in which they are studied. For example, to study integrals, one must have studied the prerequisite, namely derivatives. Although looking at the history of mathematics, integrals were discovered before derivatives. However, according to the fundamental theorem of calculus, explaining the concept of integrals requires derivatives. Likewise, to master derivatives, it will be easier for someone to understand the limits of functions (because derivatives are defined using limits), and so on. Figure 2 illustrates a very strict mathematical hierarchy.

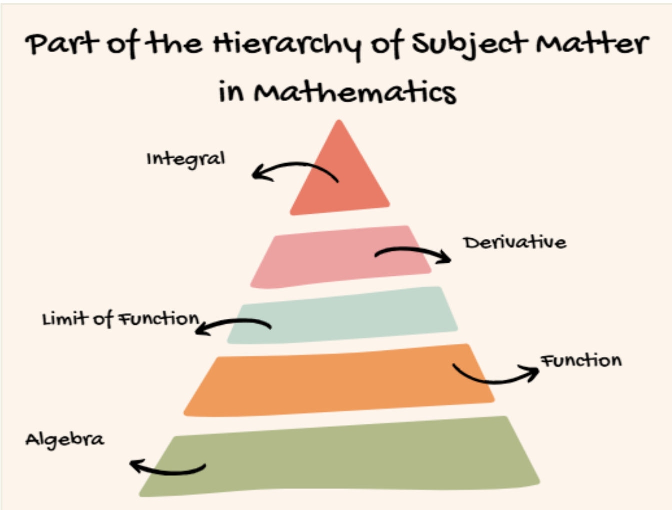


Figure 2. Part of the Hierarchy of Subject Matter in Mathematics

This hierarchy can be continued until students understand the concepts of points, lines, and planes, which are dimensionless (zero dimensional). This strict hierarchy in mathematical materials is what often leads to mathematics being considered a difficult subject. Therefore, by understanding the hierarchy well, it is hoped that students will find solutions to understanding mathematics and identify misconceptions or areas they don't yet understand, allowing them to review and study those areas for a better understanding.

2. The Songket Weaving Process Uses a Loom Called Kek Melayu

The shape of the Kek Melayu can be seen in figure 3. This Kek Melayu tool is used to weave songket. Any songket pattern desired can be achieved using this tool. The difference in pattern is in the process of giving the loosening thread a certain color as desired. This contains ethnomathematics, namely the concept of function (mapping). Kek Melayu is a function (mapping). The color of the woven thread is a variable of the function. The thread that is sungkit during the weaving process determines the pattern that will be produced at the end of the process. The thread is also a variable in this function, as different threads processed by Kek Melayu will produce different songkets. If the color of the thread that is sungkit is different, the resulting woven pattern will also be different. This illustrates that the process of the sungkit thread on the Kek Melayu tool is a real example of the application of the definition of function.

Figure 3. Kek Melayu (Songket Weaving Tool)

Mathematics defines a function or mapping as a special relation that maps each element of the domain to exactly one element of the codomain. The function is denoted by f: A → B. f(x) = y means that element x in A is mapped to element y in B. If f(x) = y then y is called the map/image/shadow of x in f, and x is called the pre map/pre-shadow/pre-image of y, x as a variable of this function f. A variable is a symbol or letter used to represent an unknown value or a value that can change in a mathematical expression. If the value of x substituted into the function f(x) = y is y is x_1 then the value of y will change according to the mathematical expression. If the given variable x is x_2 then the value of y will also change according to the mathematical expression. For example:

Given the function f(x) = 2x + 1. If x = 2, then the value of this function is: f (2) = 2(2) + 1 = 5. If x = 3, then the value of this function is: f (3) = 2(3) + 1 = 7. Making songket with a specific pattern using Kek Melayu is an application of this function concept. If a bamboo shoot pattern with a dominant gold color is desired, the craftsman must substitute gold thread into the process. If a different pattern is desired, the craftsman must adjust the loose thread substituted into the process. Thus, it can be understood that the mathematical concept of functions has practical applications in everyday life, namely in the process of making Malay songket. In this case, the domain of the function is the thread (and also its color), the codomain of the function is Malaysian Malay songket cloth which may be made or has been made using Kek Melayu. Meanwhile, the range of functions is the result of woven songket cloth. The function involved is: f: D → K, which is expressed as "(pattern, color) = songket result", where D is the domain and K is the codomain. The process of making Malaysian Malay songket also incorporates a mathematical concept, namely coordinate representation. When a craftsman creates a songket with a specific pattern, he or she considers and decides where to place the gold threads. If he or she makes a mistake in determining where to place the gold threads, the desired pattern will be inconsistent or unsuccessful. This means that the craftsman has applied the concept of determining the coordinates of the points (gaps) of the threads to place the gold threads. The ethnomathematics involved in this process is a two-dimensional coordinate representation. Each point where the threads meet is a cartesian coordinate system (grid system), with the x-axis representing the horizontal row of threads and the y-axis representing the vertical row of threads. Incorrectly determining the location or coordinates of the gaps will destroy the songket motif or pattern.

