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Ethnomathematics Activity in Tulungagungan Shibori Fabric Production

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ABSTRACT

Tulungagungan Shibori cloth craft is one of the cultural heritages that is still preserved by the people of "Friends of UKM Tulungagung". In the manufacture of Shibori Tulungagungan cloth, many interesting and varied geometric and abstract motifs are used. The purpose of this study is to explore the relationship between mathematics and culture, especially in the Tulungagungan Shibori cloth motif using the Shibori Itajime technique. This study uses an ethnographic approach which is an empirical and theoretical approach, which aims to obtain a comprehensive picture and analysis of culture based on field research. The results showed that there were 6 basic mathematical activities, namely: searching, counting, measuring, designing, playing, explaining. Mathematical concepts arising from Tulungagungan shibori cloth production activities can be used to introduce and understand mathematical concepts through local culture.

Keywords: *ethnomatematics, shibori, Shibori Itajime.*

1. INTRODUCTION

Mathematics and culture are two things that are closely related to the activities of daily human life. Because Mathematics is a form of culture that is integrated in all people's lives. This means that, in culture we can find various kinds of mathematical concepts. So that it can be clear that mathematics and culture are interrelated. The relationship between culture and mathematics is known as ethnomathematics [1].

But in fact, most people often do not realize that their daily activities have applied mathematical concepts [2]. Most people think that mathematics is only a subject in school. This is because mathematics that blends into the culture is simpler than the mathematics learned in school. Whereas mathematics is often used by humans in various aspects of life, for example in measuring, calculating, designing, and some buying and selling activities. In addition, people are also not used to identifying and analyzing the relationship between mathematics and the local culture. So there is a sense of public distrust, that every culture that is owned contains elements of mathematics.

It must be admitted that traditional culture has begun to erode its existence [3]. The development of globalization and the digital era which makes it easier for foreign cultures to enter is slowly shifting the importance of local culture in the eyes of the community, especially the younger generation. Various kinds of features, and social media featuring many foreign cultures make Generation Z try and emulate these foreign cultures. This condition causes local culture to be less attractive and tends to be considered old-fashioned or outdated. So there is great concern for the sustainability of culture in an area,

due to the fading of public interest in understanding local culture. Therefore, as an effort to preserve regional culture so that it does not get lost, the steps that can be taken are to introduce the culture from a mathematical point of view. It is hoped that mathematics and culture will become a unity that influences each other, so that mathematical thinking can evaluate new theories in a multidimensional way against developing cultures [4].

Humans always create something that is characteristic of their local cultur [5]. One of them is

Shibori cloth. Shibori cloth is a cloth whose colors and patterns are produced from the Shibori technique [6]. Shibori is a technique of making batik-like fabric motifs carried out in Japan [7].[8].[9]. The meaning of shibori comes from the word Shiboru which means to squeeze, clamp, press [10]. Shibori belongs to the group of traditional fabrics whose coloring is done with resist and shape-resist dyeing which is commonly referred to as tie-dye. The tie-dye technique is widely found in various countries, such as countries on the African continent such as Senegal, Mali, Gambia, Sierra Leone, Burkina Faso, Nigeria and Cameroon. Asian countries such as India, Japan and Indonesia [9]. In India Shibori is known as Bandhani. In Indonesia, Shibori is usually called by various names, although technically it is still done in quite simple ways. In Central Java it is called Tritik, in Yogyakarta it is called Jumputan, in Java it is known as Tritik, in Palembang it is called Plangi, in Banjarmasin it is called Sasirangan [11].

In cloth processing, the art of shibori has a lot of techniques used. Not only squeezing, pinching and pressing, but the Shibori technique gives a three-dimensional shape by folding, kneading, stitching, tying and twisting. Based on these various techniques, Shibori has many names according to the techniques used. One of them is Itajime Shibori's Technique.

The term Itajime in Japanese literally means 'clamping board'. *ita* (plate) and *shimi* or *jime* mean clamp [12]. This technique has been known as the process of dyeing fabric patterns that are folded in a zig zag or square manner, sandwiched between 2 wooden planks that are tightly clamped and tied with rope and then dipped in dye. The wooden board serves to protect or hold the fabric area from dyeing [12].[13]. Recently, this technique has been favored by many Indonesians, especially the Tulungagung area in East Java Province. The Itajime Shibori technique was chosen because the technique has its own advantages and even uniqueness. The process is simpler to learn, the materials are cheaper to obtain and the manufacture is faster than batik [14]. Actually this technique is similar to batik, which is doing color barriers to create a motif on the fabric. The difference is that in batik the barrier tool used is a *malam* candle, then the Itajime shibori used can be made from various tools such as rubber, thread, tongs, and so on [7].

