

Enhancing Elementary School Teachers Competence in Ethnomathematics Based Geometry Learning through Banten Batik and Mangrove Leaves

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ABSTRACT: Geometry learning in elementary schools is often dominated by abstract representations and conventional instructional materials that rely primarily on textbooks and blackboards, making it challenging for teachers to connect mathematical concepts with students everyday experiences and local cultural environments. This study explored elementary school teachers' experiences and perceptions of a participatory workshop on ethnomathematics-based geometry learning through Banten Batik and mangrove leaf ink. A descriptive qualitative approach was employed within a community engagement program involving 12 elementary school teachers in Anyar Village, Serang Regency, Banten, Indonesia. The workshop included conceptual instruction, demonstrations, hands on activities, reflection, and mentoring. Data were collected through semi-structured interviews, observations, photographs, and field notes and analyzed descriptively and thematically. The findings indicate that teachers responded positively and perceived the workshop as enjoyable, meaningful, and beneficial for developing their knowledge and pedagogical insights. Teachers were able to identify geometric concepts embedded in Banten Batik motifs, including squares, rectangles, triangles, circles, symmetry, and patterns. Mangrove leaf ink was perceived as having potential to connect mathematics learning with cultural heritage and the natural environment. The workshop also encouraged teachers to consider its implementation in classroom instruction. Further research should systematically examine changes in teacher competence and classroom practice.

KEYWORDS: Banten Batik, ethnomathematics, geometry learning, mangrove leaves, teacher professional development, elementary school

1. INTRODUCTION

Geometry is an essential component of elementary mathematics education because it develops students understanding of shapes, spatial relationships, patterns, symmetry, and measurement. Nevertheless, geometry learning at the elementary school level is often presented through abstract representations and conventional instructional materials. Such practices create challenges for teachers in connecting mathematical concepts with students' everyday experiences and local cultural environments. Therefore, elementary school teachers need instructional approaches and professional development experiences that enable them to transform abstract geometric concepts into contextual and meaningful learning activities. (Gilligan-Lee et al., 2022), (Supriadi, 2019a)

Ethnomathematics provides an important framework for connecting formal mathematics with local cultural ideas. It recognizes that mathematical ideas are embedded in the ways communities design, construct, organize, measure, and represent objects and activities within their cultural environments. In mathematics education, an ethnomathematical perspective can help connect school mathematics with students' cultural and everyday experiences, thereby making mathematical learning more meaningful and relevant (Dominikus et al., 2024), (Supriadi, 2019b)

For elementary school teachers, however, implementing ethnomathematics requires not only conceptual knowledge but also practical experience in identifying mathematical ideas embedded in cultural practices and transforming them into classroom learning activities. (Borko, 2004)

Batik is one of Indonesia's cultural practices with substantial potential for ethnomathematics-based mathematics learning. Batik motifs contain visual patterns and geometric structures that can be associated with concepts such as plane figures, symmetry, repetition, and patterns. Banten Batik, as part of the cultural heritage of Banten Province, therefore offers a meaningful local context for introducing geometry to elementary school students. The use of Banten Batik in mathematics learning has the potential to bridge formal geometric concepts with students' cultural surroundings, allowing mathematics to be experienced as part of their cultural environment rather than as an isolated school subject. (Prahmana & D'Ambrosio, 2020)

The integration of locally available natural materials may further enrich ethnomathematics-based learning by extending cultural contexts for mathematics into the surrounding ecological environment. Previous ethnomathematical research has demonstrated that Indonesian batik patterns contain mathematical and geometric ideas that can be explored as culturally meaningful contexts for mathematics learning (Prahmana & D'Ambrosio, 2020). In addition, mangrove leaves can be explored as a potential source of natural coloring materials, as extracts from *Rhizophora mucronata* leaves and propagules have demonstrated potential for natural dye applications (Pringgienies et al., 2018). Combining Banten Batik with mangrove-derived natural colorants therefore creates an interdisciplinary learning context that connects mathematics, local cultural heritage, and environmental resources. Such integration may provide teachers with opportunities to develop learning activities that are not only mathematically meaningful but also culturally and environmentally relevant.

