

## Mathematics on Cirebon Woven Fabric with Lanang Motifs

Ibnu Hasan Bisri<sup>1</sup>, Arif Muchyidin<sup>2</sup>

<sup>1</sup>MTs. Darul Hikam Cirebon, Indonesia

<sup>2</sup>IAIN Syekh Nurjati Cirebon, Indonesia

---

### Article Info

---

#### Keywords:

mathematical elements  
mathematical model  
matrix  
new lanang motif

---

### ABSTRACT

This study aims to know the mathematical elements in the lanang motif woven fabric, construct a mathematical model on the increasingly lanang patterned weaving, and construct a new mathematical model for the new lanang motif woven fabric. The data was obtained in the form of qualitative data using interview data collection techniques, observations, documentation and field notes with data analysis, namely domain analysis, taxonomic analysis, component analysis and theme analysis. The results showed that the lanang-patterned woven fabric has geometric shapes, namely pentagons, rhombuses and triangles, to make pentagons, rhombuses and triangles using a pattern formed from small polygons called a rhombus-shaped unit lattice. The mathematical model used in this research is the matrix; to create a pentagon requires a matrix of order  $103 \times 210$ , to form a rhombus requires a matrix of order  $103 \times 338$ , and to develop a triangle involves a matrix of order  $103 \times 348$ . These patterns can create new designs by manipulating the rows contained in the matrix owned by each shape.

*This is an open-access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.*



---

#### Corresponding Author:

Ibnu Hasan Bisri  
MTs. Darul Hikam Cirebon, Indonesia  
Email: [ibnu.hasanbisri31@gmail.com](mailto:ibnu.hasanbisri31@gmail.com)

---

## 1. INTRODUCTION

According to James [1], mathematics is the science of logic regarding shapes, arrangements, quantities, and concepts that relate to each other in large numbers, divided into three fields, namely geometry, analysis and algebra. Mathematics is a branch of science because mathematics can be used in various fields such as biology, physics, and mathematics. According to Trianawaty Anwar [2], mathematics is one of the basic sciences that has an essential role in everyday life and the development of science and technology.

The role of mathematics in human life and technological development is found in the education, economic and cultural sectors. According to Mulyasa [3] states, when

viewed in the education sector in the 2013 curriculum that mathematics is a compulsory subject that must be followed by students even as a National Examination at all levels of education from elementary school (SD), junior high school (SMP), and High School (SMA). However, teaching mathematics in schools only provides formulas, making students bored and dizzy having to memorize these formulas. This happens at almost all levels of education experience. One of them is like the editor in an online news media stating that there are students who think math is complicated and that students who have just heard about it are already afraid [4]–[8]. Mathematics can provide humans with reasoning systematically and critically and increase creativity. These thoughts help humans develop human thinking patterns and human attitudes when interacting [9]–[13]. For example, when people study mathematics, students are expected to be able to absorb the existing information and think whether the information is following facts or just information that is just an illusion.

The role of mathematics in the economic sector is needed as entrepreneurs must calculate the losses and profits for their business to help the economic sector. The role of mathematics in the cultural sector is like making ancient building architectures and designing images in a community skill. It has a historical value that is thick with the culture of having geometric shapes and a pattern made of mathematical models.

Koentjaraningrat [14] states that culture comes from Sanskrit, namely *Buddayah*, which is the plural form of *buddhi* (mind or reason) defined as things related to mind and reason. In English, culture is called *culture*, which comes from the Latin word *colere*, which means to cultivate or work. Widagdo [15] states in his book that culture results from the human mind achieving the perfection of life. Everything created by humans, concrete and abstract, is culture.

People do not realize that a preserved culture has the science of mathematics. Mathematics in culture is called *ethnomathematics*. Mathematics in a culture is the development of mathematics. One of the mathematical sciences in culture is woven cloth. Budiyo [16] revealed that weaving is a technique in making cloth which is made with a simple principle, namely by combining yarn lengthwise (*warp*) and transversely (*weft*) using traditional tools called non-machine looms, shortened to (*ATBM*).

