ETDC Indonesian Journal of Research and Educational Review
Volume 4, No. 4, 2025, pp 1062 - 1074

e–ISSN 2809-3682
p–ISSN 2809-7505

https://doi.org/10.51574/ijrer.v4i4.3689

Ethnomathematics of Geometric Transformation in Knitting Mosaic Patterns with Terrazzo Motifs

Erviana Nur Laili[1], Dwi Noviani Sulisawati[2], Nur Hidayatin[3]
[1, 2, 3] Universitas PGRI Argopuro Jember, Indonesia

Article Info

Article history:

Received May 31, 2025
Revised August 08, 2025
Accepted August 24, 2025

Keywords:

Ethnomathematics;
Geometric Transformation;
Knitting Motifs;
Reflection;
Rotation.

ABSTRACT

Knitting activities not only involve elements of manual skills and art but also contain patterns closely related to mathematical concepts, particularly geometric transformations such as reflection, rotation, translation, and dilation. Therefore, this study intends to explain how the activity of knitting visual-based motifs can help understand the concept of geometric transformation. The study used a qualitative descriptive approach. Two knowledgeable lecturers verified the instrument the researchers developed through interview instructions and observations. The study's results reveal that reflection is the most commonly utilized transformation in the knitting process. This reflection appears in the form of symmetrical patterns, both with respect to the vertical, horizontal, and diagonal axes. In addition to reflection, the resulting patterns also show rotation with a specific center point, shifts (translations) in the repeating motifs, and changes in size (dilation) in several parts of the design. Visual strategies used in designing motifs include dividing the plane into certain parts to arrange the pattern in a balanced manner, determining a reference point as the center of rotation or enlargement, and using a grid-like arrangement to maintain the regularity of the shape. Based on these findings, it can be concluded that knitting motifs is an activity that emphasizes aesthetic aspects and provides an in-depth learning experience regarding the concept of geometric transformation. We can use this activity as a fun, alternative, and meaningful medium to understand geometry in a real and contextual way.

Corresponding Author:

Erviana Nur Laili,
Universitas PGRI Argopuro Jember, Indonesia
Email: erviananl@gmail.com

1. INTRODUCTION

The perspective on mathematics within a culture is called ethnomathematics. According to Setiana et al. (2021), ethnomathematics is a cultural activity that recognizes that each person develops unique ways of performing mathematical tasks and mathematical ideas allow them to take root. Grouping, counting, measuring, patterning, and other processes that abstract real-world experiences into mathematics are examples of mathematical activities. Ariani et al. (2024) state that mathematics is a manifestation of human experience in their environment through observation. Logic is the foundation of mathematics because mathematical ideas are developed through thought processes (Oljayevna & Shavkatovna, 2020). "Ethnomathematics" is a term used to describe the application of mathematics among recognized cultural groups (D'Ambrosio & Rosa, 2017; Rosa & Gavarrete, 2017; Kabuye Batiibwe, 2024).

In this research, ethnomathematics is the study of the relationship between mathematics and culture. Everyday life is inseparable from mathematics (Nugraheni & Marsigit, 2021). Mathematical ideas are even present in the concept of knitting. Among women in general, knitting is a fairly popular talent. One can create various practical and beautiful crafts, including clothing, purses, tablecloths, socks, and more, using only yarn and knitting needles. Knitting patterns are available in various levels, from easy to challenging. Multiple yarn colors can also be combined to create attractive displays in mosaic crochet patterns. Mosaic patterns can be applied to various product surfaces as an aesthetic element that enhances the product's value, according to Angriani et al. (2021).

Therefore, using mosaic patterns as decorative elements can increase a product's market value in addition to producing a useful product. Mosaic patterns often involve mathematics to create repeating or symmetrical patterns using the concept of geometric transformations (Goldstine & Yackel, 2022). Geometric mathematics covers shapes, two- and three-dimensional objects, and solves geometric problems related to everyday life (Pathuddin & Raehana, 2019). In everyday life, we often encounter complex geometric shapes instead of simple two-dimensional ones (Satriawati et al., 2023). Geometric shapes are often found in craft motif patterns, one of which is knitting patterns. The two are closely related because they involve the use of shape, pattern, and structure. For example, the terrazzo pattern is a geometric knitting motif that can be transformed based on the concept of transformation.