Teacher professional development is an important component of efforts to improve instructional practices and support teachers in implementing contextual and innovative approaches to mathematics learning (Borko, 2004); (Desimone & Garet, 2015). Research on effective professional development emphasizes the importance of a focus on relevant content, opportunities for active learning, and meaningful connections between professional learning experiences and classroom practice (Garet et al., 2001). Effective professional learning can therefore provide teachers with opportunities to engage with new concepts, observe instructional approaches, participate actively in learning activities, reflect on their experiences, and consider how newly acquired knowledge can be implemented in their classrooms (Borko, 2004); (Desimone & Garet, 2015). Accordingly, a participatory workshop that combines conceptual explanations, demonstrations, hands-on practice, reflection, and evaluation may provide a meaningful professional learning experience for teachers. In this context, direct involvement in batik-making may enable teachers to move beyond theoretical understanding and experience how local cultural and environmental resources can be transformed into contextual mathematics learning media.

Based on this rationale, a participatory workshop was conducted for elementary school teachers in Anyar Village, Serang Regency, Banten, Indonesia. The workshop introduced ethnomathematics-based geometry learning through Banten Batik and mangrove-derived natural colorants. Teachers received conceptual explanations, demonstrations, and hands-on activities in which they practiced coloring Banten Batik motifs containing geometric elements. The workshop was subsequently followed by classroom implementation activities involving elementary school students.

This study specifically focuses on teachers' experiences and perceptions during the participatory workshop. Initial observations during the activity suggested that the workshop generated positive responses among participating teachers and provided opportunities for them to engage with ethnomathematical ideas through direct experience. Teachers described the activity as providing additional knowledge and insights, creating an enjoyable learning experience, and offering possibilities for transferring newly acquired ideas to their students. These initial responses provided a rationale for examining teachers' experiences and perceptions more systematically through qualitative inquiry.

Therefore, this study aimed to explore elementary school teachers' experiences and perceptions of a participatory workshop on ethnomathematics-based geometry learning through Banten Batik and mangrove-derived natural colorants.

Specifically, this study addressed the following research questions:

1. How did elementary school teachers respond to the participatory workshop on ethnomathematics-based geometry learning?
2. How did teachers identify geometric concepts embedded in Banten Batik motifs?
3. How did teachers perceive mangrove-derived natural colorants as a contextual learning medium?
4. How did teachers perceive the potential integration of Banten Batik ethnomathematics into elementary geometry instruction?

2. METHODOLOGY

2.1 Research Design

This study employed a descriptive qualitative approach within a community engagement program. A qualitative descriptive design was considered appropriate because the study aimed to explore and provide a comprehensive description of elementary school teachers' experiences, participation, and perceptions during a participatory workshop on ethnomathematics-based geometry learning. Qualitative description is particularly suitable when researchers seek to remain close to participants' accounts and provide a relatively low-inference description of experiences and events (Seixas et al., 2018).

The workshop combined conceptual instruction, demonstrations, hands-on activities, reflection, and mentoring to provide teachers with direct experience in utilizing Banten Batik and mangrove leaf ink as contextual learning resources.

2.2 Setting and Participants

The activity was conducted at an elementary school in Anyar Village, Serang Regency, Banten, Indonesia. The participants consisted of 12 elementary school teachers.

2.3 Participatory Workshop Procedure

The teacher workshop consisted of several interconnected activities.

First, the facilitators introduced the concepts of ethnomathematics, plane geometry, the characteristics of Banten Batik motifs, mangrove leaf ink, and their potential implementation in elementary geometry learning.

Second, the facilitators demonstrated the use of geometric Banten Batik motifs as mathematics learning media. The demonstration included the use of natural ink produced from mangrove leaf extraction. The teachers were introduced to the relationship between geometric elements embedded in batik motifs and mathematical concepts that could be explored in elementary classrooms.