For the people of Tulungagung the barrier device chooses to use a rubber band as a bond. Then the cloth is dipped in dye. The final result of color dyeing on Itajime Shibori has a special feature, which is that it can produce unexpected color elements and motifs on the fabric [10]. Therefore, this feature must be developed and studied further [15]. Because it is very possible that there are unlimited new inventions, in an effort to produce unique and interesting new motifs

Shibori cloth in the process includes crafts that are easy and practical to make, therefore it becomes effective for the people of Tulungagung to use it as a potential aspect and can be moved to support the community's economy. This potential aspect must be supported by Jargon as the identity of the area from which the art is located. Therefore, the Tulungagung Community group who are members of the Tulungagung Shibori community, call their Shibori Fabrics as Tulungagung Shibori Fabrics which means Tulungagung Typical Shibori Fabrics.

Many researches related to Shibori handicrafts have been carried out in Indonesia, but research related to the mathematical fundamental activities of shibori fabric production has not been carried out. For example, the research conducted by Suantara, Oktaviani & siregar [10] related to the exploration of the Shibori technique in the development of traditional Indonesian motif designs on clothing, which aims to produce Indonesian traditional motifs from the exploration of the shibori technique. Research conducted by Maziyah, Indrahti & Alamsyah [7] related to the implementation of shibori in Indonesia with the aim of knowing the shibori technique that has been carried out by traditional cloth craftsmen in Indonesia. Another study conducted by Kautsar [16] related to the exploration of the sibori technique in ready-to-wear clothing by combining three techniques on shibori batik in one product with the aim of obtaining varied compositions and producing optimal ready-to-wear products. The results of the study resulted in varied designs and increased the aesthetic value of the product. Fatmawati's research [17] Discusses improving the fine motor skills of autistic children through Shibori skills. The results showed that children were able to make shibori correctly and independently, Shibori could improve the fine motor skills of autistic children. From the four studies, it shows that there is a different footing in conducting studies on mathematical activities with ethnomathematical forms on Tulungagungan Shibori Fabrics. The four studies above show that shibori batik has been known and implemented by fabric craftsmen in Indonesia.

The selection of Tulungagungan Shibori Fabric with the Itajime technique as the object of research, because the production process contains various mathematical concepts that can be used as contextual mathematics learning innovations. In addition, the motifs are unique and distinctive, namely Geometry motifs [9] that are produced which often produce unexpected effects and sometimes cannot be repeated even though they use the same techniques and methods. This is what makes the Shibori Tulungagungan motif always growing and has the potential to be developed and explored continuously without knowing the limits of the basic techniques that have been commonly used before. Moreover, for Shibori Tulungagungan itself is an art whose emergence is relatively new in Tulungagung, so there needs to be a way so that the cloth is better known by the wider community.

With the results of this study, the researchers hope to provide good implications, namely by showing the relationship between culture and mathematics through Shibori Tulungagungan cloth craft in terms of aspects of mathematical fundamental activities according to Bishop [18] namely: Counting, Measuring, Locating, Designing, Playing, Explaining

2. METHODS

This research was conducted to reveal several mathematic concepts that emerged in the process of creating Tulungagungan shibori cloth motifs using qualitative research methods with ethnographic approach.

2.1. Research Design

The research design that is applied in ethnomathematics research refers to the research design used by Alangui [19]. There are four questions used in the Alangui dissertation as follow: Where to start looking?, How to look?, How to recognize that you have found something significant?, and How to understand what it is?

2.2. Participant and Research Sites

This research was conducted in Tulungagung Regency, East Java. The selection of data sources is done by Purposive Sampling. The participants in this study were the women of the Sahabat UMKM community who worked daily as Tulungagungan Shibori Fabric craftsmen. ho is considered to have knowledge of the process of making Tulungagungan Shibori Fabric.

2.3. Research Instruments

The instrument in this research is the researcher himself. Qualitative research instruments used in this study were observation guidelines and interview guidelines. In order to develop good research instruments, it is deemed necessary to conduct instrument validation. Instrument validation is carried out by involving Mathematics lecturers to validate it. After the validation results are accurate and satisfactory, then the researcher proceed to the next stage.

2.4. Data Collection

In this study, the data collection techniques used were observation, documentation, and interviews. Data collection was done by observation and interviews. This method is carried out by observing directly the fundamental mathematical activities of ethnomathematics activities carried out by Tulungagungan shibori craftsmen. Interview conducted on 2 employees who work at the Shibori Tulungagungan production house in the Tulungagung Regency area.

