

**HARMONY IN THE DIVERSITY OF SOLO BATIK MOTIFS AND
MATHEMATICAL CONCEPTS**

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ABSTRAK

Penelitian ini mengeksplorasi integrasi etnomatematika dalam pembelajaran matematika dengan memanfaatkan motif Batik Sidomukti asal Solo sebagai media pembelajaran. Penelitian ini dilatarbelakangi oleh perlunya mengaitkan matematika dengan budaya lokal guna meningkatkan pemahaman dan minat siswa dalam belajar matematika. Tujuan penelitian ini adalah untuk mengidentifikasi unsur matematika yang terkandung dalam motif Batik Sidomukti dan bagaimana motif tersebut dapat digunakan sebagai media pembelajaran matematika realistik. Metode penelitian yang digunakan adalah penelitian kepustakaan dengan menganalisis data primer dan sekunder yang berkaitan dengan motif Batik Sidomukti dan konsep matematika yang relevan. Hasil penelitian menunjukkan bahwa Batik Sidomukti memuat berbagai konsep geometri seperti lingkaran, segitiga, belah ketupat, dan jajar genjang, serta menerapkan konsep aljabar dan statistika dalam perancangannya. Selain itu, analisis simetri menunjukkan bahwa motif Batik Sidomukti menggunakan pola translasi tanpa pola simetri pantulan, geser, atau putar. Kesimpulan dari penelitian ini adalah Batik Sidomukti tidak hanya mempunyai nilai estetika dan budaya yang tinggi, tetapi juga dapat digunakan secara efektif sebagai media pembelajaran matematika yang menghubungkan siswa dengan konteks budayanya dan meningkatkan pemahaman matematika melalui aplikasi nyata.

Kata Kunci: Etnomatematika, Batik Sidomukti, Media Pembelajaran.

ABSTRACT

This study explores the integration of ethnomathematics in mathematics learning by utilizing the Batik Sidomukti motif from Solo as a learning medium. The background of this study is based on the need to link mathematics with local culture in order to improve students' understanding and interest in learning mathematics. The purpose of this study is to identify the mathematical elements contained in the Batik Sidomukti motif and how the motif can be used as a realistic mathematics learning medium. The research method used is library research by analyzing primary and secondary data related to the Batik Sidomukti motif and relevant mathematical concepts. The results of the study show that Batik Sidomukti contains various geometric concepts such as circles, triangles, rhombuses, and parallelograms, and applies algebraic and statistical concepts in its design. In addition, symmetry analysis reveals that the Batik Sidomukti motif uses a translation pattern without reflection, shear, or rotational symmetry patterns. The conclusion of this study is that Batik Sidomukti not only has high aesthetic and cultural value, but can also be used effectively as a mathematics learning medium that connects students with their cultural context and improves mathematical understanding through real applications.

Keywords: Ethnomathematics, Sidomukti Batik, Learning Media.

INTRODUCTION

Mathematics is a universal science and is useful in every aspect of human life. It is knowledge that cannot be separated from every human activity, even if we do not realize that many human activities depend on mathematics. In other words, mathematics is part of a culture that has existed for a long time (Rudyanto, 2019).

Batik is one of the many characteristics of Indonesian culture. Batik is highly valued for its intricate process and beautiful motifs and colors, which are full of symbolic meaning. Each batik motif has a magical symbolic meaning that is intended to provide trust and has aesthetic value for use as decoration (Irawan, Lestari and Rahayu, 2022).

Ethnomathematics helps explain the relationship between mathematics and culture. However, the goal of ethnomathematics is to understand how mathematics relates to culture, so that students and the general public can gain a better understanding of the subject and improve their ability to understand it. This shows that ethnomathematics research is essential to the study of mathematics itself, mathematical modeling, and anthropological culture (Rudyanto, 2019). Indonesia has many cultures that come from our ancestors. Indonesians should be proud of this. However, Indonesian culture has declined slightly from national socialization, so many people now forget it and do not know what it is. The sense of love for culture is decreasing along with the development of globalization, which has a negative impact on the existence of local culture and indigenous Indonesian people (Saenal, 2020).

The reality in schools is that most educators still fail to relate mathematics to local culture.(Fadlilah, Trapsilasiswi and Oktavianingtyas, 2017). This is related to the ability of teachers and their learning process to provide lessons that relate mathematics to students' daily lives so that students not only learn concepts but also learn the context of mathematics in daily life, which is better known as the term practical mathematics (Irawan, Lestari and Rahayu, 2022).