Transformation occurs when a shape changes size or position (Sari, 2023). Translation (shift), dilation (enlargement/reduction), rotation (rotation), and reflection (reflection) are all included in the definition of geometric transformation (Arsa, 2022). Translation or shift, reflection or mirroring, and rotation are examples of changes that do not change the size or shape of an object (Amirah & Budiarto, 2022). On the other hand, dilation or expansion refers to shapes that appear the same but have different sizes. Geometric transformations, such as the terrazzo pattern, are commonly used in knitting mosaic patterns.

Various investigations into geometric transformations in knitting patterns show a close relationship between mathematics and culture (Irvan, 2023; Taneo et al., 2025). A pattern is a model or form used to make or produce something (Miftah et al., 2016). A motif can be defined as a pattern resulting from a combination of shapes, lines, and other visual elements. In a design context, a motif is the smallest element that can be repeated to form a larger pattern (Kaczor et al., 2010). Motifs often reflect certain characteristics that are repeated in a work (Vindyona & Rosandini, 2020). This research topic combines different but interrelated fields, namely ethnomathematics, geometry, transformation, art, and knitting crafts. In this case, the researcher will discuss "Ethnomathematics of Geometry and Transformation in Terrazzo Motif Patterns in Knitting Crafts." Based on this, this study aims to describe the results of the ethnomathematic exploration of terrazzo motif patterns in knitting crafts, especially the concept of geometric shapes and geometric transformations.

2. METHOD

This study employed a qualitative descriptive approach to explore the geometric concepts within terrazzo mosaic patterns in knitting based on ethnomathematics. This descriptive research approach was chosen because it allows researchers to describe the phenomenon as it is, without manipulation or special treatment of the subjects. The subjects were knitters with experience knitting mosaics and symmetrical designs. Figure 1 presents an ethnomathematics model that utilizes a descriptive approach.

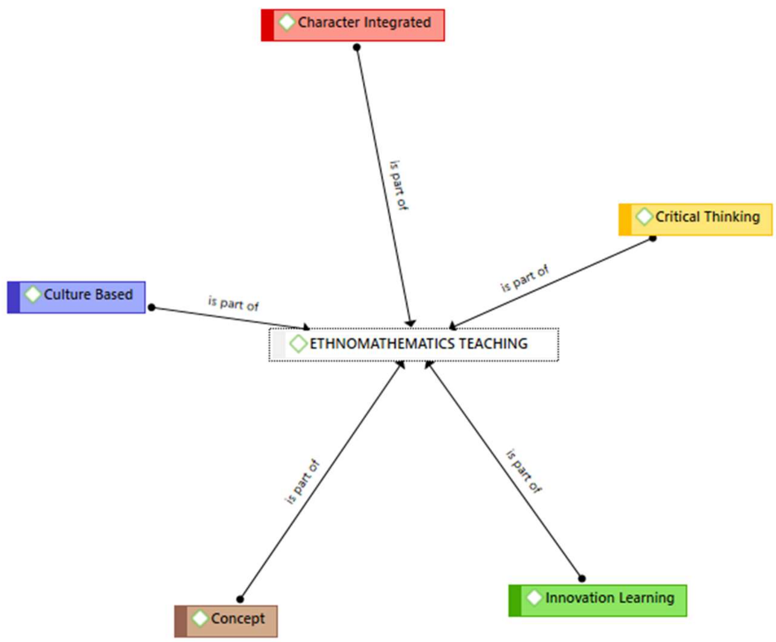


Figure 1. Ethnomathematics Model

The research steps began with identifying problems related to the presence and form of geometric patterns in knitting. To ensure the validity and reliability of the collected data, the researchers then developed an instrument in the form of interview instructions and observations, which were verified by two knowledgeable lecturers. In-depth interviews with knitters and direct observation of the knitting process were used to collect data. Field notes were created by gathering research material through interviews and observations. Geometric shapes and the changes that emerge in knitting patterns were the primary focus of observation, and participants' perceptions and understanding of the motifs they use were explored through interviews. A qualitative descriptive analysis model, which refers to the stages of data reduction, data presentation, and conclusion drawing, was used to examine the collected data (Bahasa et al., 2024).

To identify relevant key themes, such as basic geometric shapes (triangles, squares, and circles) and their transformation processes (rotation, reflection, translation, and dilation), data reduction was carried out by selecting and simplifying raw data from field notes and interview findings. The reduced data were then presented in a descriptive narrative accompanied by direct quotations or visual descriptions to strengthen the interpretation. The final stage was drawing conclusions, which were carried out by interpreting the relationship between the geometric patterns found with concepts in mathematics, particularly transformation geometry, and the ethnomathematical values reflected in the community's knitting cultural practices.

