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Exploration of Geometric Patterns in Ciwaringin Batik Motifs in Primary School Mathematics Learning

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Abstract

Local cultures such as batik are increasingly being undermined by globalisation. Education and culture are components that cannot be avoided in everyday life because both are basic needs for every member of society. The purpose of this study is to analyse geometric patterns in local wisdom in the form of Ciwaringin batik motifs that can be integrated into mathematics learning in elementary schools using the ethnomathematics approach. The method used in this research is descriptive qualitative method with ethnomathematics approach. The object of this study consisted of five Ciwaringin batik motifs namely Tebu sekeret, Gambir setemplik, Gribigan, Tambang manis, and Kembang jeruk. The result of this research is that the motifs in Ciwaringin batik have geometry aspects such as straight lines, curved lines, points, angles, squares, and triangles. These aspects can be used as media for HOTS-based questions that can improve the ability to think critically, creatively, analytically, and be able to solve a problem. With the combination of HOTS and ethnomathematics, not only cultural aspects are preserved, but also mathematics learning becomes more contextual and relevant to students' daily lives.

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INTRODUCTION

Nowadays, local culture is highly threatened by globalisation, facing the risk of erosion of local wisdom culture from time to time. For example, the "Korean Wave" is currently rife, where this phenomenon is able to influence and even shift the culture of the community such as music, clothing, lifestyle, perspective, food and others (Winata et al., 2023). This phenomenon is often caused by a lack of attention to local cultural heritage or perhaps a lack of awareness of the importance of preserving these values. Local wisdom is considered as social capital and is necessary to uphold integrity and accountability within a community since it shapes the social and cultural values that influence people's attitudes and behaviors (Lismayanti et al., 2023). Local culture is a cultural identity. According to (Rohisa, 2022) Cultural identity is an identity of the culture of a particular community or ethnicity and this cultural identity contains various cultural characteristics and cultural personality of the community. A community's identity is based on its local culture, which embodies its values, traditions, and heritage (Intem et al., 2020). Although local culture is the foundation of a community's identity, modernisation often results in shifting priorities, and many of these aspects are being abandoned by the younger generation.

Culture and education have an inseparable intrinsic relationship. According to Budiarto (Ulum et al., 2018), education and culture are unavoidable components in everyday life as both are basic needs for every member of society. Incorporating cultural elements into the classroom can offer depth and introduce teachers and students to the ideals of local wisdom, all while making learning more interesting and enjoyable (Pathuddin & Mariani, 2023). Education is not only about transferring academic knowledge, but also about preserving and respecting cultural values that shape the character and identity of a nation. In the learning process, integrating cultural values is crucial to shaping students' personalities (Syarif et al., 2016). This will be an effective tool to combat globalisation that can erode the identity of this nation. Awareness of the importance of integrating culture in the education process has prompted the Ministry of Education and Culture to issue Kepmendikbud number 56/m/2022. The importance of including local content in the curriculum at all educational levels is emphasized by this decree. According to (Chuangprakhon, 2023) it is crucial to incorporate local content into the curriculum for a number of reasons: 1) It instills in students an appreciation for their local culture, self-respect, and awareness of their environment. 2) By increasing one's awareness and appreciation of oneself and others, it helps people develop their life skills or talents. 3) It emphasizes learning through first-hand experiences with local sources by encouraging students to participate in activities to find answers on their own. 4) By assisting students in learning about the arts and cultures of their own hometowns, local arts and cultures are preserved. As a result, it offers a strong basis for developing a more varied and rich learning environment.

The idea of ethnomathematics is an intriguing development in the fusion of culture and education. The study of ethnomathematics looks into different cultures to identify the mathematical components that are present in them. Ethnomathematics is defined as an academic field that explores the relationship between culture and mathematics (Astuti et al., 2024). It also involves applying students' concepts, methods, and ideas to conceptualize, generalize, and apply diverse sources of information to represent real-world problems in various contexts. Learning mathematics and preserving regional cultural values are harmoniously balanced by ethnomathematics. Ethnomathematics can also be used as a mathematics learning tool or resource (Agasi & Wahyuono, 2016). As a smart solution, ethnomathematics not only makes sense of mathematical concepts in a more contextualised way, but also fosters an

appreciation of cultural richness. In line with the opinion (Irsyad, Sujadi, & Setiana, 2020) that ethnomathematics has the advantage of being superior in describing the relationship between mathematics and culture.