Realistic mathematics learning views mathematics as a human activity. According to this approach, students should benefit from learning mathematics in class by providing real examples from everyday life. In addition, the realistic mathematics learning process utilizes students' potential to improve their analytical skills by considering the application of mathematics in everyday life.(Febriyanti and Irawan, 2017). According to Susanti, realistic mathematics learning involves students' thinking in analyzing material based on everyday situations, so that mathematics becomes an everyday activity.(Kusumaningrum and Nuriadin, 2022).The basic principle of realistic mathematics learning is to provide students with the opportunity to re-explore mathematical concepts and principles under the guidance of adults (Salsabila and Suparni, 2022).

Learning media is an educational tool that can help teachers expand students' knowledge. Teachers can use various types of learning media to provide knowledge to their students. By using learning media, teachers can foster students' interest in learning new things and make learning materials easy to understand. To achieve school teaching goals, teachers must be able to choose the most appropriate and most suitable learning media (Nurrita, 2018). Solo is a cultural city which is famous for its batik industry.(Sulistyo and Pratiwi, 2013). Various batik motifs have been produced in Solo, including Sekar Jagad batik, Cuwiri batik, Wahyu Tumurun batik, and Sidomukti batik.(Jordy, Magdalena and Novamizanti, 2018). The Sekar Jagad Batik motif has a philosophical meaning that symbolizes love and has elements to maintain peace. This meaning of love makes the Sekar Jagad batik motif often used in wedding processions.(Sedonya et al., 2022). The Cuwiri Batik motif itself is usually used in the mitoni or seven-month ceremony because it has a philosophical meaning which means "expecting prosperity and goodness in life and being respected by others"(Trixie, 2020). The Wahyu Tumurun Batik Motif contains a philosophical meaning, namely the hope or request to receive revelation (gift), guidance and direction from God Almighty, far from obstacles and barriers. The Wahyu Tumurun batik motif is used during the siraman ceremony.(Muhadiyatiningsih and Hikmawati, 2018). Next for the Sidomukti Batik motifsecaPhilosophical ra has the meaning of nobility and glory (Ishartono and Ningtyas, 2021).

The Sidomukti Batik motif is among the most popular Solo batik designs and holds a significant place in the traditional culture of the Solo community. This motif is commonly featured in traditional Central Javanese wedding attire. The name "Sidomukti" originates from two Javanese words: *sido*, meaning "to continue," and *mukti*, which refers to "a life of sufficiency, prosperity, or well-being." By wearing Sidomukti batik, the bride and groom express their hopes for a happy, prosperous married life blessed with fortune and grounded in devotion to God (Meindrasari & Nurhayati, 2019).

Sidomukti Batik also holds potential as a culture-based learning medium. Its popularity in Solo makes it a relatable and practical resource for integrating cultural heritage into education. Specifically, Sidomukti Batik can serve as a tangible medium for realistic mathematics learning. This approach aligns with the idea that using culturally relevant materials enhances students' understanding of mathematical representation skills. It also encourages them to engage actively by researching, analyzing, and expressing their ideas during the learning process (Salsabila & Suparni, 2022).

The geometric patterns within Sidomukti Batik are rich with mathematical concepts, providing representations of real-world geometric shapes found in students' surroundings. This connection facilitates students' ability to visualize abstract concepts, such as shapes and patterns, in a more concrete and relatable context (Kusumaningrum & Nuriadin, 2022). Ethnomathematics research has gained momentum in exploring cultural elements in mathematical education. For instance, Sariningtias (2020) analyzed Ngawen Temple and identified geometric forms like cubes, truncated square pyramids, and square pyramids. Similarly, Practicum (2021) explored mathematical elements in Lhoknga community rattan crafts, revealing geometric concepts such as lines, circles, angles, and transformations. Okti (2022) examined the geometric patterns in various types of batik, while Risdiyanti (2018) explored geometric transformations embedded in Javanese cultural values. Ishartono (2021) focused on Sidoluhur Batik, uncovering diverse geometric elements.

Despite these advancements, little research has specifically delved into the ethnomathematics patterns and concepts within Sidomukti Batik and its application as a learning medium. Recognizing this gap, researchers are motivated to explore the potential of utilizing Sidomukti Batik as a medium for realistic mathematics learning. This endeavor seeks to innovate within the educational field, particularly in mathematics, by integrating the art and cultural heritage of batik into mathematical education. This integration emphasizes the inseparability of mathematics and cultural practices in daily life, offering new dimensions for both teaching and learning.