Third, the 12 participating teachers engaged in a hands-on activity by coloring Banten Batik motifs using mangrove leaf ink. The motifs incorporated geometric concepts including squares, rectangles, triangles, circles, symmetry, and patterns. This activity was intended to provide teachers with direct experience in identifying geometric concepts embedded in cultural artifacts and considering their potential integration into mathematics instruction.

Fourth, following the hands-on activity, teachers participated in semi-structured interviews. The interviews explored their understanding of geometric concepts represented in batik motifs, perceptions of mangrove leaf ink as a learning medium, experiences during the workshop, and views regarding the potential implementation of the activity in mathematics classrooms.

2.4 Data Collection

Three sources of qualitative data were used in this study.

First, semi-structured interviews were conducted with teachers after the workshop. The interview questions focused on teachers' impressions of the activity, perceived learning benefits, the use of batik as a mathematics learning medium, and the potential transfer of the activity to students. The interview records documented positive responses concerning knowledge development, enjoyment, concentration, patience, and potential classroom application.

Second, observations were conducted during the workshop using an observation sheet covering teacher participation, the ability to identify geometric concepts, creativity, and the ability to integrate local culture into mathematics learning.

Third, photographs and field notes were collected as supporting documentation of the workshop process and teachers' participation.

2.5 Data Analysis

The qualitative data were analyzed descriptively and thematically. Interview transcripts, observation records, and field notes were reviewed to identify recurring patterns in teachers' experiences and responses.

The analysis focused on four themes: 1. teacher participation and engagement; 2. identification of geometric concepts in Banten Batik; 3. teachers' perceptions of mangrove leaf ink as a learning medium; and 4. teachers' perceptions of the potential integration of ethnomathematics into classroom instruction.

Findings from the three data sources were compared to identify consistent patterns and strengthen the interpretation of teachers' experiences. Interview quotations were used to represent teachers' perspectives, while observations and field documentation provided contextual support for the interview findings.

2.6 Ethical Considerations

Participation in the activity and interviews was conducted as part of the community engagement program. Teachers' identities were anonymized when reporting the qualitative findings, and the interview data were used for research and publication purposes.

3. RESULTS AND DISCUSSION

3.1 Teacher Engagement and Positive Experiences during the Workshop

The workshop generated positive responses among the participating teachers. Their responses indicated that the activity was perceived as enjoyable, meaningful, and beneficial. One teacher explained that the activity provided additional knowledge and

insights while simultaneously creating a relaxing experience through batik-making. She stated that the activity enabled her to feel more relaxed after dealing with various thoughts and responsibilities associated with teaching.

Another teacher responded positively and described the training simply as enjoyable. Similarly, a Grade 1 teacher described the activity as highly enjoyable and emphasized its potential to develop concentration and patience.

These findings suggest that the participatory and hands-on nature of the workshop created a positive professional learning environment. Rather than positioning teachers as passive recipients of information, the workshop engaged them directly in a cultural activity. This interpretation is consistent with research on teacher professional development emphasizing that active learning and opportunities for teachers to engage directly with relevant content and practices are important characteristics of effective professional learning (Desimone & Garet, 2015). The experiential dimension of the workshop may therefore have contributed to teachers' positive perceptions because they were able to participate directly in the learning process before considering its potential classroom application.

The finding is relevant to teacher professional development because meaningful professional learning involves opportunities for teachers to actively engage with new ideas, practice relevant activities, and connect professional learning with instructional practice (Borko, 2004); (Desimone & Garet, 2015). The workshop therefore provided more than information about ethnomathematics; it created an experience through which teachers could explore the relationship between mathematics, cultural practices, and natural materials. Such active engagement may support teachers in developing new understandings and considering how these understandings can be adapted to their own instructional contexts (Borko, 2004)(Desimone & Garet, 2015).