As a concrete example, the use of batik motifs as a medium for learning mathematical geometry in elementary school. In accordance with previous research conducted by (Fazalani & Saputra, 2022) showed that batik can be used as a medium to increase children's creativity while learning and help them overcome the limitations of learning media. The same thing was also done by Karimah, Kusuma, & Noto (2021) in their research which used batik motifs from Trusmi Cirebon as a knowledge resource in learning mathematics in secondary schools. By using batik, it not only creates higher engagement but also builds pride in local cultural heritage. The batik used in this study is Ciwaringin batik motif from Flora Boutique. Ciwaringin batik itself is a typical Cirebon batik originating from Ciwaringin Village. Batik Ciwaringin itself is different from Batik Trusmi because Batik Ciwaringin uses traditional materials. In addition to raising the selling price, utilizing natural dye in Ciwaringin batik, Cirebon, provides several environmental benefits (Tresnawati et al., 2020). Furthermore, since natural dye ingredients may be reused, there is no waste. Batik Ciwaringin has a geometric pattern motif that is suitable to be used as a medium for learning mathematics. Batik is an effective medium for students to develop their knowledge of geometrical shapes and study transformations because, according to ethnomathematics studies, it uses geometric concepts and provides a meaningful learning environment for students to interact with these concepts (Sahara et al., 2024). Geometric patterns have a basic structure adapted from flat shapes such as squares, rectangles, circles, triangles, parallelograms, and line patterns that form lanes (HK & Wulandari, 2019). Ciwaringin batik motifs with geometric structures include Limaran, Tebu Sekeret, Tiga Negerian, Tali Manis, Dlorong, Kawung, Hokokai, Limaran Trungtung, Limaran Manggaran, Limaran Tembokan, Limaran Doktoran, Limaran Coret, Limaran Kembang Jeruk, Tembang Manis, Dlorong Liris, Moti Kotak, and others (Machdalena et al., 2023). However, in this study, the motifs that will be studied are only a few motifs including tebu sekeret, gambir setemplik, gribigan, tambang manis, and kembang jeruk.

Local content is not only part of the curriculum, but also integrated into teaching methods that provide deeper understanding and meaning for students. In addition, using ethnomathematics can improve critical thinking skills. This critical thinking ability is very important because it is used in all knowledge, especially mathematics. According to (Suryawan et al., 2023) students' critical thinking abilities were effectively enhanced by using ethnomathematic. Research conducted (Suhartini & Matyanti, 2017) also shows that ethnomathematics can develop students' critical thinking skills, which include interpretation, analysis, evaluation, and decisions. This is also in line with the results of research (Adi et al., 2023) which shows that students taught with an ethnomathematics approach have better mathematical critical thinking skills than students taught without an ethnomathematics approach. A statement from (Zaenuri et al., 2018) also said that the ethnomathematics method helps students understand the material because it is directly related to their culture and their daily activities in society. Many articles have examined mathematics learning with local wisdom, but not many have discussed Batik Ciwaringin, therefore the researcher conducted a study that aims analyse geometric patterns in local wisdom in the form of Ciwaringin batik motifs that can be integrated into mathematics learning in elementary schools using the ethnomathematics approach. So that with ethnomathematics education is not only an academic process, but also a vehicle to maintain, inherit, and appreciate the cultural wealth that exists in a region.

METHODS

In this study, researchers used qualitative research methods using scientific logic, emphasizing process analysis of inductive thinking processes connected to the dynamics of relationships between observable events. This research uses an ethnomathematics approach, which is a research approach based on culture to investigate how it relates to mathematical concepts.

The object of this research consists of five motifs of Ciwaringin batik, namely Tebu sekeret, Gambir setemplik, Gribigan, Tambang manis, and Kembang jeruk. Each motif has various geometry elements. For example, tebu sekeret and gambir setemplik have geometric elements in the form of flat shapes, namely a square on tebu sekeret and a triangle on gambir setemplik.

This research was conducted at the Flora Boutique show room located in Ciwaringin, Cirebon Regency, West Java. The research instruments used by researchers were interviews, observation, documentation, and literature review. Indicators of this research instrument include Ciwaringin batik motifs and aspects of geometry contained in the batik motifs.