METHODOLOGY

This research method uses a library research approach. Library research namely research originating from ingredients bibliography. Because of That, What is being done is an exploration of some data It is good data primary as well as data secondary with 1 steps concrete as follows: read and study carefully in-depth primary data such as journals which constitute results study, thesis or dissertation related to form Sidomukti Solo batik motif. Meanwhile, for data secondary, elite pens read and study journals that are relevant to this research, then analyze What mathematics material can use Sidomukti Solo batik as a learning medium.

RESULT AND DISCUSSION

Solo Sidomukti Batik Motif

Batik Sidomukti is one of the easiest to find. Solo Central Java brides often wear Sidomukti motifs. Batik Sidomukti comes from the word "sido", which means "so", which means "continue", and "mukti", which means "a life of sufficiency, prosperity, or well-being." Copyright (c) 2024 EDUCATOR : Jurnal Inovasi Tenaga Pendidik dan Kependidikan

By wearing the Sidomukti batik motif, the bride and groom hope that they will always be happy and blessed with fortune during their married life without forgetting God the creator (Meindrasari and Nurhayati, 2019).

After the Giyanti Agreement in 1755, the Mataram kingdom was divided into two palaces, namely Yogyakarta and Solo. All equipment, tools such as gamelan, clothing, and batik, including Sidomukti batik were brought to Yogyakarta. Then, the Solo Palace remade all the equipment and tools including Sidomukti batik but with a different style. The basic geometric pattern of Solo-style Sidomukti batik consists of square fields, also known as rhombus fields. The main pattern, this pattern represents a symbol of power. The motif of Sidomukti Solo batik can be seen in Figure 1. below.



Figure 1. Structure of the Sidomukti Batik Jarik Pattern

The Sidomukti batik motif consists of the main components of the tree of life, garuda wings, butterflies, buildings, thrones and meru. In addition, there are also complementary components in the form of plants and flowers. The explanation of each component of Batik Sidomukti is as follows:

Main Elements

The main elements and symbolic meanings of the Sidomukti batik motif include the following:

Tree of Life



Figure 2. Visual Form of the Tree of Life from Sidomukti Batik

The tree of life is referred to as the tree of heaven, the tree of life, and the tree of hope, and has symbolic meaning of the belief that God has the power to give hope to humans.

Garuda Wings



Figure 3. Visual Form of Guruda's Wings from Batik Sidomukti

The shape of the garuda's wings shows that humans can control their lust and achieve the perfection of life. There is a relationship between the symbol of the garuda's wings on the jarik cloth worn by the bride and groom and their lives because the garuda's wings symbolize strength, fortitude, protection, wisdom, and might.

Butterfly



Figure 4. Visual Form of Butterfly from Sidomukti Batik

Butterflies represent ideals, beauty, and hope. Newlyweds must have great hopes for building a household, such as having children, earning money, and feeling unprecedented happiness.

Building

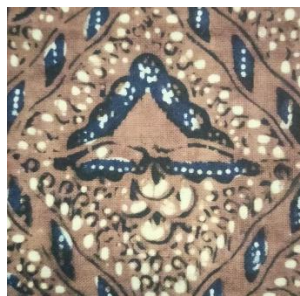


Figure 5. Visual Form of Building from Sidomukti Batik

In Sidomukti batik, the building shows the house where the two prospective brides and grooms will live. depicts the best place to live if you want to build a rich family. The elements in the building show the hope that humans must reflect the nature of a solid house, which can accommodate all problems faced in life, especially those related to the household, so that humans can also maintain and organize everything more wisely (Yuliana et al., 2019).

Throne

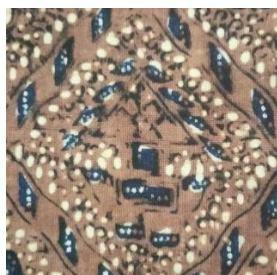


Figure 6. Visual Form of the Throne from Sidomukti Batik

The throne ornament depicts a high position and standing. This throne is a symbol of hope for a high status and dignity, noble, and respected by many people, such as a leader or king.

Meru



Figure 7. Visual Form of Meru from Sidomukti Batik

The main ornament in the form of Meru is a symbol of mountains, land, and earth. The mountain ornament symbolizes grandeur and majesty, like a large mountain that looks majestic from a distance. This comes from the teachings of the four elements of life known as sangkan paraning dumadi or the origin of life, besides fire, water, and air.