A Cartesian coordinate system is a coordinate system that uniquely assigns each point on a plane to a series of numerical values, which are the distances of the point from two fixed, perpendicular lines measured in the same unit of length. The vertical fixed line is called the vertical axis (y-axis) and the straight fixed line is called the horizontal axis (x-axis). Determining the coordinates of points in making songket is illustrated in figure 4.

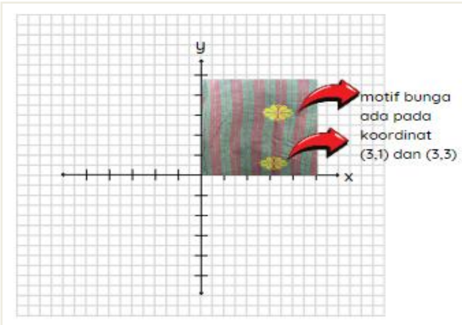


Figure 4. Cartesian Coordinates Determining the Location of Songket Motifs

3. The Cost of Making Malaysian Malay Songket

The cost of making Malaysian Malay songket is more expensive than that of songket imported from India. This is because Malaysian Malay songket is handmade by skilled craftsmen. The higher production costs of Malaysian songket are due to higher wages than those of Indian songket. Making high-quality, handmade songket is also quite time-consuming, taking at least a month. This fact can be a contextual source for teaching equivalent comparisons. Equivalent comparisons are a type of comparison between two variables whereby if one variable increases in value, the other variable also increases in value, and vice versa. For example, the problem is as shown in figure 5.

It took Mrs. Siti 30 days to complete a piece of songket she ordered from her. On the 25th day, she received an additional order for three pieces. How long did it take her to complete all the orders?

Figure 5. Example of Ethnomathematics Questions for Linear Equation Systems

4. Geometry in Malaysian Malay Songket Patterns

Geometry is found abundantly in Malaysian Malay songket patterns. The plane shapes in question are parallelograms, rectangles, squares, and triangles. The following is a description of the plane shapes in question:

a. Parallelogram

A parallelogram is a plane shape that has two pairs of parallel, equal-length edges and non-right angles. Opposite angles are equal. If all four edges are equal in length, it is called a rhombus. The image of a songket pattern containing a parallelogram shape is shown in figure 6.

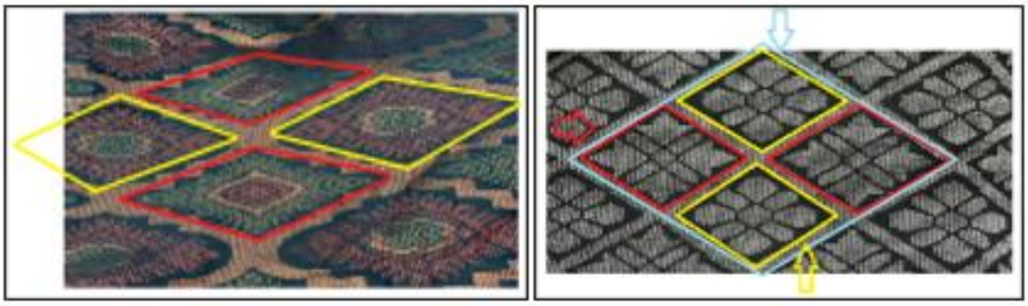


Figure 6. Parallelogram Shape in Songket Patterns

b. Rectangle

A rectangle is a flat shape that has four sides, the opposite sides are the same length and the four angles form right angles. The image of a songket pattern containing a rectangular shape is shown in figure 7.