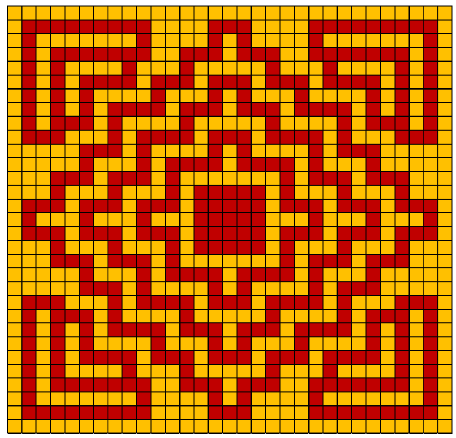


Figure 2. Terrazzo Motif Mosaic Pattern

3. RESULTS AND DISCUSSION

Results

Reflection is the most dominant transformation because it naturally occurs in the process of creating symmetrical patterns in knitting activities. The strategies used by each subject demonstrate diverse approaches to knitting activities. Based on interviews with the three knitters, there are differences in technique during the process of creating terrazzo motifs.

Subject 1

P : *Good afternoon. Have you ever made this terrazzo mosaic pattern before?*
S1 : *Good afternoon, Miss. I've made this pattern before, but the colors are different from the one you showed me.*
P : *I wanted to ask, how do you make a terrazzo pattern?*
S1 : *For example, Miss, I divide it into four sections.*
P : *Can you explain which section is knitted first?*
S1 : *I work on one section first, and when I'm done with the other section, I just flip the pattern. For example, the yellow triangle is Canada on the bottom, then the other section is on top, and the opposite side is also flipped.*
P : *So, is it enough to just make one pattern at the beginning?*
S1 : *Yes, that's right, because the pattern is mirrored to make it easier to make.*

Subject 1 explains that the knitting pattern in the picture can be made by dividing the pattern into four equal parts, such as dividing a field into four quadrants, namely the upper right quadrant (I), upper left (II), lower left (III), and lower right (IV).

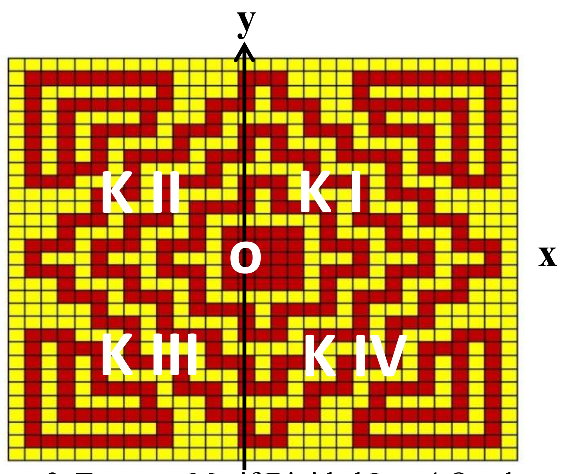
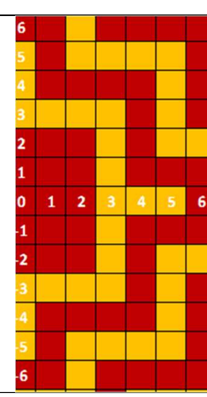


Figure 3. Terrazzo Motif Divided Into 4 Quadrants

To simplify the process, simply focus on creating one section first, for example, the upper right quadrant (I). In this quadrant, the basic pattern that appears is red lines resembling a ladder or triangle that point outward from the center of the image. Once the first quadrant is complete, the remaining three quadrants can be completed using reflection techniques. The reflections referred to are mirror images: the upper right quadrant (I) is created by reflecting the lower right quadrant (IV) (reflecting against the vertical axis), the lower left quadrant is created by reflecting the lower right quadrant (IV) (reflecting against the horizontal axis), and all quadrants can reflect twice, as in the example of the upper right quadrant (I), namely to the left and down. With this method, pattern creation becomes much simpler because there is no need to draw each section manually. By understanding the principles of division and reflection, even complex patterns can be arranged more quickly and neatly.

Table 1. Concept of Geometric Transformation in Subject 1

The Concept of Geometric Transformation	Geometry Concept	Figure
Reflection on knitting motifs (x,y) → (x, -y) = (4,4) → (4, -4)	Triangle	

Subject 1 uses the method of dividing into four quadrants and reflection as a method of simplifying the pattern, so that the process of making the motif becomes more systematic.