Complementary Elements

Plant



Figure 8. Visual Form of Plants from Sidomukti Batik

In Sidomukti batik, plants have a symbolic meaning, namely depicting enough food. They also depict plants that are bowing down, like rice, which the more it bows down, the fuller it is.

Flower



Figure 9. Visual Form of Flowers from Sidomukti Batik

In Sidomukti batik, flowers are placed on each corner of the rhombus because they depict the Qibla Papat Limo Pancer, which is depicted on the divider between the four main motifs: the qibla papat, the building, the butterfly, and the tree of life, which depicts the journey of the bride and groom at home. The pancer and the five are ourselves. A drop of white blood and a clot of red blood are represented by flowers in the Sidomukti batik motif as a reference to the Qibla Papat Limo Pancer. All the red and white blood will merge and give birth to a baby. (Yuliana et al., 2019).

Analysis of the Sidomukti Batik Ornamental Pattern Collection

Based on Figure 1. it can be seen that the main motif of the ornament on Batik Sidomukti consists of 6 main images, namely the tree of life, garuda wings, butterflies, buildings, thrones and meru. The pattern is depicted in Figure 10.

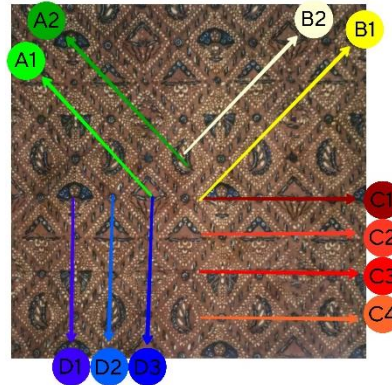


Figure 10. Collection of Sidomukti Batik Ornamental Patterns

Based on the picture above, we can see that the members of each set are as follows. The set A_1 and A_2 is a set of Sidomukti Batik motif elements towards the top left. The set B_1 and B_2 is a set of Sidomukti Batik motif elements towards the top right. The set C_1 , C_2 , C_3 and C_4 is a collection of elements of the Sidomukti Batik motif horizontally. The set D_1 , D_2 and D_3 is a collection of elements of the Sidomukti Batik motif vertically.

$A_1 = \{\text{meru, sayap garuda, kupu - kupu, bangunan}\}$

$A_2 = \{\text{sayap garuda, singgasana, bangunan, pohon hayat}\}$

$B_1 = \{\text{pohon hayat, sayap garuda, singgasana, bangunan}\}$

$B_2 = \{\text{sayap garuda, kupu - kupu, bangunan, meru}\}$

$C_1 = \{\text{pohon hayat, meru}\}$

$C_2 = \{\text{bangunan}\}$

$C_3 = \{\text{kupu - kupu, singgasana}\}$

$C_4 = \{\text{sayap garuda}\}$

$D_1 = \{\text{kupu - kupu, pohon hayat}\}$

$D_2 = \{\text{sayap garuda, bangunan}\}$

$D_3 = \{\text{kupu - kupu, pohon hayat}\}$

Based on the analysis of the members of the set in each element vertically, horizontally, and diagonally to the right and left, it is found that:

$A_1 \cup A_2 = B_1 \cup B_2 = C_1 \cup C_2 \cup C_3 \cup C_4 = D_1 \cup D_2 \cup D_3 =$

$\{\text{sayap garuda, pohon hayat, kupu - kupu, bangunan, singgasana, meru}\}$

Geometry

There are several geometric concepts contained in the Sidomukti Batik motif, as follows:

1. Circle

A circle is a set of all points on a plane that are equidistant from a fixed point on the plane. The fixed point of the circle is called the center of the circle, while the distance from a point on the circle to the center point is called the radius of the circle. In the Sidomukti Batik motif, there are many that have geometry with a circular shape.

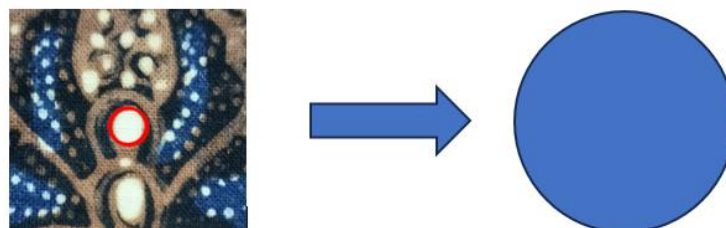


Figure 11. Circle Pattern on Sidomukti Batik

2. Triangle

A triangle is three different lines where the endpoints of one line segment coincide with the starting points of another line segment.

