Numbers sequence in batik Jlamprang motif of Pekalongan

S F ‘Adna*, N B Nasution and D Mardhiyana
Department of Mathematics Education, Universitas Pekalongan, Indonesia

*Corresponding author's e-mail: syitafatih@unikal.ac.id

Abstract. The background of this study is the intention of using Batik Jlamprang motif as a context to teach mathematics in junior high school in Pekalongan. It is known that Batik Jlamprang is an original batik motif from Pekalongan. However, the use of Batik Jlamprang as a context for teaching in school is still rare. Therefore, this study aims to describe the certain mathematical concepts that can be taught by using Batik Jlamprang motif, which is the concept of the arithmetic sequence. We gathered data from the public library and electronic media, and then we observed them. Also, we visited the Museum Batik of Pekalongan to get a broader view of the data. The result of this study shows that the motif of Batik Jlamprang can be used as an introduction about arithmetic sequences but cannot be used to teach the concept of the sum of the first n\textsuperscript{th} term.

1. Introduction
Mathematics is a science that cannot be separated from the problems of daily life, so Mathematics becomes a subject that receives special attention from the Government. Mathematics must be taught from elementary to secondary education. Mathematics is also a subject included in the National Examination. Compared to other matters, Mathematics gets the most hours portion [1].

Despite getting an extra time of learning, mathematics is still less understood by students. It is caused by a lot of teachers present mathematics learning abstractly. Students are directed to work on problems based on the formula given by the teacher (or we can say the formal phase). Of course, learning like this does not instill mathematical concepts. Hence, a lot of students have very little understanding of mathematics. The teacher should be able to associate mathematical concepts with everyday life. Learning mathematics must be as concrete as possible for students to more easily understand mathematical concepts [2]. The teacher can stimulate students by giving them problems of daily life, and one of those problems can be found in the culture of the community. Mathematical concepts can hinder people's culture [3]. The Mathematics learning approach by adopting culture as the planting of the concept is called ethnomathematics.

In detail, ethno is defined as a socio-cultural context, and mathematics means explaining, understanding, and doing things such as defining, measuring, classifying, concluding, and modeling [4]. Meanwhile, the tics suffix comes from the word techné, which means technique. Ethnomathematics aims to give learners and researchers deeper insights into the concepts and relations between mathematics and culture [5]. Ethnomathematics can be described as the way in which people from certain cultures use mathematical ideas and concepts through the qualitative, relational, and spatial aspects of people's lives [6]. Mathematics is regarded as a cultural construction [7]. Hence,
ethnomathematics is considered to be a product of cultural development. It states that nowadays, needs to ethnomathematics be integrated into every class of mathematics [8].

The main purpose of implementing ethnomathematics as motivating and stimulating means of the students is to solve saturation and to learn difficulties [9]. With Ethno-mathematics, students can get to know an almost eroded culture of society. It also preserves the culture of the community. Cultures that can be introduced to students in learning mathematics are traditional houses, special foods of an area, regional arts, or crafts produced from several regions. Thus it will be easier for teachers to instill cultural values into the lives of their students [10].

The world of education, in particular mathematics learning, needs to discuss everything related to culture, given the importance of culture and education as an effort to form knowledgeable people [11]. Learning culture-based mathematics can provide interesting experiences for students in learning. Through ethnomathematics, students become motivated to enjoy mathematics and do not consider mathematics as a frightening subject [12]. Also, ethnomathematics learning is effective for students' mathematical literacy abilities [13].

Students can easily absorb mathematics learning based on local culture. It is because the culture is inherent in everyday life. Culture is the whole and all units of various investments that are produced and / or applied in a community [6]. Each region has its cultural traditions. Coastal areas certainly have different cultural traditions from inland or mountainous regions. Each tradition has characteristics that are hardly found in other regions. This characteristic is a symbol of a particular regional cultural tradition [3]. One of the cities that is famous for its culture is Pekalongan City.