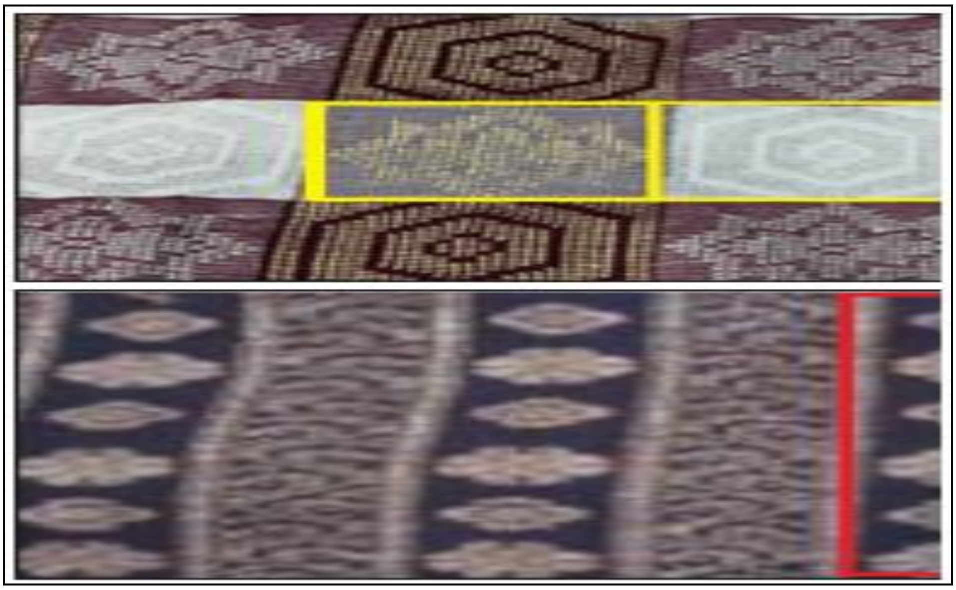


Figure 7. Rectangle Shape in *Songket* Patterns

c. Square

A square is a flat, quadrilateral shape with four sides of equal length and four right angles. The image of a songket pattern containing a square shape is shown in figure 8.

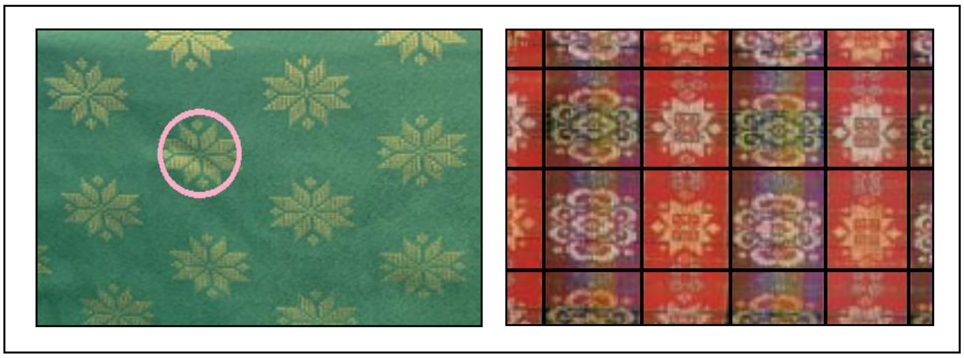


Figure 8. Square Shape in Songket Patterns

d. Triangle

A triangle is a flat shape bounded by three straight lines that form three angles. The image of a songket pattern containing a triangle shape is shown in figure 9.

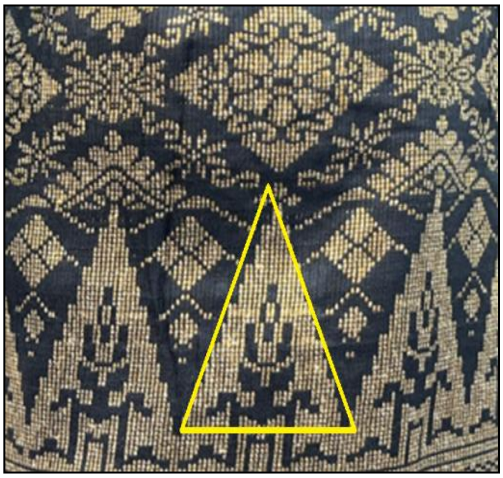
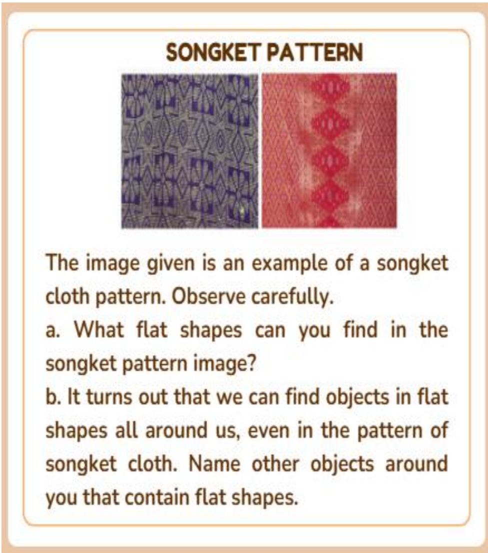


Figure 9. Triangle Shape in Songket Patterns

5. Ethnomathematics in the form of lines contained in the patterns of Malaysian Malay songket cloth.

Songket patterns contain line elements. These line patterns can easily be found in most songket patterns. Below are some examples of songket patterns that contain lines.