Cirebon is an area in Indonesia that makes two types of woven fabric motifs, one of which is *lanang* motif woven fabric. The *lanang* motif woven fabric is a woven fabric used for men because, in this *lanang* motif, the length of the woven fabric made is only about

---

---

1.2 meters; with this length, this woven fabric can only be used as a sarong for men, and this lanang motif does not have threads gold in the motif. This lanang motif is called tajung woven fabric or lurik fabric in its place of origin, Palembang, West Sumatra. This statement is the same as in Salim's research [17] regarding the headgear woven fabric, which states that the cape woven fabric is one of the woven fabrics that does not use gold thread for male sarongs.

The lanang-patterned woven fabric has mathematical elements such as geometry in the shape of a pentagon, quadrangle and triangle, making a mathematical model for crossing two threads, namely an elongated thread (warp) and a transverse thread (weft), so that it becomes a lanang-patterned woven fabric and manufacture a new motif derived from lanang-patterned woven fabric by exchanging rows and unit grids. This problem is exciting to be raised in a study that the researcher will do, namely, wanting to link culture in the form of woven fabric crafts with mathematics, geometry, and mathematical models.

## **2. METHOD**

The type of research used in this research is descriptive qualitative research. The descriptive method is data collected by qualitative methods in the form of words, pictures, and not numbers and then explained so that it can be described. Researchers go into the field, study a process or natural discovery, and record, analyze, interpret, report and draw conclusions from the process. This descriptive research is not intended to test specific hypotheses but only describes "what is" about analyzing mathematical elements in the woven fabric. This descriptive research aims to make a systematic, factual and accurate description, picture, or painting of the facts, characteristics and relationships between the phenomena being investigated.

Before conducting research, researchers must determine in advance what types of data are needed to be related to the research. Based on the data source, data collection can be done using primary and secondary sources. Primary data is obtained by researchers directly without going through intermediaries, namely by interacting or communicating directly. Such as visual data in the form of photographs of woven fabrics, then focused on the crossing pattern between two longitudinal and transverse threads so that they become motifs on woven fabrics. Besides that, it can also be in the form of written data from interviews with resource persons who know about the object, namely woven fabrics. The data collection techniques used in this study were interviews, documentation methods, observations, and field notes.

---

### 3. RESULTS AND DISCUSSION

#### 3.1. Mathematical Model on Lanang Patterned Woven Fabric

The mathematical model is to describe a narrative in mathematical form by being given a symbol. The elaboration process is called modelling or modelling, which is nothing but a thought process [18]. The mathematical model used by the researcher is the matrix. Purwanto [19] states that the matrix is a line of elements in the form of a rectangular number. Matrix is a structured collection of numbers placed in rectangular rows and columns and is bounded by two square brackets [20]–[23]. The matrix is a series of elements in the form of numbers placed in rectangular rows and columns bounded by two square brackets. The number of rows and columns determines the form of the matrix.

The mathematical model in the image on the lanang-patterned woven fabric is the pentagon, the rhombus, and the triangular elements. The model that will be made is a matrix with elements of one (1) and zero (0); the researcher uses element one (1) because the thread that is transverse in the position above the thread is elongated while the element is zero (0) because it is symbolized as the thread that is transverse in the position under the elongated thread. After getting the mathematical model, the researcher also got a pattern for making this lanang woven fabric motif.

In order to better understand the longitudinal (warp) thread, what is the position of the thread and what is the transverse (weft) position of the thread on the woven fabric, the researcher illustrates the image as follows:

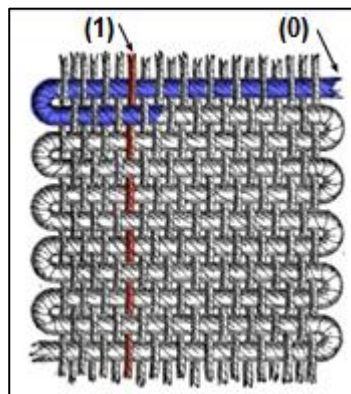


Figure 1. Woven Fabric Embroidery

---











Figure 9. New Motif Made of Rhombus Pattern Manipulation

Alternating rows can manipulate the matrix in the triangular elements. The rows that are swapped, namely from the 1st to the 53rd row, are swapped with the 54th to 103rd rows and vice versa so that it will be in the following form:

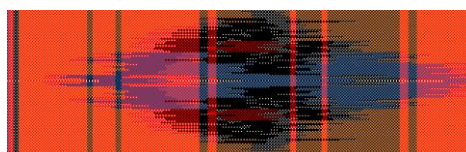


Figure 10. New Motif Made of Triangle Pattern Manipulation

### 3.3. Discussion

Lanang patterned woven fabric is a culture that is in the community. Especially in the Cirebon area, woven fabrics existed in 1947; that in 1947 there were Cirebon people who became woven fabric craftsmen in Karang Sari Village Blok Kelebak. Meanwhile, those who produce woven fabrics in Kertasari Village, Gombang Block, Weru District, and Cirebon Regency from 1950 to 2018 still survive. Lanang-patterned woven cloth is one of the products he makes.