2.5. Data Analysis

Data analysis techniques through the stages of data reduction, data presentation, conclusion drawing and verification

3. RESULT AND DISCUSSION

Based on the results of observations and data collection during the study, data were obtained regarding the activities carried out by craftsmen when making Shibori Tulungagungan fabrics. That is like measuring the size of the fabric to be made and designing the Shibori fabric motif with the Itajime Shibori folding technique. Actually, there are many basic techniques for making shibori. Among them are: Mokume Shibori, Karamatsu Shibori, Awase Ori – Nui, Ori – Nui Shibori, Arashi Shibori, Itajime shibori, nui shibori, kanoko shibori, kumo shibori. This research focuses on the Tulungagungan Shibori craftsmen, who prefer to use the Itajime Shibori technique.

This technique has been known as the process of dyeing fabric patterns that are folded in a zig zag or square manner, sandwiched between 2 wooden planks that are tightly clamped and tied with rope and then dipped in dye. The wooden board serves to protect or hold the fabric area from dyeing [12].[13]. However, for the production process of Tulungagungan shibori cloth, it does not use a clamp board, but uses a rubber band as a holder. The reason he chose to use the Itajime Shibori technique, because with the Itajime Shibori Technique, the folded fabric involves a model with geometric shapes.

There are several kinds of shapes that are commonly used, namely: square folds, rectangles, isosceles triangle folds, equilateral triangle folds, parallelogram folds, and envelope model folds. The folds after being dipped into the dye will produce different and unique motifs. One example is the folding model of isosceles triangles and equilateral triangles, the dyed results will produce flower-like motifs and resemble the kawung and lotus flower motifs. This motif is the hallmark of Tulungagungan Shibori Fabric.

Based on the results of interviews and documentation of the research subjects, there are mathematical activities contained in the activity of producing Shibori Tulungagungan cloth using the Itajime technique. In this study, the fold model observed was using the isosceles triangle and equilateral triangle fold models.

3.1 Locating

Location activity here is a certain point/object position [20]. In this activity, the activities that arise are when the craftsman determines the place to supply raw

materials. There is a place where the supplier of raw materials is fixed, because it has been subscribed for a long time and the available raw materials are sufficient for the production process. In addition, if the order increases, the raw materials will also be added.

In addition, location activities also appear when determining where to market the finished product. There are those who take part in the exhibition of handicraft products. Some are marketed on social media. Some use social media.

Location activities also apply to placing employees according to their skills and abilities in the Tulungagungan Shibori fabric production process

3.2 Counting

Counting means finding the amount (the remainder, the income) by adding, subtracting, and so on [21]. Counting activity is seen when the craftsman counts the pieces of fabric in a roll with a length of at least 50 yards. Because each roll has a different length. 1 yard = 91.44 cm. So 50 yards = 50 x 91.44 = 4572 cm = 45 meters = 45.72 cm and when rounded = 45 m. If 1 piece of cloth is 2 m long, the craftsman can calculate the cloth needs by dividing 45: 2 = 22.5. So that 1 roll of cloth, will get 22 pieces. The mathematical activity that occurs is using the concepts of multiplication, division and long conversion.

Craftsmen also calculate the need for dyes used for coloring and water glass for fixation. The type of dye used is a synthetic type of remasol dye. While water glass is used in the fixation process. The purpose of fixation is to lock in color and give a gradation effect to the motif. The need for water glass and dyes used depends on the number of fabrics, motifs and techniques that will be desired.

Counting activity is seen when adding 2 colors to produce new colors such as light green, dark green, dark black, and orange. If we want a light green color, then the yellow color with the blue color is mixed in a ratio of 1: 1, so the yellow color is 100 ml + the blue color is 100 ml. If you want dark green, then the ratio between yellow and blue is 1: 5, so yellow is 100 ml + blue is 500 ml. If you want a solid black color, then the ratio between yellow and black is 1: 7, so a mixture of 50 ml yellow + 350 ml black. if you want orange, use red mixed with yellow in a ratio of 1: 2, so red is 100 ml + yellow is 200 ml. Likewise with other colors, obtained from mixing the main colors with a certain ratio. 1 liter of dye solution is enough to dye 3 pieces of triangular fabric with a size of 2 meters.