The data analysis technique used in this study adapts the Miles and Hubberman analysis model (Umrati & Wijaya, 2020) starting with reducing data, presenting data, and drawing conclusions. The research started from determining the problem to be studied by conducting a study on some literature. After determining the problem, researchers designed research instruments and validated them with several validators. Furthermore, data collection was carried out by means of interviews, observations, and documentation. Data collection was carried out for one month during November 2023. Interviews were conducted with the resource person, Mr Fathoni, in a semi-structured manner with questions covering aspects of geometry. Furthermore, observations were made of batik motifs guided by the informant. Finally, by documenting the activities carried out using camera media as evidence of observation results. After the data is collected, the data will be processed and analysed and ended with drawing conclusions.

RESULTS AND DISCUSSION

Ciwaringin batik motifs can be used as a medium to introduce mathematical concepts such as geometry, making it easier to understand abstract mathematical concepts. These mathematical concepts include straight lines, curved lines, parallel lines, symmetry, points, angles, squares, and triangles.

Figure 1. Interview process with interviewees

Based on the results of research conducted at flora boutique in november 2023, there are ciwaringin batik motifs with geometric patterns, including tebu sekeret, gribigan, gambir setemplik, tambang manis, and kembang jeruk.

Table 1. Mapping geometry concepts on batik motifs

Batik Motifs	Image Explanation	Geometry Concepts
Tebu Sekeret 	This tebu sekeret motif has a symmetrical square pattern. This symmetry can also be used as a medium for geometric transformation in the form of reflection or mirroring.	Square
Gambir Setemplik 	Gambir setemplik consists of a pattern of facing triangles. This pattern, like tebu sekeret, can be used as a medium for reflection or mirroring.	Triangle
Gribigan 	The gribigan motif consists of vertical and horizontal lines repeatedly.	Straight lines and parallel lines
Tambang Manis 	The Tambang manis motif has twisting lines and an identical dot.	Curved lines and points
Kembang Jeruk 	Apart from tebu sekeret, there are other motifs that have square elements, namely kembang jeruk. Kembang jeruk have elements of dots and lines that stand out.	Square, point, and straight line

Based on table 1, there are several concepts of flat shapes in Ciwaringin Batik, namely square in Tebu sekeret and Kembang jeruk motifs, and triangle in Gambir setemplik motif.

In addition to geometric elements such as flat shapes, lines, and points, there is also a form of geometric regularity of reflective transformation or mirroring in the batik motif of Ciwaringin Gambir setemplik, namely as follows:

The basic shape is a triangle.

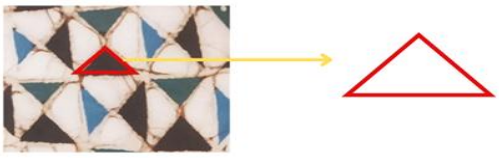


Figure 2. The basic form of batik gembir setemplik motif

The shape of the Gambir setemplik batik motif can be seen as the result of reflection or mirroring of the basic form. The results of mirroring figure 2 on the x and y lines produce the following shapes.

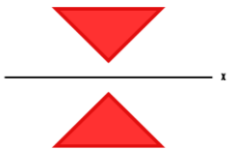


Figure 3. X-axis mirroring

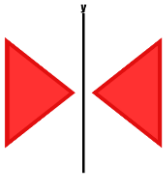


Figure 4. Y-axis mirroring

The combination of figures 3 and 4 results in the following motifs for Gambir setemplik.

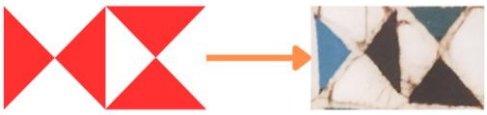


Figure 5. Combining the x- and y-axis mirroring results

Thus, the Gambir setemplik batik motif as shown in figure 5 is obtained.

In this study, researchers explored geometric patterns in Ciwaringin batik motifs that can be integrated into mathematics learning in elementary schools using an ethnomathematics approach. An alternative for enhancing high-level thinking skills (HOTS) that are continuous with mathematics is the integration of batik motifs with geometry learning materials.