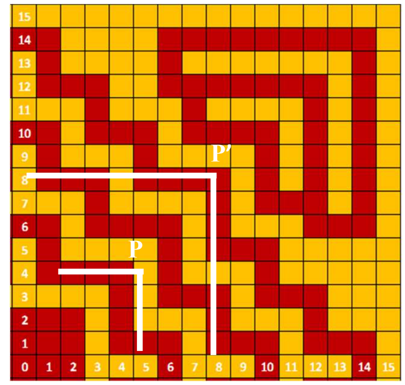
Subject 2

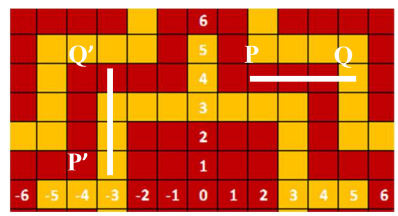
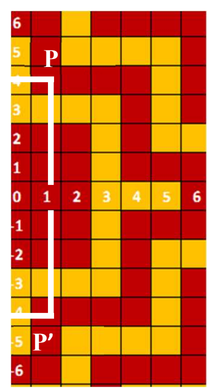
P	:	*Ma'am, how come this pattern is so neat in all directions? Where are you start?*
S2	:	*I usually start from the middle, Ma'am. I consider the center point the center. From there, I work my way outward, right, left, top, and bottom, to balance everything.*
P	:	*So, don't you start from the corners first?*
S2	:	*No. Starting from the corners, it's sometimes difficult to match the other sides. But starting from the center, all sides can be divided evenly. So, the right and left can be similar, and the top and bottom too.*
P	:	*It's like a mirror pattern, isn't it, Ma'am?*
S2	:	*Yes, like a mirror. But sometimes it rotates, so it looks like a symmetrical circle. I don't use calculations, just look at it to see if it's even.*

In subject 2, the knitting technique used begins by determining the center point, which serves as the main axis, and then begins knitting by forming a small red square in the center. The knitting motif in the image is a symmetrical pattern created by starting from the center point and expanding outward in layers. The center point consists of a 5x5 red square surrounded by layers of yellow and red lines, resembling a rhombus. The process of creating this motif is carried out in stages, following a specific pattern, then expanding in various directions to form the entire motif. The expansion referred to in this process is a dilation transformation, which is a change in size that becomes larger without changing the original shape and the center point.

Additionally, this motif exhibits a reflection transformation due to its mirror symmetry along the vertical and horizontal axes that intersect at the center point. The motif in the image demonstrates a rotational transformation if the work begins in a circular manner from the center point. This transformation is evident in the pattern that repeats symmetrically in all four quadrants, where each part is the result of a rotation of the other parts about the center point (0,0). Each pattern in the quadrant appears identical but is rotated 90°, 180°, and 270° about the coordinate center. Therefore, this pattern has fourth-order rotational symmetry, meaning its shape remains the same after being rotated four times in one complete rotation (360°). Therefore, understanding geometric transformations is very advantageous in creating symmetrical and aesthetically pleasing knitting patterns.

Table 2. Transformation Concept in Subject 2

<table>
<tr><th>The Concept of Geometric Transformation</th><th>Geometry Concept</th><th>Figure</th></tr>
<tr><td>Dilation in knitting motifs
$P(x,y)\xrightarrow{[o,k]}P'(kx,ky)$
$=P(4,4)\xrightarrow{[o,2]}P'(2.4,2.4)$
$=P(8,8)\xrightarrow{[o,2]}P'(8,8)$</td><td>Triangle</td><td>
</td></tr>
<tr><td>90° rotation on knitting pattern
$P(x,y)\rightarrow P'(-y,x)$
$=P(1{,}4)\rightarrow P'(-4{,}1)$

$Q(x,y)\rightarrow Q'(-y,x)$
$=Q(4,4)\rightarrow Q'(-4{,}4)$</td><td>Rectangle</td><td>
</td></tr>
<tr><td>Reflection on knitting motifs
$P(x,y)\rightarrow P'(x,-y)$
$=P(4{,}4)\rightarrow P'(4,-4)$</td><td>Triangle</td><td>
</td></tr>
</table>

Subject 3

P : *Ma'am, I noticed your knitting method is different from others. Where are you starting, ma'am?*

S3 : *I usually start from the bottom left corner, then work my way to the right, ma'am. When I get to the end, I move up to the top row, then work my way to the left. And so on until I reach the top...*