To mix 1 liter of water glass solution, it takes 10 grams of water glass and 1.5 liters of water. Then the ratio between water glass and water is 1: 1.5. This solution is enough to dye 2 pieces of cloth with a size of 2 meters each. This mathematical activity when making a water glass solution uses the concept of comparison. The mathematical activity that arises when the process of mixing colors and water glass uses the concepts of comparison and addition.

The next counting activity appears when the craftsman determines the amount of fabric dyeing in the dye. To make Shibori Tulungagungan fabric with Remasol synthetic dye, only 1 dyeing is required. Meanwhile, Tulungagungan Shibori fabric with natural dyes requires up to 10 dyeing. Based on this, the ethnomathematics that appears when the craftsman determines the number of dyes is counting.

While the activity of dyeing cloth into dyes and water glass there is a reduction concept. Because the solution seeps into the fabric. And when the dye solution has run out, and the folds of the fabric are still there, the dye solution can be added again in its place. This activity contains the mathematical concept of addition. And so on. In a day 1 person can produce a triangular Itajime shibori fold of about 15 pieces of cloth. The time needed to finish 1 piece of cloth with a kawung motif is about 1 hour, with a note that the fabric is already folded and ready to be dyed. and the weather is not raining. Because after being dipped in a solution of dye and waterglass. The folded cloth is opened and dried on the floor. After drying the cloth is washed and rinsed up to 7 times until the water is completely clear. Then in the sun to dry. So if we want to order 60 pieces it will take at least 4 days to complete. This mathematical activity when estimating the processing time for this Tulungagungan Shibori cloth order uses the concepts of worth comparison, counting and time conversion.

Determination of the selling price of Tulungagungan shibori cloth is also determined from the dye and type of fabric. Shibori with natural dyes is more expensive than shibori with synthetic dyes. When using natural dyes, 1 piece of shibori cloth costs Rp. 350,000. For 1 piece of shibori cloth with synthetic dye, the price is Rp. 100,000,-. If you want to use a box, there is an additional price, namely 1 box for Rp. 5.000.-. for the price of cloth when participating in exhibitions and bazaars there is a 30% increase. This is done because when participating in the bazaar or exhibition requires accommodation costs. When sold via social media, the price remains unchanged, it's just that there is an additional postage fee that is adjusted to the distance of delivery. The mathematical activity that occurs when determining the selling price of Shibori Tulungagungan cloth uses the concepts of social arithmetic, counting, and percentages.

The calculation of wages is done on a daily basis, where every day employees get a wage of Rp. 8,000 to Rp. 50,000 depending on the expertise of each employee. For the distribution of employees who fold, roll or tie cloth, they get a wage of Rp. 8000, - for 1 piece of cloth. For employees of the division of color solution and water glass as well as color dyes, they get a salary of Rp. 5,000

for 1 piece of cloth. For employees of the drying and washing and ironing divisions every day they get a wage of Rp. 50.000,-. And employees in the packaging department and serve customers in 1 day get a wage of Rp. 30,000. The minimum salary received by employees when paid in 1 week is 7 times the wages earned. So that in 1 week at least employees get a salary of 7 x Rp 30,000,0 = Rp. 210,000. and the biggest income earned by employees is 7 x Rp.50.000,- = Rp. 350.000,-. Mathematics activities that occur when determining employee wages use the concepts of addition, multiplication and division.

3.3 Measuring

Measuring activity is an activity that aims to get an idea of the dimensions/ the shape of an object [21]. The activity of measuring appears when the craftsman measures a piece of cloth. Craftsmen measure the fabric using a tape measure and cut according to the order. In general, the fabric is cut to a size of 2 x 1.15 m. for large sizes, craftsmen usually cut fabric with a size of 2.5 m or 3m. when the fabric used is rayon, the length of the fabric is 20 cm more.

Another measuring activity is during the process of making basic folds, namely accordion folds. So that the resulting color-dyeing motif is neat and symmetrical, the fabric that has been cut is then folded according to the accordion to form a pattern for precision. The fabric is folded like making pleats like the picture below. The size of the fold length is adjusted to the width of the fabric. If 1 cloth is 1.15 cm wide then when making accordion folds with a size of 5 to 6 cm as shown in picture 1, it will form 6 folds as shown in picture 2 below. Mathematical activity when folding accordion fabrics using the concepts of division, folding symmetry, reflection, lines and angles, rectangles and similarity.

The measuring activity is carried out when the craftsman wants to mix a solution of dye and water glass using a measuring device, namely using a dipper and a measuring cup which is equivalent to 1 liter of water and 1.5 liters of water.