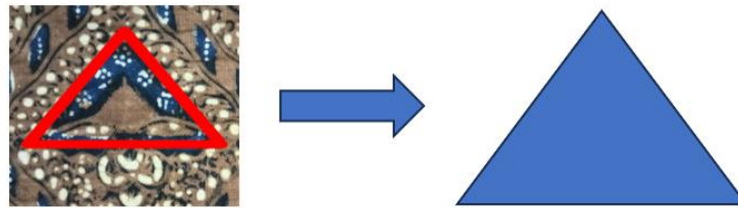


Figure 12. Triangle Pattern on Sidomukti Batik

3. Rhombus

A rhombus is a quadrilateral that has two pairs of parallel sides that are all the same length.

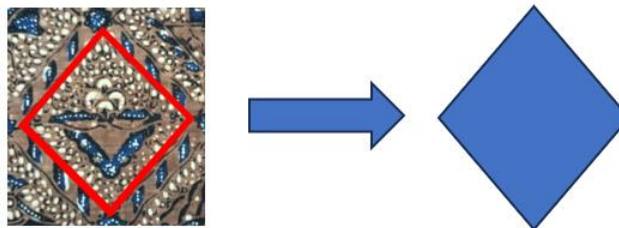


Figure 13. Rhombus Pattern on Sidomukti Batik

4. Parallelogram

A parallelogram is a flat shape that has four sides with opposite sides parallel and the same length and opposite angles the same size.

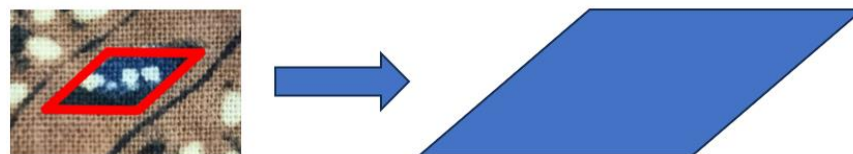


Figure 14. Pattern Parallelogram At Batik Sidomukti

Algebra and Statistics

The concept of algebra includes the activities of counting, measuring, and counting. Counting activities occur when the batik maker determines the number of motifs on one piece of cloth. Measuring activities occur when the batik maker measures the fabric requirements for several motifs in the manufacturing process. Counting activities occur when the batik maker mentions a number and unit for a certain size. Counting activities relate to one bucket, one dipper, five minutes, and two hours. The units often used are centimeters (cm), meters (m), liters (l), ounces (hg), and grams (gr).

In making Batik Sidomukti there are 6 main motifs on one piece of cloth, one of the motifs is a building motif and between the first building motif and the next building motif in the vertical direction there is one motif that pauses, namely the Garuda wing motif. It can be seen in Figure 15. one building motif is 8.5 cm high and 8 cm wide. On a batik cloth measuring 40 cm x 40 cm, it can only contain 2 horizontal rows with each row containing 5 building motifs as in Figure 16.