Pekalongan has a city branding that is the world's city of Batik, which stores fascinating culture and local wisdom. Among these cultures are sintren dance, kuntulan, dhuror, khoul, gunungan megono, syawalan, which are famous for making giant balloons and lopis, and so on [14].

Pekalongan is an advanced city in the field of crafts and folk arts. Therefore, Pekalongan was named by UNESCO as a creative city in December 2014. Pekalongan is also known as the City of Batik. For the Pekalongan community, batik has become wealth in the economic and cultural fields. Batik became an icon of the city of Pekalongan. The Government preserves batik with the establishment of the Batik Museum. Several types of batik motifs, batik equipment, and batik processes are available at the Batik Pekalongan museum. According to an interview with one of the guards of the Pekalongan Batik museum, the development of Pekalongan batik since 17 AD The Pekalongan batik motif that is the characteristic of Pekalongan city is Jlamprang batik. Even though Pekalongan has many batik motifs, Jlamprang Batik is the best known by the public. No wonder the Jlamprang motif adorns some ornaments in the town of Pekalongan. Jlamprang batik motifs are geometric batik designs in the form of fried eggs consisting of rectangular and rectangular shapes arranged to resemble woven on patola woven fabrics with distinctive colors of Pekalongan.

The geometrical motifs of Jlamprang batik can be used as a medium for learning mathematics. On this Jlamprang batik motif, there are two basic forms, namely circle and square. Each square on Jlamprang batik motifs, surrounded by four circles. In this paper, we showed that these squares and circles form arithmetics numbers sequence. As references, there are some researches before that studied the use of specific batik pattern to teach the student about number sequence. One of them studied the use of Timor weaving pattern in developing student's worksheets about number sequence [15]. This study results a teaching material based on the Timor weaving that is valid and practical. Also, there was a study about the use of Adipurwo Batik to teach about number patterns [16]. In this study, it was shown that Adipurwo Batik could be a suitable context to teach the material especially to teach about an arithmetic sequence differed by 3. Moreover, there was also a study about the use of Batik Kediri to teach about the arithmetic sequence [17].

Despite the lack of study about Pekalongan culture, there was a study about the use of certain environmental issues in Pekalongan in teaching mathematics [18]. In this study, it was shown that students can learn about mathematics based on the environmental problem they face everyday. By implementing this in class, we can hope that students are not only able to understand the mathematics,
but they can also understand about the cause of the problem around them and moreover, they can understand, at least, the logic to solve it.

Based on the discussion above, it looks that using a familiar batik motif to teach about number sequence is quite promising. However, especially in Pekalongan, most teachers have not implemented it in class. This is because teachers still do not know how to use Jlamprang motif to teach about number patterns in class. Therefore, in this paper, we show the use of Jlamprang motif in teaching students about arithmetic number sequence. This paper aims to explore the form of Ethno-mathematics in Jlamprang motif to teach about number sequence and to know about how well can Jlamprang motif facilitated learning about arithmetic number sequence.

2. Methods
This study aims to explore ethnomathematics based mathematics learning with Jlamprang batik media. Through Jlamprang batik motifs, students can learn about numbers sequence. We studied the issue using a qualitative descriptive approach. Qualitative descriptive research describes or depicts the object of research based on facts that appear or as they are [19].

The data are taken through observation, interviews, and literature study. The observation was done by visiting the Batik Pekalongan museum located at Jl. Jatayu No.3, Panjang Wetan, Pekalongan Utara, Pekalongan. Observation activities at the Batik Pekalongan museum were conducted to study several batik motifs that could be applied in learning mathematics. Interviews were conducted with a number of students and mathematics teachers in Pekalongan Junior High School to obtain data on the use of ethnomathematics. The results of interviews with students, Mathematics learning has not been associated with Pekalongan culture. Some students are not familiar with Pekalongan batik. While the results of interviews with teachers obtained the results that mathematics learning has not used a cultural approach. The teacher also does not have Ethno-mathematics teaching materials. Some teachers are not familiar with Ethno-mathematics learning. A literature study is used to analyze the scope of material that can be related to culture.