Figure 1. How to fold an accordion

Figure 2. Many folds

The activity of measuring appears when the craftsman mentions the number of numbers and units to state the size of the material. The craftsmen mention yards and centimeters (cm) as the unit of fabric length and the unit of measurement for the width of the fold, kilo which means kilogram (kg) as the unit for expressing the weight of natural dyes, liter as the unit used to express the volume of waterglass, milli which means milliliter (ml). used to express the volume of dye used, one jar to express the amount of waterglass, and gram (gr) is a unit used to express the weight of powdered dye used in the coloring process. Based on this, the ethnomathematics contained in the activity mentions the number of numbers, standard units and conventional units

3.4 Designing

Design activities are activities carried out by the community related to the activities of making designs that have certain functions [21]. Design activities arise during the process of planning to make Shibori Tulungagungan fabric motifs. The motifs that appear on the fabric depend on the type of technique used. With color dyeing. To make a motif resembling kawung batik, it uses the Itajime technique with an isosceles triangle fold model.

Before dyeing, the fabric is folded (accordion folds) into 6 folds, to facilitate the dyeing process. And then folded in a zig-zag angle with 90^0 and 45^0 repeatedly until all the fabrics are folded to form an isosceles triangular prism, like the folds in picture 3. Next, the fabric is tied with rubber. Besides functioning to bind the folds of fabric, rubber also functions as a barrier during the dyeing process in dyes and water glass solutions. Mathematical activity when making Itajime Shibori's cloth folds with an isosceles triangle model using the concepts of lines and angles, reflection, translation, building a triangular prism space, flattening an isosceles triangle as shown in Figure 3 below.

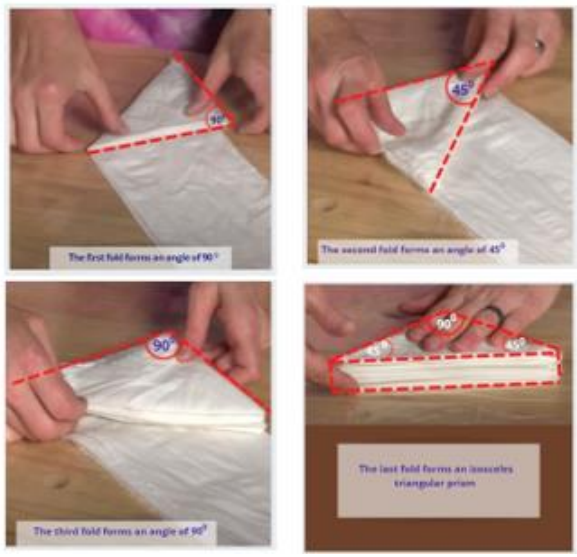

Figure 3. Itajime Shibori's technique with an isosceles triangle model

Design activities also appear during the process of determining the color for the motifs that arise. The colors

that appear on the Tulungagungan shibori motif are influenced by the folding and dyeing techniques. For color dyeing with the Itajime shibori technique, it begins and ends with water glass immersion. This water glass functions as a color enhancer and also a color lock / fixation and gives a gradation effect to the motif. The duration of immersion in the waterglass solution is only 2 seconds. Design the color dyeing process as shown in Figure 4 below.

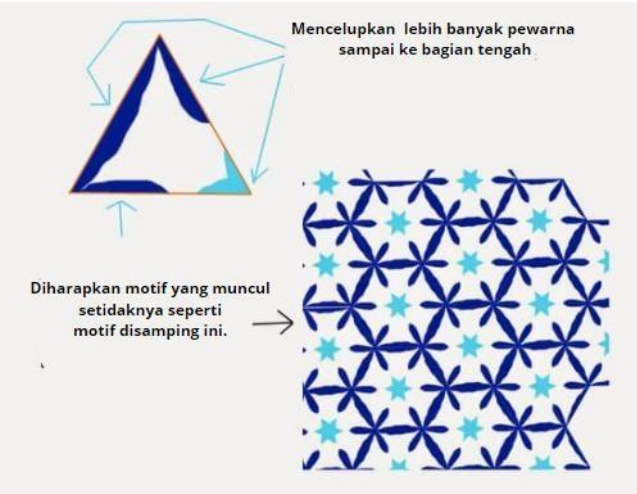

Figure 4. Design of a color dyeing plan to form a motif

After the color dyeing design is made, it is then tested on a small cloth as shown in Figure 5 to check the correctness of the planned design. After the design appears as desired, the fabric is dyed with large folds. as in figure 6.