Project

Design a songket pattern from flat shapes such as parallelograms, squares, rectangles, circles, and triangles.

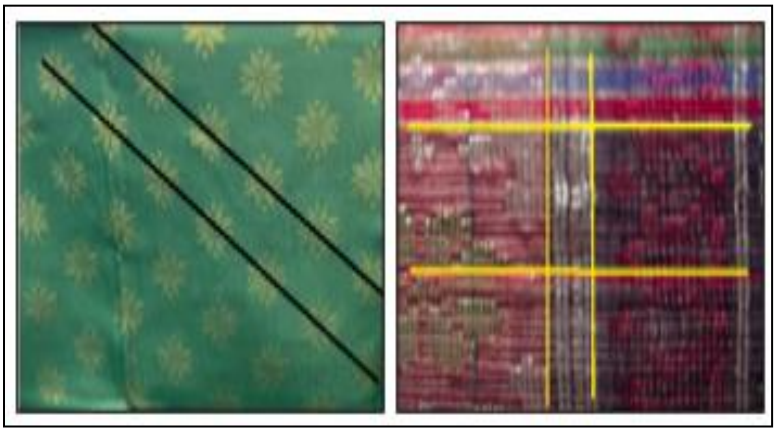


Figure 10. Line Shapes on Songket Patterns

A line is a collection of points arranged in a continuous line. The term 'line' is essentially a basic concept; its meaning is not defined. A line is also a two-dimensional object. A line represented by a segment (straight or curved) is merely an illustration, as lines have only length but no width. Meanwhile, the line segments commonly used to represent lines must have width. If a thick line is drawn in various directions and extends infinitely, it will form a plane. A plane is also a fundamental resolution. A plane is two dimensional, possessing only length and width (area) but no volume.

This ethnomathematics concept, which uses lines, can be used as a resource for learning mathematics in the classroom. One option is to present students with problems, as shown in figure 11.

In a village, local residents create a traditional woven songket cloth with a pattern of parallel and crisscrossing lines. The cloth is 100 cm long and 50 cm wide. They create a pattern with straight lines spaced 5 cm apart, both horizontally and vertically, forming small squares across the fabric.
1. How many horizontal lines are there on the cloth?
2. How many vertical lines are there on the cloth?
3. How many squares are formed by these lines across the fabric?

Figure 11. Example of a Mathematical Problem Involving Ethnomathematics of Flat Shapes in Songket Cloth

6. Coloring Patterns in Malaysian Malay Songket

In the Malay Malaysian songket cloth, there are ethnomathematical elements in the form of a sequence of numbers. The color pattern is in accordance with the topic of the number of sequences. One of the color patterns on Malaysian Malay songket is shown in figure 12.

Figure 12. Coloring Patterns in Malaysian Malay Songket

A number sequence is a sequence of numbers arranged in a row according to certain rules. The numbers that make up a sequence are called terms of the sequence. This number sequence pattern can be used as a learning resource. Some examples are in the form of problems, as shown in figure 13.

Figure 13. Example of a Question Involving Ethnomathematics in The Form of a Sequence of Numbers in a Songket Pattern

7. **Ethnomathematics in the form of reflection in Malay-Malay songket patterns**

In songket patterns, ethnomathematics in the form of reflection is present. Reflection is a geometric transformation that produces an image of an object by reflecting it along a specific line, called the mirror line or axis of reflection. Characteristics of reflection:

a. The distance between each point of the object and the mirror line is equal to the distance of its image from the mirror line.
b. The angle between the object line and the mirror line is equal to the angle of the image.
c. The object and its image have the same shape, but the orientation of the original object changes. If the object moves clockwise, its image will move in the opposite direction.
d. Reflection along the x-axis produces an inverted image along the y-axis, and vice versa.

Figure 14 shows one of the Malaysian Malay songket motifs that contains a mirrored shape.