Figure 1. Teachers hands on activity in coloring Banten Batik motifs using mangrove leaf ink as a contextual medium for ethnomathematics based geometry learning

3.2 Development of Teachers Knowledge and Pedagogical Insights

An important finding was teachers' recognition that the workshop expanded their knowledge and provided new insights. One teacher explicitly stated that the activity increased her knowledge and understanding. Another teacher described the activity as a source of additional knowledge that could subsequently be transferred to children.

This finding indicates that the workshop had the potential to broaden teachers' understanding of how local cultural resources can be incorporated into mathematics learning. The use of Banten Batik provided teachers with a concrete cultural artifact through which geometric concepts could be recognized and discussed. This interpretation is consistent with ethnomathematical perspectives emphasizing the importance of connecting mathematical learning with cultural contexts and everyday practices (Dominikus et al., 2024). Previous research has also demonstrated that Indonesian batik patterns can provide meaningful contexts for identifying and exploring mathematical and geometric ideas (Prahmana & D'Ambrosio, 2020).

From a pedagogical perspective, this is important because teachers' implementation of culturally contextualized mathematics learning requires the ability to recognize mathematical ideas embedded within cultural practices and transform them into meaningful learning activities. Through the hands-on activity, teachers were not only introduced to geometric concepts but also experienced the process of connecting these concepts with batik motifs. Such active engagement is consistent with research on teacher professional development emphasizing the importance of content-focused learning, active participation, and opportunities to connect professional learning with instructional practice (Desimone & Garet, 2015).

The teachers' recognition that the knowledge could be transferred to students further indicates the emergence of pedagogical awareness. Rather than viewing batik-making solely as a cultural activity, teachers began to recognize its potential as a learning resource that could be adapted for elementary mathematics instruction. This process of connecting professional learning experiences with potential classroom practice is an important dimension of teacher learning and professional development (Borko, 2004); (Desimone & Garet, 2015).



Figure 2. Elementary school teachers presenting their Banten Batik motif creations developed during the ethnomathematics based geometry workshop using mangrove leaf ink.

3.3 Recognizing Geometric Concepts in Banten Batik

The workshop positioned Banten Batik motifs as contextual resources for exploring elementary geometry. During the hands-on activity, teachers practiced coloring batik motifs containing geometric elements, including squares, rectangles, triangles, circles, symmetry, and patterns.

The activity was designed to help teachers identify mathematical concepts embedded in cultural artifacts and consider how these concepts could be transformed into classroom learning activities. This approach is consistent with ethnomathematics research that emphasizes the identification and exploration of mathematical ideas embedded in cultural practices and artifacts (Rosa & Orey, 2010).

The use of batik motifs as geometry learning resources offers an opportunity to connect formal mathematical terminology with visual and cultural experiences. Previous research has demonstrated that Indonesian batik patterns can provide meaningful contexts for identifying and exploring mathematical and geometric ideas (Prahmana & D'Ambrosio, 2020). Rather than introducing plane figures solely through textbook illustrations, teachers can guide students to observe geometric structures within culturally meaningful objects.

This approach may also support a shift in teachers' perspectives regarding mathematics learning resources. Cultural artifacts can function as meaningful mathematical representations when teachers are able to identify relevant mathematical structures and formulate appropriate learning questions. In this study, the hands-on process provided teachers with an opportunity to experience this transformation directly. The use of culturally situated contexts in mathematics learning is consistent with research emphasizing the value of connecting mathematical ideas with learners' cultural experiences and everyday contexts (Dominikus et al., 2024).

However, the present study does not claim that teachers' geometric competence statistically increased because no quantitative pre-test and post-test data were collected. The findings instead indicate that the workshop created opportunities for teachers to engage with and identify geometric concepts within Banten Batik motifs.

3.4 Mangrove Leaf Ink as a Cultural and Environmental Learning Medium

The integration of mangrove-derived natural colorants introduced an additional contextual dimension to the workshop. Instead of using conventional coloring materials, teachers practiced coloring Banten Batik motifs using natural coloring materials prepared from mangrove leaves. This combination connected cultural heritage with the surrounding natural environment. Previous research has demonstrated the potential of *Rhizophora mucronata* leaves and propagules as sources of natural dyes, supporting the use of mangrove-derived materials as environmentally contextualized coloring resources (Pringgienies et al., 2018).