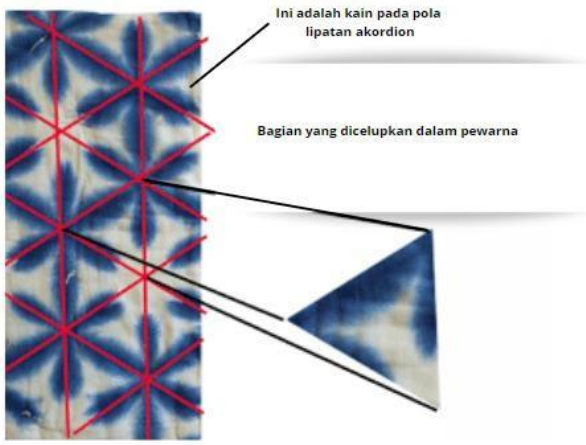

Figure 5. Trial of dyeing motif designs on small fabrics

After the color is dipped in a solution of water glass and dye, the fabric is ready to be folded. The cloth that is opened is stretched under the hot sun with a duration of just 5 minutes. The results of the motifs that appear are as shown in Figure 7 below. In Figure 7, it can be seen that the motifs produced are found to have found various mathematical concepts that can be explored. At first glance, the motifs that appear are similar to the kawung batik motifs and various geometries.

Figure 6. Color dyeing process

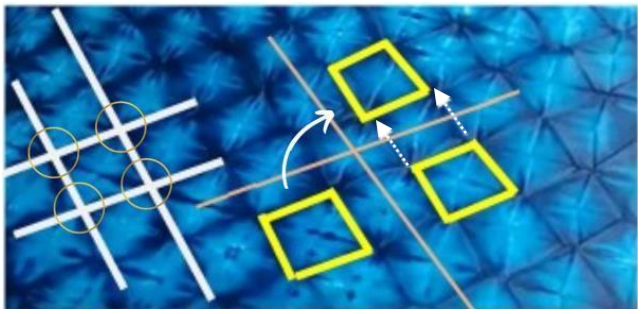

Figure 7. The dyed motif contains mathematical concepts

Mathematical concepts that appear in Figure 7 include the concept of lines and angles, the relationship between angles (opposite angles, unilateral inner angles, unilateral external angles, opposite angles, straight angles, opposite inner angles, opposite outer angles), transformation geometry (reflection, rotation, translation)

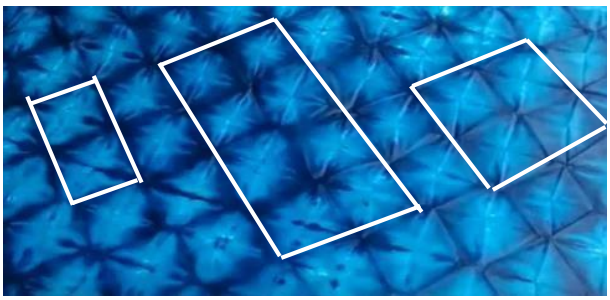

Figure 8. The immersion motif contains mathematical concepts

Figure 8 contains the mathematical concepts of similarity and congruence, area & perimeter, geometry of rectangular shapes. There are several examples of motifs resulting from color dyeing with itajime shibori folds in an isosceles triangle mod.

In addition to the kawung motif which uses an isosceles triangle model, there is also a lotus flower motif that uses equilateral triangle folds. The folding technique is the same as an equilateral triangle, only the difference is the size of the angle at the beginning of the fold. The

first fold must form an angle of 600. Then it is folded in a zig zag until the last as in picture 10.

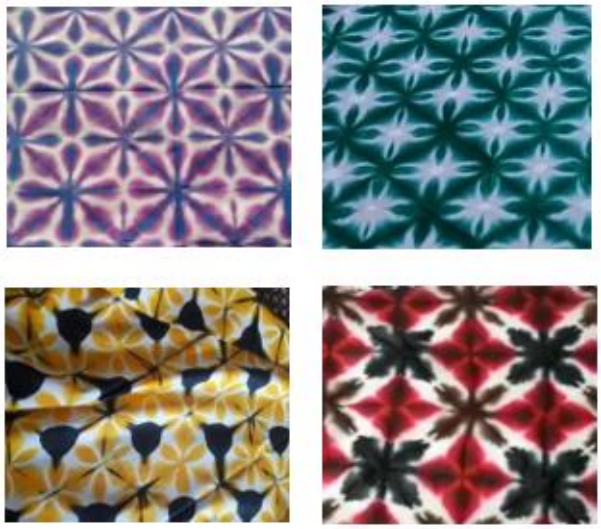

Figure 9. Another example of itajime shibori motif with isosceles triangular folds.