P : *Oh, so you move up each row, ma'am?*

S3 : *Yes, it's like sweeping the floor, back and forth. It's easier for me to work from the corner, neater, and I don't miss anything.*

P : *But the result looks like the right and left, doesn't it, ma'am? Like a mirror?*

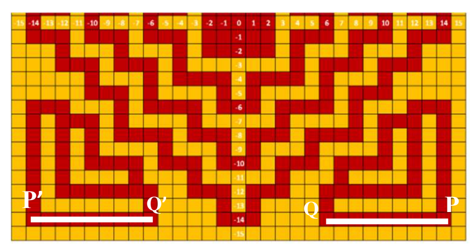
S3 : *Yes, I didn't mean to think of it like a mirror. But when it's finished, it does look the same, left and right, top and bottom.*

Subject 3 emphasizes the importance of the center point as the main reference in the processes of rotation, dilation, and reflection, which shows a profound understanding of the interrelationships between transformations.

In subject 3, the knitted motif shown in the image is a geometric grid-based arrangement composed of two primary colors: red and yellow. The process of creating this motif is carried out systematically, starting from the bottom right corner of the work area, then moving vertically upwards until reaching the end of the row. After completing one row, the process continues by moving up to the next row above it and knitting in the opposite direction, from top to bottom. This pattern is repeated until the entire area is completed, forming a consistent zigzag pattern.

Mathematically and visually, the process of creating the terrazzo motif in subject 3 demonstrates a geometric transformation, namely a reflection transformation. This transformation reflects a diagonal line extending from the bottom right corner to the top right corner.

Table 3. Concept of Transformation in Subject 3

The Concept of Geometric Transformation	Geometry Concept	Figure
Reflection on knitting motifs $P(x,-y) \rightarrow P'(-x,-y)$ $= P(14,-14) \rightarrow P'(-14,-14)$ $Q(x,-y) \rightarrow Q'(-x,-y)$ $= Q(14,-6) \rightarrow Q'(-14,-6)$	Rectangle	

Subject 3 uses a grid-based approach, where patterns are constructed through diagonal reflection analysis, demonstrating a strong spatial understanding in forming symmetry. The following is a summary of all subjects' results in Table 4.

Table 4. Summary of Results of All Subjects

N	Refleksi	Dilatasi	Rotasi	Translasi
Subject 1	√	_	_	_
Subject 2	√	√	√	_
Subject 3	√	_	_	_

Discussion

The research findings indicate that Subject 1 elucidates that the knitting pattern depicted in the image can be constructed by partitioning the design into four equal segments, analogous to splitting a field into four quadrants: the top right quadrant (I), upper left (II), lower left (III), and lower right (IV). To streamline the procedure, concentrate on developing one portion initially, such as the upper right quadrant (I). This quadrant exhibits a fundamental pattern of red lines like a ladder or triangle, radiating outward from the center of the image. Upon completion of the first quadrant, the subsequent three quadrants can be finalized via reflection techniques. The reflections mentioned are mirror images: the upper right quadrant (I) is formed by reflecting the lower right quadrant (IV) across the vertical axis, the lower left quadrant is generated by reflecting the lower right quadrant (IV) across the horizontal axis, and each quadrant can undergo two reflections, as illustrated by the upper right quadrant (I), specifically to the left and downward. This method simplifies pattern generation by eliminating the necessity to hand sketch each area. Comprehending the principles of division and reflection enables the efficient and orderly arrangement of intricate patterns.

In subject 2, the knitting technique commences by identifying the central point, which acts as the primary axis, followed by the creation of a slight red square at the center. The knitting motif depicted in the illustration is a symmetrical design originating from a central point and radiating outward in successive layers. The focal point comprises a 5x5 red square encircled by layers of yellow and red lines, like a rhombus. The creation of this theme occurs in stages, according to a precise pattern, and subsequently expands in multiple directions to complete the motif. The expansion mentioned in this technique is a dilation transformation, which increases size while preserving the original shape and center point.

This motif demonstrates a reflection transformation owing to its mirror symmetry along the vertical and horizontal axes that converge at the central point. The pattern in the illustration illustrates a rotating change, commencing in a circular fashion from the central point. This transformation is apparent in the symmetrically repeating pattern throughout all four quadrants, where each segment results from a rotation of the previous segments around the central point (0,0). Each pattern in the quadrant is identical but rotates 90°, 180°, and 270° around the coordinate center. This pattern exhibits fourth-order rotational symmetry, indicating that its structure is invariant after four rotations inside a full 360° turn. Consequently, comprehending geometric transformations is quite beneficial for designing symmetrical and visually appealing knitting designs.