Mathematics is closely related to higher-order thinking skills or HOTS. In line with Kamarullah's (2017) statement that the purpose of learning mathematics is to provide knowledge or provision for students in higher order thinking (HOTS). According to (Intan et al., 2020) high-level thinking skills (HOTS) is an ability that supports students to think critically, creatively, analytically, and be able to solve a problem. High-level thinking skills will stimulate students to analyse or manipulate previous information so that it is not monotonous (Budiono et al., 2016). That way, students are expected to be able to explore the concepts they acquire, foster new ideas, communicate ideas and ideas and work together in solving a problem they face. The levels to assess higher order thinking skills are: analyse (C4), evaluate (C5), and create (C6) (Dinni, 2018). High-level thinking skills are not only improved in cognitive aspects but are able to improve students' skills and affective aspects (Fanani & Kusmaharti, 2014). One way to improve higher order thinking skills is by testing students with Higher Order Thinking Skills (HOTS) questions. HOTS questions are given to measure students' ability to understand and solve problems.

HOTS (Higher Order Thinking Skills) questions are an instrument that assesses students' higher order thinking skills so that students do not just remember or restate but students are expected to be able to develop their ideas and ideas (Giani et al., 2015). In addition, mathematics learning does not only use calculations or formulas but also involves students' reasoning skills in solving a problem (Helmawati, 2019). HOTS is also closely related to Ethnomathematics. Ethnomathematics allows students to analyse various mathematical concepts in their cultural context. The integration of HOTS in ethnomathematics learning can encourage students to analyse, compare and evaluate mathematical knowledge in various cultures. In addition, ethnomathematics offers contextualised learning by referring to real cultural situations, for example batik motifs. Batik motifs can be a medium that is very suitable for the HOTS dimension because indicators of abilities such as analysing, evaluating and creating are found in the elements of batik motifs. This is in line with Richardo's research (2017) that batik motifs can be utilised in learning because understanding related to the concept of flat buildings associated with surrounding culture can actually construct students' thinking or understanding.

In this study, researchers classified HOTS questions about geometry based on the HOTS dimensions of analysing (C4), evaluating (C5), and creating (C6).

Analysing (C4)

In the C4 question, the model of the math problem is to analyse the batik motif image related to the geometric elements in the batik motif. For example:

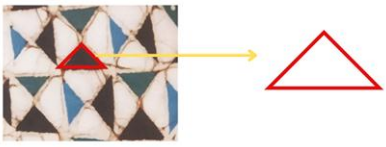
Table 2. Examples of C4 questions that integrate batik motifs

Question	Answer
 From the gribigan batik motif above, what geometry elements are found in the gribigan batik motif?	Straight line Point Angle
 What geometric elements are found in the Tambang manis batik motif above?	
Observe the Kembang jeruk batik motif below!  Write down the geometric elements you find in the motif!	

Evaluating (C5)

In question C5 the question model is a story question. For example:

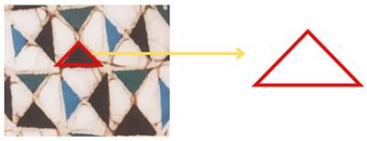
Table 3. Examples of C5 questions that integrate batik motifs

Question	Answer
 The picture above is the Gambir setemplik batik motif, one of the Ciwaringin batik motifs. Gambir setemplik motif has geometry element in the form of equilateral triangle. If the triangle has a height of 8 cm and a base of 30 cm, find its area and perimeter!	

Creating (C6)

In question C6 the question model is in the form of mirroring geometry so that it can form the batik motif. For example:

Table 4. Examples of C6 questions that integrate batik motifs

Question	Answer
 The picture above is a Gambir batik motif as one of the Ciwaringin batik motifs. Make a mirroring so that it can form the motif!	