The woven cloth with the lanang motif is a woven cloth that men only use because this woven cloth does not use a gold thread and is not made as a scarf. The colours in the lanang-patterned woven fabric have a particular meaning in everyday life. The red colour has the meaning of courage which is contained in the historical story of the courage of the figures and soldiers of war; the green colour has the meaning of fertility and the wealth of natural products contained in fertile and natural conditions [24]–[28]. Rich in natural products, the colour yellow has the meaning of openness and warmth contained in the social life of the people who are relatively open and build togetherness with other people, and black colour has the meaning of the socio-cultural life of the people who still maintain a mystical side to their traditional forms of belief [29].

The researcher found the main shapes contained in the lanang-patterned woven fabric, namely pentagon elements, rhombus elements and triangular elements; the three forms were only repeated in one woven fabric on the basis that the researchers focused on the three shapes, namely pentagon elements, rhombus elements and triangular elements. Each

element is contained in a unit lattice to form its elements, such as a pentagonal element contained in a rhombus-shaped unit lattice as much as 3,141 having the properties of one-time rotation of  $180^\circ$ , vertical shift and reflection about the y-axis. This rhombus element is filled by a unit lattice of 3,486, which has the property of rotation of  $180^\circ$ , experiencing sideways or horizontal displacement and reflection on the x-axis. The triangular elements are filled by 3,645 unit grids having  $360^\circ$  rotation, horizontal shift and reflection about the x-axis.

The process of making woven cloth still uses traditional tools. The artisans use a thread arrangement technique to make lanang-patterned woven cloth using traditional tools. In the process of making woven fabrics, the threads extend in a parallel position, but when pulled to each other, the position of the longitudinal threads will be above and below so that when the transverse thread is inserted into the longitudinal thread, there will be an embroidery process, this results in the display of threads, and the transverse threads pinched each other. When the longitudinal and transverse threads are pinched together, they form a woven fabric. The researcher numbered one (1) and zero (0) to better understand it. Numbering one (1) is the transverse thread above the transverse thread, and the numbering zero (0) is below the transverse thread.

Each pattern that resembles a pentagon, rhombus and triangle is made using a mathematical model in the form of a one (1) and zero (0) element matrix. To form a pentagon element pattern, 103 rows of colourful transverse threads are the shape of a pentagon and 210 columns of longitudinal threads of only one colour. Forming a rhombus element pattern requires 103 rows of colourful transverse threads that are rhombus shapes and 338 columns of longitudinal threads of only one colour. Another part to form a triangular element pattern requires 103 rows of colourful transverse threads that are triangular shapes and 348 columns of longitudinal threads of only one colour.

The unit grid is a small part of the polygon. Polygons are points connected so that their shape resembles a flat shape. Based on the explanation above, there is mathematics in the lanang patterned woven fabric, namely unit lattice, geometry and a mathematical model in the form of a one (1) and zero (0) element matrix. This explains that mathematics can be integrated with culture in the community, which is called ethnomathematics [30]–[34]. Each pentagon pattern, rhombus and triangular element can be made into new patterns and produce new shapes. From new patterns made from woven patterns with a lanang pattern, artisans can make various patterns

---

---

#### 4. CONCLUSION

Based on the description of the data analysis and discussion and the results, it is concluded that the mathematical elements contained in the lanang-patterned woven fabric are geometry and crystallographic groups. The geometry is like a pentagon pattern consisting of a unit lattice which is a crystallographic group in the form of a rhombus as many as 3,141 having a rotational property of  $180^\circ$  and a shift towards up or down with a reflection about the y-axis. The rhombus consists of a rhombus-shaped unit lattice of 3,486, which has a rotational property of  $180^\circ$  and a sideways shift with a reflection on the x-axis. It resembles a triangle consisting of a rhombus-shaped unit lattice of 3,645, having a rotational property of  $360^\circ$  and a shift towards up or down with a reflection on the y-axis.