Subject 3 emphasizes the value of the center point as the primary reference in the processes of rotation, dilatation, and reflection, demonstrating a deep comprehension of the interconnections among transformations. Furthermore, In topic 3, the depicted knitted motif is a geometric grid arrangement consisting of two predominant colors: red and yellow. The creation of this theme is executed methodically, commencing from the bottom right corner of the workspace and progressing vertically upward until the completion of the row. Upon finishing one row, the procedure advances by ascending to the subsequent row above and knitting in the reverse direction, from top to bottom. This pattern is reiterated until the entire area is finished, creating a uniform zigzag design. The creation of the terrazzo motif in subject 3 exemplifies a geometric transition, namely a reflection transformation, both mathematically and visually. This transformation represents a diagonal line going from the bottom right corner to the top right corner.

Research results indicate that knitting activities can strengthen understanding of the concept of geometric transformation. In the process of creating knitted motifs, the concept of symmetry applies, indicated by the shifting position of the shape/motif, as does the concept of enlargement (dilation), both of which are included in geometric transformations. Therefore, knitting can also be considered a form of ethnomathematics. In the context of mathematics, ethnomathematics is an alternative approach that considers the application of mathematical ideas that have developed in society while still considering various objectives (Albanese et al., 2017; Albanese & Perales, 2020; Prahmana, 2022). Cultural differences will result in variations in mathematical practices (Brown et al., 2019; Sulisawati et al., 2021). Culture-based learning is an innovation in mathematics education that challenges the notion of mathematics as inflexible and connects it to something interesting, such as culture (Pulungan & Adinda, 2023; Nguyen et al., 2025). Thus, mathematics can take different forms and change along with the evolution of society due to cultural history (Permana, 2019). Additionally, different approaches to mathematics in community activities are recognized by ethnomathematics (Sunzuma & Maharaj, 2021; Cesaria et al., 2025). This conclusion is reflected in the three subjects' consistent use of the concept of reflection in geometric transformations along the vertical, horizontal, and diagonal axes in planning the steps for creating knitting motifs.

Practical Implications

1. Application of Ethnomathematics Concepts: This research can serve as a reference for applying ethnomathematics concepts in mathematics learning to improve students' understanding of geometric transformations.
2. Development of Learning Materials: The results of this research can be used to develop mathematics learning materials based on culture and ethnomathematics.
3. Increasing Student Interest: This research can increase students' interest in learning mathematics by linking mathematical concepts to local culture.

Theoretical Implications

1. Development of Ethnomathematics Theory: This research can contribute to the development of ethnomathematics theory and its application in mathematics learning.
2. Application of Geometric Transformations: The results of this research can provide examples of the application of geometric transformations in the context of culture and ethnomathematics.
3. Development of Ethnomathematics-Based Learning Models: This research can serve as a reference for developing more effective ethnomathematics-based learning models to improve students' understanding of mathematics.

Implications for Society

1. Cultural Preservation: This research can help preserve local culture by linking mathematical concepts to that culture.
2. Increasing Public Understanding: The results of this research can improve public understanding of the importance of culture in mathematics learning.
3. Curriculum Development: This research can be a reference for developing a mathematics curriculum based on culture and ethnomathematics.

4. CONCLUSION

Building upon the data analysis obtained from the three research subjects, it can be concluded that the activity of knitting visual-based motifs significantly contributed to the understanding of the concept of geometric transformation. All three subjects consistently demonstrated the application of reflection transformations, both along the vertical, horizontal, and diagonal axes. This reflection serves as the primary foundation for creating symmetrical and structured patterns. In addition to reflection, the subjects also utilized other transformations such as rotation, dilation, and translation to create coherent and aesthetically pleasing motifs. Each subject demonstrated a distinct approach to their thinking and motif creation: Subject 1 relied on a strategy of quadrant division and reflection as a method of pattern simplification, thus making the motif creation process more systematic. Subject 2 emphasized the importance of the center point as the primary reference in the rotation, dilation, and reflection processes, demonstrating a profound understanding of the interrelationships between transformations. Subject 3 used a grid-based approach, where the pattern was constructed through diagonal reflection analysis, demonstrating a strong spatial understanding of symmetry.