3. Result and Discussion
Jlamprang Batik is a typical Pekalongan City batik inspired by the culture of Gujarat (India). The specialty of Jlamprang batik is a symmetrical motif consisting of circles, squares, stars, and flowers. This motif is a development of Potola fabric motifs from India, which are geometrically shaped, sometimes in the shape of a star or wind, and using twigs that have rectangular edges.

![Figure 1. Batik Jlamprang motif.](image)
Figure 1 presents an example of Batik Jlamprang motif of Pekalongan. It can be seen that the motif consists of two main geometry objects. They are squares and circles. Both items are shown in yellow color in figure 1. We can also see that every circle is surrounded by 4 squares. Therefore, we can draw a simpler picture of figure 1, as it was shown in figure 2.

![Figure 2. Illustration for one square motif.](image1)

Next, if we have two squares (clearly shown in figure 3), then there are six circles surround the squares. Moreover, if we have three squares (clearly in figure 4), then there are eight circles surround the squares.

![Figure 3. Illustration of two squares motif.](image2)

If we continue the process, then we will see that the number of the circles on the \(n\)th steps is differed by 2 with the number of circles in the \((n-1)\)th step. Hence, the number of circles form an arithmetic sequence with the first term is four, and the difference is 2.

![Figure 4. Illustration for three squares motif.](image3)

Using this point of view, we can use Batik Jlamprang motif as a context to teach about the arithmetic sequence in school. To be more specific, it can be used at the informal phase of learning. As we already know, the informal phase is the phase in which students are trying to understand the concept. In this phase, teachers are suggested to use any contexts or experiences that are familiar with the student's daily life [20][21]. Once the students understand the concepts, the teacher can start the formal phase, which is introducing the mathematic symbol of the first term, difference, and the \(n\)th term \((U_n)\). Table 1 gives us a quick review about the process so far.
Table 1. The summary of the process.

| Step Number | Number of The Squares | Number of The Circles |
|-------------|-----------------------|-----------------------|
| 1           | 1                     | 4                     |
| 2           | 2                     | 6                     |
| 3           | 3                     | 8                     |
| 4           | 4                     | 10                    |

Unfortunately, the process, as described above, can't be used to introduce the concept of the sum of the first n terms ($S_n$). For proving this statement, let us try to use the motif to introduce the concept of the sum of the first three terms. Then we need to draw Figure 2, 3, and 4 on the same drawing plane, as shown in figure 5. The result shows that the number of circles in the picture is 18.

Figure 5. The illustration for showing the concept of $S_3$.

Figure 5 shows us the picture that we wish to get if we use Batik Jlamprang motif to introduce the concept of $S_3$. Next, we crop Batik Jlamprang motif in a way that the result has the same number and same arrangement of squares. The result is shown in figure 6. It can be seen that the number of circles in figure 6 is not the same as the number of circles in figure 5. Therefore, we cannot use Batik Jlamprang motif to introduce the concept of $S_3$.

Figure 6. The result for cutting with the same number of squares.

Using Jlamprang motif as an introduction when teaching about arithmetic number sequence can be an effort to increase student's conceptual understanding and (probably) student's problem-solving ability. Understanding the concept in the informal phase before starting the formal phase is the key for through understanding of a certain concept. Using a problem that is faced every day by students in real life can be a trigger to bring up student's conceptual understanding.
4. Conclusion
From the discussion above, we can conclude that the Batik Jlamprang motif, which originally comes from Pekalongan can be used to teach mathematical concept about number sequence, especially the arithmetic sequence. However, the motif can't be used to teach about the sum of the n\textsuperscript{th} first term. From this result, we recommend the mathematics teacher of Pekalongan to use Batik Jlamprang motif in mathematics learning in school. Using this way, we hope students will have a meaningful understanding of the concept of arithmetic sequence since they are already familiar with the motif. As for the concept of the sum of the first n\textsuperscript{th} term, the teacher can start directly from the formal phase since we can't use Batik Jlamprang motif. Another recommendation is for researchers to develop some learning material for mathematics using Batik Jlamprang motif.

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