The use of mangrove-derived natural colorants has pedagogical potential because it allows mathematics learning to be situated within a broader cultural and environmental context. Teachers can potentially use such activities to discuss geometric concepts while simultaneously introducing students to local natural resources and cultural practices. This approach is consistent with place-based education, which emphasizes experiential and contextual learning by connecting educational activities with local places, cultures, communities, and ecological environments (Yemini et al., 2025).

The teachers' positive responses to the activity support the perceived feasibility of using such an integrated learning medium within the context of this workshop. Overall, the responses indicated that the activity was enjoyable and meaningful, while teachers also expressed the potential for transferring the experience to their students. The integration of local cultural and environmental resources may therefore provide opportunities for learning activities that extend beyond abstract classroom materials and connect mathematical learning with learners' immediate contexts. Such contextual and experiential connections are central characteristics of place-based educational approaches (Yemini et al., 2025).

Nevertheless, the present findings should be interpreted primarily as evidence of teachers' perceptions and experiences rather than as evidence of measurable improvements in environmental knowledge or sustainability awareness. Further research is needed to examine changes in environmental knowledge, sustainability awareness, and the physical and chemical properties of mangrove-derived natural colorants through systematic measurement.

3.5 Potential Transfer to Elementary Mathematics Classrooms

The final theme concerned teachers' recognition of the potential to transfer the workshop experience into classroom learning. One teacher explicitly described the activity as providing knowledge that could be transferred to children. The broader activity also generated expectations that students could learn mathematics through play and enjoyable activities while developing greater enthusiasm for learning.

This finding is particularly important because one of the central purposes of teacher professional development is to support changes in teachers' knowledge and instructional practice. Research has shown that professional development is more likely to influence classroom practice when teachers have opportunities to focus on relevant content, actively engage with learning activities, and connect professional learning with their instructional contexts (Desimone & Garet, 2015). In the present context, the workshop provided teachers with a concrete example of how local cultural resources could be transformed into mathematics learning media. The potential classroom application lies in the combination of observation, exploration, discussion, and hands on practice. Teachers can invite students to identify geometric shapes in batik motifs, analyze symmetry and patterns, compare geometric structures, and subsequently create or color their own motifs. Such activities are consistent with ethnomathematics based approaches that use cultural artifacts as meaningful contexts for identifying mathematical ideas and connecting formal mathematical concepts with learners' cultural experiences. Previous research has also demonstrated that batik motifs contain geometric concepts, including plane figures, symmetry, and geometric transformations, which can be explored as contextual resources for mathematics learning (Prahmana & D'Ambrosio, 2020).

The integration of observation, exploration, discussion, and hands-on activities may therefore provide a learning environment in which mathematical concepts are connected with local cultural identity and meaningful experiences. Research on teacher professional development similarly emphasizes the importance of active learning experiences that allow teachers to engage directly with relevant content and consider its potential application in instructional practice (Garet et al., 2001).

The findings therefore indicate that the workshop may serve as a potential bridge between teacher professional development and culturally contextualized mathematics instruction. However, because the present study primarily examined teachers' perceptions and experiences, claims concerning actual changes in classroom practice should be reserved for future research involving classroom observations, follow-up studies, and evidence of sustained instructional implementation. This limitation is important because

teachers may encounter challenges when translating newly acquired knowledge and instructional approaches into sustained classroom practice without continued support.

4. CONCLUSION

This study demonstrates that a participatory workshop on ethnomathematics based geometry learning through Banten Batik and mangrove leaf ink provided elementary school teachers with positive and meaningful learning experiences. The integration of conceptual instruction, demonstrations, hands-on practice, reflection, and mentoring enabled teachers to actively engage in the learning process and experience how mathematical concepts can be connected with local cultural and environmental resources.