As a suggestion, teachers can apply the concept of ethnomathematics in mathematics learning to improve students' understanding of geometric transformations and relate it to local culture. This research can be a reference for developing mathematics learning materials based on culture and ethnomathematics. This research can encourage the integration of culture in mathematics learning to increase students' interest and understanding. Further research can be conducted to develop a more effective ethnomathematics-based learning model to improve students' understanding of mathematics. In addition, further research can be conducted to develop culture-based learning media that use ethnomathematics concepts to improve students' understanding of mathematics.

REFERENCES

Albanese, V., Adamuz-Povedano, N., & Bracho-López, R. (2017). The evolution of ethnomathematics: Two theoretical views and two approaches to education. In *Ethnomathematics and its diverse approaches for mathematics education* (pp. 307-328). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-59220-6_13

Albanese, V., & Perales, F. J. (2020). Mathematics conceptions by teachers from an ethnomathematical perspective. *Bolema: Boletim de Educação Matemática*, *34*(66), 1-21. https://doi.org/10.1590/1980-4415v34n66a01

Amirah, A., & Budiarto, M. T. (2022). Etnomatematika : Konsep Matematika pada Budaya Sidoarjo. *MATHEdunesa*, *11*(1), 311–319. https://doi.org/10.26740/mathedunesa.v11n1.p311-319

Anggriani, S. D., Sidyawati, L., & Prasetyo, A. R. (2021). Kerajinan Kayu Ornamen Cukli dengan Teknik Mozaik untuk Menambah Nilai Estetik. *Invensi*, *6*(1), 65–78. https://doi.org/10.24821/invensi.v6i1.4441

Ariani, A. E. N. R., Dewanti, A. R., & Sumotarto, U. (2023). Peningkatan Pengetahuan dan Keterampilan Mengaplikasikan Mosaik Keramik pada Furnitur Berbahan Kayu Bekas. *Journal of Dedicators Community*, *7*(3), 271-284. https://doi.org/10.34001/jdc.v6i2.3608

Arsa, N. T. (2022). *Eksplorasi Batik Banyumas sebagai sumber pembelajaran matematika (Studi Etnomatematika di Rumah Batik Anto Djamil Sokaraja Kabupaten Banyumas)* (Doctoral dissertation, UIN Prof. KH Saifuddin Zuhri Purwokerto).

Brown, B. A., Boda, P., Lemmi, C., & Monroe, X. (2019). Moving culturally relevant pedagogy from theory to practice: Exploring teachers' application of culturally relevant education in science and mathematics. *Urban Education*, *54*(6), 775-803. https://doi.org/10.1177/0042085918794802

Cesaria, A., Adnan, M., Kemal, E., Rismen, S., Ramadoni, R., & Delyana, H. (2025). Exploring concepts of ethno-mathematics to introduce the local culture and its values for higher education students. *Al-Jabar: Jurnal Pendidikan Matematika*, *16*(1). https://doi.org/10.24042/ajpm.v16i1.26490

D'Ambrosio, U., & Rosa, M. (2017). Ethnomathematics and its pedagogical action in mathematics education. In *Ethnomathematics and its diverse approaches for mathematics education* (pp. 285-305). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-59220-6_12

Goldstine, S., & Yackel, C. (2022). A mathematical analysis of mosaic knitting: constraints, combinatorics, and colour-swapping symmetries. *Journal of Mathematics and the Arts*, *16*(3), 183-217. https://doi.org/10.1080/17513472.2022.2058819

Irvan, I. (2023). Ethnomathematics exploration in geometric transformation learning in batak woven cloth. *International Journal Reglement & Society (IJRS)*, *4*(3), 248-253. https://doi.org/10.55357/ijrs.v4i3.427

Kabuye Batiibwe, M. S. (2024). The role of ethnomathematics in mathematics education: A literature review. *Asian Journal for Mathematics Education*, *3*(4), 383-405. https://doi.org/10.1177/27527263241300400

Kaczor, O., Guéhéneuc, Y. G., & Hamel, S. (2010). Identification of design motifs with pattern matching algorithms. *Information and Software Technology*, *52*(2), 152-168.