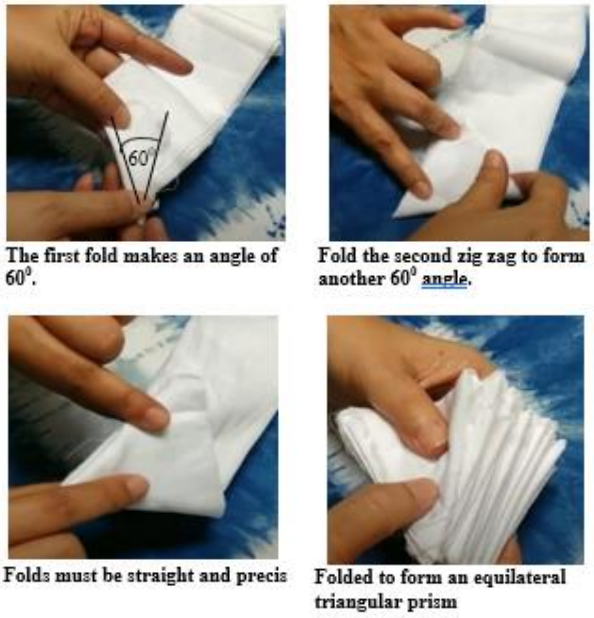

Figure 10. Itajime Shibori's technique with an equilateral triangle model

After making the folds, just like the isosceles triangle fold model, then the next step is to dip it into the dye and water glass solution. The results of color dyeing will appear as shown in Figure 11.

3.5 Playing

Playing activity is an activity that is fun, has a certain pattern and encourages someone to set a strategy [20]. To keep customers coming back to buy our products requires strategy and planning. This is where the fundamental mathematical activity of playing is depicted when we are diligent in managing planning and strategy. In this case the craftsmen design a strategy whether a product that has been produced will be reproduced or not. Namely adding variations of motifs or colors from existing products. Or not producing anymore because to maintain the exclusivity of the products that have been produced previously. This mathematical activity in the process of repeating production with the same colors and motifs uses the concept of multiplication.

Figure 11. Example of itajime shibori motif with equilateral triangle folds

3.6 Explaining

Explaining is an activity that is usually associated with the question word "why" in reading natural phenomena. Based on the results of interviews of researchers with craftsmen, it shows that the motifs resulting from color dyeing that appear have no special meaning in their manufacture. What is in the mind in exploration becomes the motive. The technique used is the result of the imagination of the motif maker without looking at the philosophical meaning behind the motif made. Based on this, it can be explained that the making of the Tulungagungan shibori cloth motif has no philosophical or special meaning, where the motifs that appear are unpredictable results that are influenced by the techniques used, color absorption and the conditions around them.

4. CONCLUSION

Mathematical fundamental activities are found and exist in Tulungagungan shibori fabric production activities. The locating activity includes actions to determine the location of the raw material supplier based on quality reasons and has become a subscription to shibori fabric producers. Placing employees according to expertise and determining the marketing place. The

counting activity includes determining the number of fabrics produced, determining the selling price of fabrics, determining new colors and determining the wages received by employees. Determining the length of the fabric when folding, measuring the unit of length and weight is an activity that is included in measuring activities. Playing activities, namely the determination of a product that has been produced will be reproduced or not. The desingning activity can be found in the process of determining the shibori technique and what type of fold model is used to the process of immersing it in a dye solution and waterglass. The explaining activity is found in the reasons why the Shibori Tulungagungan cloth does not have a special philosophical or meaning. Because the motive that appears is a result that can not be predicted beforehand. The motifs that appear depend on the techniques used, the absorption of colors and the conditions around them.

AUTHORS' CONTRIBUTIONS

The authors confirm contributions to the paper as follows: study conception and design: Ratih Puspasari, Pradnyo Wijayanti; Mega Teguh Budiarto. Data collection: Ratih Puspasari, Setyo Hartanto, Moh. Gufron. Analysis and interpretation of results: Ratih Puspasari, Setyo Hartanto, Moh Gufron, Mochammad Amiirudin Full paper authors: Ratih Puspasari, Pradnyo Wijayanti; Mega Teguh Budiarto

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REFERENCES

[1] F. AL Ahadi, Zaenuri, and A. N. Cahyono, "Exploration of Ethnomatematics in the Samin Tribe and Its Relationship with Mathematical Concepts," *Unnes J. Math. Educ. Res.*, vol. 10, no. 2, pp. 184–189, 2021.