The teachers demonstrated their ability to identify various geometric concepts embedded in Banten Batik motifs, including squares, rectangles, triangles, circles, symmetry, and patterns. The workshop also broadened teachers pedagogical insights into the use of cultural artifacts as contextual resources for mathematics learning. Furthermore, the use of mangrove leaf ink introduced an additional contextual dimension by connecting geometry learning with local natural resources and the coastal environment.

The positive responses expressed by the teachers also indicated their recognition of the potential for transferring the workshop experience into elementary mathematics classrooms. Teachers identified opportunities to engage students in observing geometric shapes in batik motifs, exploring symmetry and patterns, comparing geometric structures, and creating or coloring their own motifs. Thus, the workshop has the potential to bridge teacher professional development with culturally responsive and contextual mathematics instruction.

Nevertheless, the findings should primarily be interpreted as evidence of teachers' experiences and perceptions. The study does not provide statistical evidence of increased teacher competence because no quantitative pretest and post-test data were collected. Therefore, future research should incorporate quantitative measures of teacher competence, classroom observations, and follow-up studies to examine the sustainability and effectiveness of integrating Banten Batik ethnomathematics and environmentally based learning media into elementary geometry instruction.

REFERENCES

1. Borko, H. (2004). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher*, 33(8). <https://doi.org/10.3102/0013189X033008003>
2. Desimone, L. M., & Garet, M. S. (2015). Best practices in teachers' professional development in the United States. *Psychology, Society and Education*, 7(3). <https://doi.org/10.25115/psye.v7i3.516>
3. Dominikus, W. S., Madu, A., Blegur, I. K. S., & Jemamun, M. U. (2024). ETHNOMATHEMATICS IN CACI DANCE OF MANGGARAI COMMUNITY AND ITS INTEGRATION IN MATHEMATICS LEARNING. *Journal of Law and Sustainable Development*, 12(2). <https://doi.org/10.55908/sdgs.v12i2.3035>
4. Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4). <https://doi.org/10.3102/00028312038004915>
5. Gilligan-Lee, K. A., Hawes, Z. C. K., & Mix, K. S. (2022). Spatial thinking as the missing piece in mathematics curricula. In *npj Science of Learning* (Vol. 7, Issue 1). <https://doi.org/10.1038/s41539-022-00128-9>
6. Prahmana, R. C. I., & D'Ambrosio, U. (2020). Learning geometry and values from patterns: Ethnomathematics on the batik patterns of yogyakarta, indonesia. *Journal on Mathematics Education*, 11(3). <https://doi.org/10.22342/jme.11.3.12949.439-456>
7. Pringgienies, D., Yudiati, E., Tri Nuraini, R. A., Susilo, E. S., & Rahayuningsih, E. (2018). Optimal concentration of mangrove (*Rhizophora mucronata*) leaf and propagule based natural dye. *Malaysian Journal of Fundamental and Applied Sciences*, 14(1–2). <https://doi.org/10.11113/mjfas.v14n1-2.1011>
8. Rosa, M., & Orey, D. C. (2010). Culturally relevant pedagogy : an ethnomathematical approach. *Horizontes*, 28(1).
9. Seixas, B. V., Smith, N., & Mitton, C. (2018). The qualitative descriptive approach in international comparative studies: Using online qualitative surveys. *International Journal of Health Policy and Management*, 7(9). <https://doi.org/10.15171/ijhpm.2017.142>



10. Supriadi, S. (2019a). Didactic design of sundanese ethnomathematics learning for primary school students. *International Journal of Learning, Teaching and Educational Research*, 18(11). <https://doi.org/10.26803/ijlter.18.11.9>
11. Supriadi, S. (2019b). Didactic design of sundanese ethnomathematics learning for primary school students. *International Journal of Learning, Teaching and Educational Research*, 18(11). <https://doi.org/10.26803/ijlter.18.11.9>
12. Yemini, M., Engel, L., & Ben Simon, A. (2025). Place-based education—a systematic review of literature. In *Educational Review* (Vol. 77, Issue 2). <https://doi.org/10.1080/00131911.2023.2177260>

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