The matrix model to form a pentagon requires 103 rows of transverse threads and 210 columns of longitudinal threads. To make a rhombus, you need 103 rows of transverse threads and 338 columns of longitudinal threads. To form a triangle requires 103 rows of transverse threads and 348 columns of longitudinal threads.

The new model is created by swapping rows in the matrix. The rows swapped in the matrix to make a pentagon, namely from rows 1 to 47, are swapped with rows from 48 to 103. The rows swapped in the matrix to make a rhombus are from rows 1 to 51, with rows from 52 to 103. The rows swapped in the matrix to make a triangle from rows 1 to 53 are swapped with rows from 54 to 103.

#### REFERENCES

- [1] R. C. James, *Mathematics Dictionary*, 5th ed. New York: Chapman & Hall, 1992.
  - [2] N. T. Anwar, "Peran Kemampuan Literasi Matematis pada Pembelajaran Matematika Abad-21," *Pros. Semin. Nas. Mat.*, vol. 1, pp. 364–370, 2018.
  - [3] H. Mulyasa, *Pengembangan Implementasi Kurikulum 2013*. Bandung: Remaja Rosdakarya, 2013.
  - [4] J. Boaler, *Mathematical mindsets: Unleashing students' potential through creative mathematics, inspiring messages and innovative teaching*. books.google.com, 2022.
  - [5] E. D. Lovell and M. Lockhart, "Female community college STEM student-parent-researchers living in poverty: Fear, fulfillment, and family," *Community Coll. J. Res.* ..., 2022, doi: 10.1080/10668926.2021.1873873.
  - [6] C. A. LópezLeiva, G. Noriega, and ..., "From students to cofacilitators: Latinx students' experiences in mathematics and computer programming," *Teach. Coll.* ..., 2022, doi: 10.1177/01614681221104104.
  - [7] K. Ohsiek, *HARD PASS: An Arts-Based Autoethnography Regarding the Experience of a Graduate Student of Mathematics*. ir.library.oregonstate.edu, 2022.
  - [8] R. Lambert, D. Hernández-Saca, R. Mireles-Rios, and ..., "'It Is Like a Feeling': Theorizing Emotion
-