[2] F. I. Gunawan, "Kajian Etnomatematika Serta Analisis Fundamental Matematis Menurut Bishop pada Industri Kain Cual Bangka Belitung," Magister Pendidikan Matematika, Universitas Sanata Dharma, 2019.

[3] S. Sel, "Nilai Budaya Tergerus Zaman," *https://sumeks.co/nilai-budaya-tergerus-zaman/*, 2020. [Online]. Available: https://sumeks.co/nilai-budaya-tergerus-zaman/. [Accessed: 11-Aug-2021].

[4] O. A. Cimen, "Discussing Ethnomathematics: Is Mathematics Culturally Dependent?," *Procedia - Soc. Behav. Sci.*, vol. 152, pp. 523–528, 2014.

[5] Nurhayati, "Melestarikan Budaya Seni Kain Jumputan Palembang," *Progr. Stud. Pendidik. Sejarah, FKIP Univ. Muhammadiyah Palembang*, pp. 10–15.

[6] S. Andi *et al.*, "Pembuatan dan Pemanfaatan Kain Shibori sebagai Produk Lanjutan," vol. 1, no. 2, 2021.

[7] S. Maziyah, S. Indrahti, and Alamsyah, "Implementasi Shibori Di Indonesia," *Kiryoku*, vol. 3, no. 4, pp. 214 –220, 2019.

A. Salsabila, "Pemanfaatan Teknik Lipat-Ikat Celup untuk Menghasilkan Tekstur pada Kain Busana," *J. Proceding Art Des.*, vol. 4, no. 1, pp. 60–77, 2017.

[8] N. Juniati and L. Yuwanto, "Pemanfaatan Seni Shibori Sebagai Alternatif Psychological Health Dan Behavioral Health Dalam Psychological First Aid Penyintas Bencana," *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1–15, 2018.

[9] D. Suantara, E. Oktaviani, and Y. Siregar, "Shibori Technique Exploration in Developing Indonesian Traditional Motif Design in Clothing Fabric Surface," *Arena Tekst.*, vol. 32, no. 2, pp. 67–76, 2017.

[10] Fitinline, "Sejarah Kain Jumputan di Indonesia,"

[11] *Fitinline*, 2015. [Online]. Available:

[12] https://fitinline.com/article/read/sejarah-kain-jumputan-di-indonesia/. [Accessed: 12-Aug-2021].

[13] W. Kate, "Itajime Gasuri: Digital Warps," in *9th International Shibori Symposium 2014 - Plenary Template*, 2014, pp. 1–7.

[14] M. Arai and Y. I. Wada, "Beni Itajime: Carved Board Clamp Resist Dyeing in Red," in *Textile Society of America Symposium Proceedings*, 2010.

[15] S. Wardoyo and T. S. Widodo, *Inovasi Perancangan Motif Tie - Dye*. 2016.

[16] R. Maharani and J. Martono, "Aplikasi Teknik Arashi Shibori Pada Jenis - Jenis Kain Sutra Untuk Scraf," *J. Tingkat Sarj. Senirupa dan Desain*, vol. 1, no. 1, pp. 1–8.

[17] D. S. Kautsar, "Eksplorasi Teknik Shibori Pada Pakaian Ready To Wear," in *e-Proceeding of Art & Design*, 2017, vol. 4, no. 3, pp. 905–920.

[18] Fatmawati, "Improving Fine Motor Skills of Children With Autism through Shibori Training," *Adv. Soc. Sci. Educ. Humanit. Res.*, vol. 388, no

[19] 3rd International Conference on Special Education (ICSE), pp. 240–242, 2019. J. Bishop, Mathematical Enculturation : A Cultural Perspective on Mathematics Education. 1988.

[20] W. V. Alangui, "Stone Walls and Water Flows: Interrogating Cultural Practice and Mathematics," *A thesis for the degree of Doctor of Philosophy in Mathematicss Education The University of Auckland*, pp. 1–211, 2010.

[21] F. Aini, "Kajian Etnomatematika terhadap Tradisi Weh-wehan di Kecamatan Kaliwungu Kendal," *J. Pendidik. Mat. Raflesia*, vol. 06, no. 01, pp. 50–59, 2021.

[22] U. Fadlilah, D. Trapsilasiwi, and E. Oktavianingtyas, "Identifikasi Aktivitas Etnomatematika Petani Padi pada Masyarakat Jawa di Desa Setail," *Kadikma*, vol. 6, no. 3, pp. 45–46, 2015.