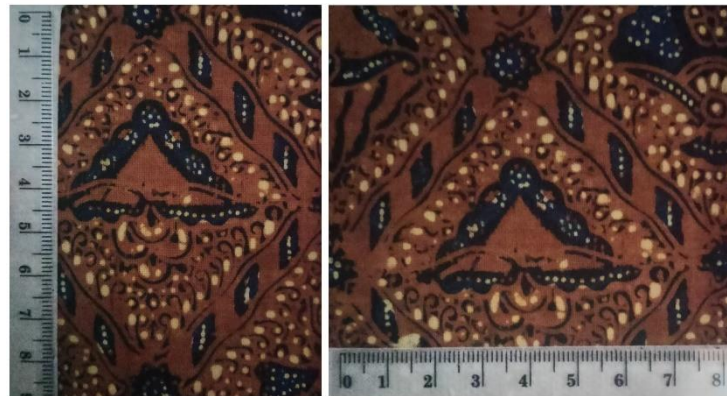


Figure 15. Size of Building Motif

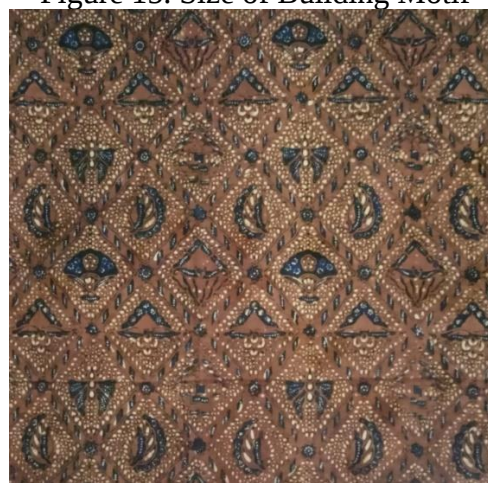


Figure 16. Batik Sidomukti 40 cm × 40 cm

The concept of statistics includes the average (mean), the middle value (median), and the value that often appears (mode). The concept of mean can be found when we calculate the average appearance of various motifs on a Batik Sidomukti cloth. The concept of median and mode can be seen when we have data on the appearance of various motifs on Batik Sidomukti. Statistics also includes the concept of data presentation, as can be seen in table 1 which is a presentation of data on the number of appearances of each Batik Sidomukti motif in Figure 16.

Table 1. Sidomukti Batik Motif Data

NO	Motif Name	Emergence
1.	Tree of Life	4
2.	Garuda Wings	10
3.	Butterfly	4
4.	Building	10
5.	Throne	4
6.	Meru	4
	Amount	36

From Table 1. the mean, median and mode can be calculated. The mean of the data is known to have a total of 36 motifs with a total of 6 motifs, so the mean of the data is 6. If we look at the order of the motifs as in the table, the median of the data is on the 18th motif, namely the butterfly motif and the 19th building motif. Judging from the data, there are 2 modes (bimodus), namely the garuda wing motif and the building motif, totaling 10.

Symmetry Analysis

The symmetrical pattern in Batik Sidomukti does not have a sliding, reflection or rotation pattern, but is a translation of the basic motif.(Astriandini & Kristanto, 2021). Shifting is the shifting of a plane, line, or point in a certain direction and distance. Rotation itself means shifting from one point to another in a geometric plane by rotating about the center of the point.(Yanti & Haji, 2019). While reflection means having the same size of shadow, they move in the opposite direction.(Albab et al., 2014). Figure 9. The following shows the symmetry pattern of Sidomukti batik. The basic pattern, represented by the green rectangle, is repeatedly transformed to produce the motif. Two translation vectors are used, the first in blue and the second in yellow (Astriandini and Kristanto, 2021).

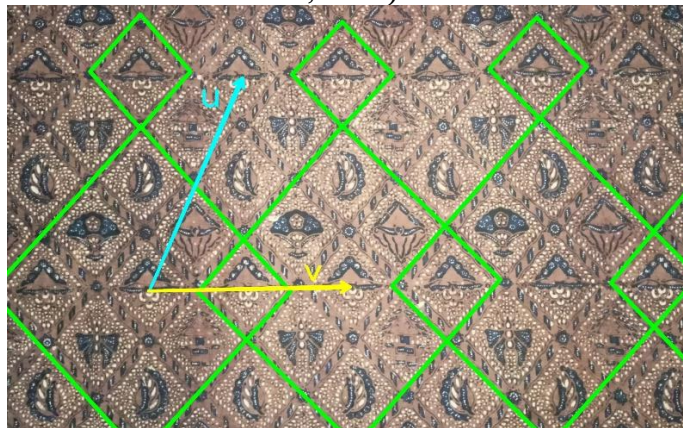


Figure 17. Analysis of Symmetry Patterns of Sidomukti Batik

CONCLUSION

Batik Sidomukti comes from the word "sido", which means "to be" or "continue", and "mukti", which means the bride and groom hope that they will always be happy and blessed with fortune while living "a life of sufficiency, prosperity, or well-being." Batik Sidomukti is a cultural heritage rich in symbolism, especially in the context of Javanese weddings in Solo, Central Java. Each element of the motif, such as the tree of life, garuda wings, butterflies, buildings, thrones, and meru, contains deep philosophical meanings, representing hope, strength, and greatness in life. In addition, this batik motif also contains mathematical concepts such as geometry, algebra, statistics, and symmetry that can be used as a medium for learning realistic mathematics. The use of Batik Sidomukti in learning not only connects students with cultural heritage, but also improves their understanding of mathematical concepts through contextual and concrete representations. One way to preserve Solo culture is by continuing to use batik, especially Sidomukti batik in weddings which is applied to bridal wear.

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