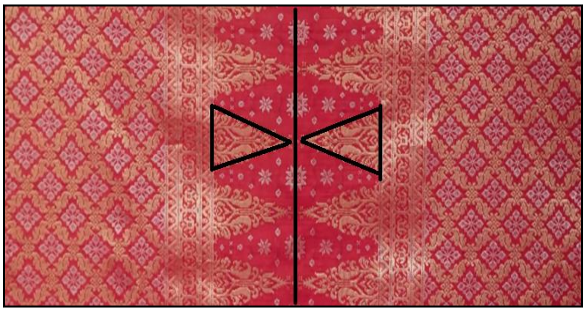


Figure 14. Songket Pattern Containing Reflections

This ethnomathematics can be used as a context for creating mathematical problems on the topic of reflection. An example problem is presented in figure 15.

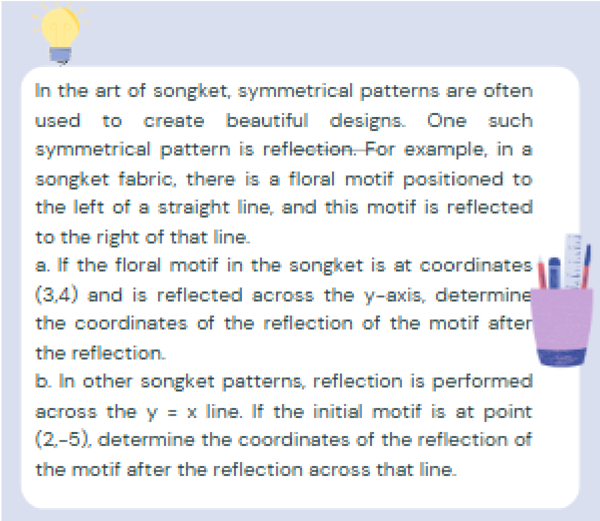


Figure 15. Example of a Reflection Problem Involving a Songket Pattern

The use of cultural context in mathematics learning often produces good mathematics learning outcomes, for example, mathematical understanding (Oktavia, Yustitia, Hadi, & Wijaya, 2025). Literacy (Angga, Tugba, & Yelken, 2024) and numeracy skills (Pramulia, 2025). Various approaches can also be collaborated with this ethnomathematics and provide satisfactory results for students. Among these approaches are Realistic Mathematics Education or RME (Nursyahidah, Mariani, & Wijayanti, 2025), Problem-Based Learning (Isrokatun, 2019), and the STEM (Science, Technology, Engineering, and Mathematics) approach (Pramasdyasari, Aini, & Setyawati, 2024). Likewise, its integration with technology in learning is also recommended (Sofnidar, 2025).

CONCLUSION

Malaysian Malay songket cloth consists of six patterns: Chained Bay Pattern, Vertical Lines, Scatter Pattern, Chessboard, Horizontal Lines, and Triangle Shape. Several other patterns may be found on Malaysian songket cloth, but these seven patterns are the traditional patterns of Malaysian Malay.

Malaysian Malay songket cloth contains several ethnomathematic elements. The ethnomathematics found in this Malaysian Malay songket cloth are: (a) The stages of making Malaysian Malay songket cloth imply a hierarchy. Hierarchy implies stages that must be observed or implemented. This aligns with the hierarchy of material in mathematics. This hierarchy of material must be considered in mathematics learning. Students must gradually accept and understand mathematical material, which can lead to difficulties in understanding mathematics. (b) The loom for Malaysian Malay songket cloth, called "Kek Melayu," incorporates the application of the concept of function. Where "Kek Melayu" is the mathematical function, the yarn is the domain of the function, and the resulting songket cloth is the codomain of the function. The yarn color can also be expressed as the domain of this function, and the resulting songket pattern as the function's codomain. In both cases, the function's range is the same as its codomain. (c) This "Kek Melayu" loom also incorporates the concept of determining point coordinates. When a songket craftsman creates a pattern by weaving yarn of a certain color, he or she must be able to determine the coordinates of the colored yarn to be woven into the pre-arranged arrangement of threads to create the desired motif. (d) The patterns and motifs of Malaysian Malay songket cloth contain several plane shapes (parallelograms, rectangles, squares, circles, triangles), the concept of lines, the concept of number patterns, and the concept of reflection. These various concepts can be used in creating mathematical problems or problems, and can also serve as learning resources, such as objects, data, facts, ideas, or examples, that can facilitate student learning.

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Conflict of Interest	:	The authors declare no conflict of interest.
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