- 
- in Mathematics through Complex Embodiment,” *Mathematics*, 2022, [Online]. Available: <https://www.mdpi.com/2227-7390/10/6/937>.
- [9] D. K. Diehl, “What exactly is ‘social’ about social networks?: Accounting for socio-cultural context in networks of human interaction,” *Qual. Quant.*, 2022, doi: 10.1007/s11135-022-01410-z.
- [10] J. Williams, S. M. Fiore, and F. Jentsch, “Supporting Artificial Social Intelligence With Theory of Mind,” *Frontiers in Artificial Intelligence*. ncbi.nlm.nih.gov, 2022, [Online]. Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8919046/>.
- [11] N. Rabb, T. Law, M. Chita-Tegmark, and ..., “An attachment framework for human-robot interaction,” *Int. J. ...*, 2022, doi: 10.1007/s12369-021-00802-9.
- [12] J. Hinds, O. Brown, L. G. E. Smith, L. Piwek, and ..., “Integrating insights about human movement patterns from digital data into psychological science,” *Curr. Dir. ...*, 2022, doi: 10.1177/09637214211042324.
- [13] W. Wood, A. Mazar, and D. T. Neal, “Habits and goals in human behavior: Separate but interacting systems,” *Perspect. Psychol. ...*, 2022, doi: 10.1177/1745691621994226.
- [14] Koentjaraningrat, *Manusia dan Kebudayaan di Indonesia*. Jakarta: Rineka Cipta, 2004.
- [15] D. Widagdo, *Ilmu Budaya Desa*. Jakarta: Bumi Aksara, 2008.
- [16] Budiyo, *Kriya Tekstil Jilid 1*. Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan, 2008.
- [17] N. S. Salim, “Kain Songket Palembang dengan Penerapan Teknik Batik sebagai Produk Fesyen,” *J. Vis. Art Des.*, vol. 7, no. 2, p. 92, 2016, doi: 10.5614/j.vad.2016.7.2.2.
- [18] U. Pagalay, *Matematika Modelling*. Malang: UIN Malang Press, 2009.
- [19] Purwanto, *Aljabar Linier*. Jakarta: Ercontara Rajawali, 2005.
- [20] D. T. Valentine and B. Hahn, *Essential MATLAB for engineers and scientists*. books.google.com, 2022.
- [21] G. Isotton, C. Janna, and M. Bernaschi, “A gpu-accelerated adaptive fsai preconditioner for massively parallel simulations,” *Int. J. ...*, 2022, doi: 10.1177/10943420211017188.
- [22] F. J. Ariza-López, J. L. García-Balboa, and ..., “Thematic quality assessment of land surface geospatial data based on confusion matrices: A matrix set for research on measures and procedures,” *Geosci. Data ...*, 2022, doi: 10.1002/gdj3.116.
- [23] L. Costantini, C. Sciarra, L. Ridolfi, and F. Laio, “Measuring node centrality when local and global measures overlap,” *Phys. Rev. E*, 2022, doi: 10.1103/PhysRevE.105.044317.
- [24] Ф. Тухраева, “The Role Of Colors In Literature,” *ЦЕНТР НАУЧНЫХ ПУБЛИКАЦИЙ (buxdu. uz)*, 2022, [Online]. Available: [http://journal.buxdu.uz/index.php/journals\\_buxdu/article/view/7414](http://journal.buxdu.uz/index.php/journals_buxdu/article/view/7414).
- [25] S. Doshi, “The influence of culture, evolving symbolisms and globalization on defining colour forecasting in India,” *Fash. Style Pop. Cult.*, 2022, [Online]. Available: <https://www.ingentaconnect.com/content/intellect/fspc/2022/00000009/f0020001/art00002>.
- [26] A. V Zhandarova, S. N. Semenova, V. V Zakharova, and ..., “Problems Of Translating Chengyu From Chinese On The Example Of Colour Notation,” *Russian Linguistic ...*. rulb.org, 2022, doi: 10.18454/RULB.2022.30.22.
- [27] C. X. Thung and H. Ahmad, “Colour psychology in kindergarten classroom,” *ARTEKS J. Tek. Arsit.*,
-

- 
- 2022, [Online]. Available: <https://journal.unwira.ac.id/index.php/ARTEKS/article/view/1188>.
- [28] F. I. Kartashkova and L. E. Belyaeva, "Colour Meaning in English Literary Pieces," *RUDN Journal of Language Studies* .... journals.rudn.ru, 2022, [Online]. Available: <https://journals.rudn.ru/semiotics-semantics/article/view/30709>.
- [29] E. S. Leuape and S. Dida, "Dialetika Etnografi Komunikasi Emik-Etik Communication Ethnography Emic-Ethics Dialectical in," *J. Kaji. Komun.*, vol. 5, no. 2, pp. 147–158, 2017.
- [30] J. BAYUG, "The Impact of Mathematics in Shaping the Understanding of Nature and Humanity," *Int. J. Arts, Sci. Educ.*, 2022, [Online]. Available: <https://www.ijase.org/index.php/ijase/article/view/134>.
- [31] D. Permatasari, "Jami'darul Mutaqqim Mosque: Ethnomathematics Exploratory," *Kadikma*, 2022, [Online]. Available: <https://jurnal.unej.ac.id/index.php/kadikma/article/view/28207>.
- [32] Y. Abtahi, "What if I was harmful? Reflecting on the ethical tensions associated with teaching the dominant mathematics," *Educational Studies in Mathematics*. Springer, 2022, doi: 10.1007/s10649-021-10117-1.
- [33] P. Frejd and K. Muhrman, "Is the mathematics classroom a suitable learning space for making workplace mathematics visible?—An analysis of a subject integrated team-teaching approach ....," *J. Vocat. Educ. Train.*, 2022, doi: 10.1080/13636820.2020.1760337.
- [34] G. Bini, O. Robutti, and A. Bikner-Ahsbabs, "Maths in the time of social media: conceptualizing the Internet phenomenon of mathematical memes," ... *J. Math.* ..., 2022, doi: 10.1080/0020739X.2020.1807069.
-