Miftah, M. N., Rizal, E., & Anwar, R. K. (2016). Pola Literasi Visual Infografer Dalam Pembuatan Informasi Grafis (Infografis). *Jurnal Kajian Informasi Dan Perpustakaan*, *4*(1), 87. https://doi.org/10.24198/jkip.v4i1.11635

Nguyen, M. T., Vu, T. V., Mai, H. A., & Tran Thi Tuyet, M. (2025). Exploiting traditional ethnic costumes from Northern mountainous regions of Vietnam in teaching preschool children mathematical patterns: potential and barriers. *Cogent Education*, *12*(1), 2534170. https://doi.org/10.1080/2331186X.2025.2534170

Nugraheni, L. P., & Marsigit, M. (2021). Realistic mathematics education: An approach to improve problem solving ability in primary school. *Journal of Education and Learning (EduLearn)*, *15*(4), 511-518. https://doi.org/10.11591/edulearn.v15i4.19354

Oljayevna, O., & Shavkatovna, S. (2020). The development of logical thinking of primary school students in mathematics. *European Journal of Research and Reflection in*

Educational Sciences, *8*(2), 235-239.

Pathuddin, H., & Raehana, S. (2019). Etnomatematika: Makanan Tradisional Bugis Sebagai Sumber Belajar Matematika. *MaPan*, *7*(2), 307–327. https://doi.org/10.24252/mapan.2019v7n2a10

Permana, W. H. (2019). Etnomatematika: aplikasi bangun datar dan peluang pada permainan tradisional kebudayaan Korea Selatan. *Jurnal Pendidikan Dan Pembelajaran Terpadu*, *1*(2), 138-150. https://doi.org/10.32696/pgsd.v1i2.360

Prahmana, R. C. I. (2022). Ethno-realistic mathematics education: The promising learning approach in the city of culture. *SN Social Sciences*, *2*(12), 257. https://doi.org/10.1007/978-3-030-82723-6_5

Pulungan, N. A., & Adinda, A. (2023). Eksplorasi etnomatematika dalam permainan tradisional kelereng daerah Padangsidimpuan Selatan. *JURNAL MathEdu (Mathematic Education Journal)*, *6*(1), 21-28. https://doi.org/10.37081/mathedu.v6i1.4809

Rosa, M., & Gavarrete, M. E. (2017). An ethnomathematics overview: An introduction. In *Ethnomathematics and its diverse approaches for mathematics education* (pp. 3-19). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-59220-6_1

Sari, I. D. (2023). Eksplorasi Batik Saho Balikpapan Pada Materi Transformasi Geometri. In *Prosiding Seminar Nasional Pendidikan Matematika, Universitas Mulawarman* (Vol. 3, pp. 192-203). https://jurnal.fkip.unmul.ac.id/index.php/psnpm/article/view/2484

Satriawati, G., Kholis, N., Dwirahayu, G., & Sobiruddin, D. (2023). Pengembangan Bahan ajar transformasi geometri berbantuan website: Pendekatan Project-Based-Learning Mozaik Geometri. *JINoP (Jurnal Inovasi Pembelajaran)*, *9*(1), 1–15. https://doi.org/10.22219/jinop.v9i1.23581

Setiana, D. S., Ayuningtyas, A. D., Wijayanto, Z., & Kusumaningrum, B. (2021). Eksplorasi etnomatematika Museum Kereta Kraton Yogyakarta dan pengintegrasiannya ke dalam pembelajaran matematika. *Ethnomathematics Journal*, *2*(1), 1–10. https://doi.org/10.21831/ej.v2i1.36210

Sulisawati, D. N., Amalia, D., & Djamali, M. F. (2021). Eksplorasi Konsep Dilatasi Etnomatematika Pada Batik Tembakau Jember. *Prismatika: Jurnal Pendidikan Dan Riset Matematika*, *4*(1), 56–64. https://doi.org/10.33503/prismatika.v4i1.1441

Sunzuma, G., & Maharaj, A. (2021). In-service mathematics teachers' knowledge and awareness of ethnomathematics approaches. *International Journal of Mathematical Education in Science and Technology*, *52*(7), 1063-1078. https://doi.org/10.1080/0020739X.2020.1736351

Taneo, P. N., Turmudi, T., Nurlaelah, E., & Fatimah, S. (2025). Analisis Transformasi Geometri dalam Motif Anyaman Daun Lontar Masyarakat Amanuban: Kajian Etnomatematika. *Media Pendidikan Matematika*, *13*(1), 413-428. https://doi.org/10.33394/mpm.v13i1.15571

Vindyona, S. P., & Rosandini, M. (2018). Pengolahan Motif Dengan Inspirasi Pola Garis Alam Yang Diaplikasikan Pada Busana Ready-to-wear. *EProceedings of Art & Design*, *5*(3).