Local batik motifs reflect the cultural and historical richness of a region. The integration of local wisdom into mathematics learning can make the material more contextual and relevant to students, bridging the gap between theoretical and applied mathematics. In line with research (Hanafi et al., 2022) which states that learning with batik patterns can develop students' mathematics skills and cultural literacy, especially batik through contextual HOTS questions. The integration of local content such as batik is very important, in line with the opinion of Humaeroh & Rahayu (2020) who say that the benefits of using batik in learning are to make learning more meaningful by using real examples and also to introduce Indonesian cultural heritage to the next generation of the nation. Numerous studies have made similar claims, such as this one: using ethnomathematics, which incorporates local culture into mathematics instruction, can increase mathematics' relevance and application for all students while also assisting them in understanding their cultural and historical background (Johnson et al., 2022). This integration is thought to help students become more adept at creatively bridging mathematical ideas with cultural practices, which will increase the meaning of mathematics and provide them a better understanding of the mathematical knowledge that exists in their social and cultural surroundings (Roza et al., 2020). The goal of incorporating local wisdom into mathematics instruction is to provide students a deeper understanding of the subject matter by relating it to their everyday experiences and cultural norms (Buchori et al., 2022). The claim that ethnomathematics connects mathematical ideas to students' everyday lives and cultural experiences in order to improve their ability to make meaningful connections and to comprehend mathematics more deeply lends credence to this (Prastika & Abidin, 2021). The study's findings demonstrate that it was possible to successfully incorporate local knowledge—specifically, Javanese batik ethnomathematics—into math lessons by using an Android application that focused on flat shapes and their transformation features (Irawan et al., 2022). The study's findings demonstrate how incorporating local knowledge with mathematics—more especially, the Gaple card game—allows for the exploration of ideas like universal sets, intersections, unions, and complements (Almaghfiroh et al., 2023). Through this integration, kids can learn mathematical concepts like geometry through familiar cultural objects, which makes it easier for them to mix old and new knowledge (Yandani & Agustika, 2022). The research findings suggest that incorporating local knowledge, particularly Sundanese ethno mathematics, into mathematics instruction enhances students' mathematical learning outcomes and problem-solving skills (Permana, 2023). The study's findings indicate that there are a number of advantages to teaching numeracy ideas connected to geometrical shapes through the integration of local knowledge and mathematics, more especially ethnomathematics. Deep learning is

encouraged, teachers can apply past knowledge in the classroom, students are able to remember and connect newly taught concepts, and names of geometric forms from other languages that teachers might not be aware of are just a few advantages (Mukwambo et al., 2023).

By drawing their attention, the use of regional batik motifs can raise student engagement. Learning mathematics can be made more engaging and enjoyable by incorporating cultural elements that are meaningful to the students. This will increase their motivation to learn. As part of the learning activities, students can actively participate in the creation or analysis of batik motifs. This process can build problem-solving, critical thinking and collaboration skills. Using local batik motifs can also help students appreciate and understand their own cultural heritage. It can create a sense of identity and pride in the local culture. Through local content-based learning, students are expected to realise the importance of preserving their cultural heritage. Hopefully, students can understand and appreciate the richness of local culture involving traditions, history, art and values of the local community.

CONCLUSION

The conclusion of this research is that Ciwaringin batik has high cultural value and needs to be preserved as an important part of local cultural heritage. One approach that can be taken to preserve it is through the use of ethnomathematics, namely integrating Ciwaringin batik motifs into mathematics learning with a focus on the HOTS (Higher Order Thinking Skills) dimension.

Ciwaringin batik motifs that are integrated into maths problems include Tebu sekeret, Gambir setemplik, Gribigan, Tambang manis, and Kembang jeruk. Geometry aspects contained in Ciwaringin batik motifs include straight lines, curved lines, points, squares, and triangles. From these aspects, geometry questions were created and classified based on the dimensions of HOTS, namely analysing (C4), evaluating (C5), and creating (C6).

The integration of Ciwaringin batik motifs in mathematics learning can provide multiple benefits. First, it can enrich students' learning experience by exploring local cultural values. Second, mathematics learning that focuses on the HOTS dimension can stimulate students' critical, creative, and analytical thinking, helping them develop the skills needed to face the challenges of the modern world.

Through this approach, not only the cultural aspects are preserved, but also the learning of mathematics becomes more contextual and relevant to students' daily lives. In this way, Ciwaringin batik is not only a beautiful art object, but also an educational tool that builds awareness of cultural values and develops students' cognitive potential. Therefore, the integration of Ciwaringin batik motifs in HOTS-based mathematics learning is one of the effective efforts to preserve Indonesia's cultural heritage while advancing mathematics education in schools.

Suggestions for further research. This research only focuses on HOTS questions, in the future it can be focused on its relation to critical thinking abilities and creative thinking abilities.

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