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Semiotic analysis on *Malangan Batik* for elementary school mathematics learning

Dyah Worowirastri Ekowati [1 *], Arina Restian [1], Erna Yayuk [1], Kamariah [2]

[1] Primary Teacher Education Department, University of Muhammadiyah Malang, East Java, Indonesia
[2] Mathematics Education Department, Musamus Merauke University, Merauke, Indonesia

[*] Correspondence: worowirastri@umm.ac.id

Abstract

Among the cultural richness in Indonesia, one of which is the *Malangan batik* cloth. The use of *Malangan batik* cloth is not only for clothing and decoration needs but also becomes part of the subject matter. In elementary school learning, *Malangan batik* cloth is one of the learning materials for Arts, Culture, and Crafts. In the thematic learning applied in elementary schools, Arts, Culture, and Crafts subjects do not stand alone. However, it must be related to other subjects, one of which is mathematics. The reality, on the ground, most teachers find it difficult to link the two. Bridging the link between these two subjects is carried out through semiotic analysis with its six primary objects. This study aimed to conduct a semiotic analysis of *Malangan batik* for elementary mathematics learning. The research was conducted in a qualitative descriptive manner with an ethnographic approach. Data were collected through observation, documentation, and interviews with two elementary school mathematics teachers and two *Malangan batik* makers. The research period is January-March 2022. The results of the study found that elementary mathematics concepts (numbers, algebra, geometry, measurement, statistics, and capital selection) have been identified according to six primary semiotic objects, namely language, problem-situation, concepts, procedures, properties, and arguments. By understanding each semiotic object, *Malangan batik* has the potential to increase students' mathematical activities that are contextual, interesting, and meaningful for students.

Keywords: elementary school; *Malangan batik*; mathematics learning; semiotics

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Introduction

As an archipelagic country, Indonesia has various customs, languages, ethnicities, and cultures. Among the cultural wealth in Indonesia namely batik cloth. Examples of batik fabrics in Indonesia, including *Megamendung batik, kawung batik, lasem batik, Pekalongan batik, palace batik, Malangan batik* and many other batiks (Sudarmin et al., 2019; Syahputra & Soesanti, 2016). Especially *Malangan batik* cloth is local wisdom from Malang (Rahmanto et al., 2021). *Malangan batik* cloth is not only for clothing but also becomes part of the subject matter (Putri et al., 2020). In elementary school learning, *Malangan batik* cloth is one of the learning materials for Art, Culture, and Crafts (Regina, 2018).

This subject does not stand alone in implementing Arts, Culture, and Crafts learning in elementary schools. It is because the learning done in elementary school is done by applying thematic learning. The 2013 curriculum has given birth to learning in the form of a unit called thematic (Purnamasari & Purnomo, 2021). Thematic learning is one of the models in integrated learning (integrated instruction) that leads students to be active in seeking and discovering concepts and principles of science as a whole and meaningful for students (Setyaningrum et al., 2013).

The implementation of thematic learning is still a concern of the government regarding teacher readiness, infrastructure that supports learning activities, and the students themselves (Salamah, 2014). Also, elementary school teachers have difficulty linking the existing material in each subject (Sutisna & Subarjah, 2016). These include teachers who have difficulty linking Arts, Culture, and Crafts subject matter using Malangan batik cloth with mathematics subjects (Ekowati & Widya, 2014). Most teachers and students view mathematics as a scientific field that is not influenced by culture (Pathuddin et al., 2021). It places mathematics learning in elementary school only from the abstract and away from daily life activities (Ekowati & Suwandayani, 2020). Most students become afraid and have difficulty learning mathematics. In addition, the basic concepts of mathematics taught in schools sometimes have no relationship with the problems that arise in the field. As a result, students' mathematical abilities are pretty low (Nugrahanto & Zuchdi, 2019).

Historically, human life is inseparable from mathematical activity. Therefore, learning mathematics must be done concretely and interestingly (Ekowati & Suwandayani, 2020). If this is applied, it is hoped that students will be able to use mathematics to solve problems in everyday life (Ekowati et al., 2017). Therefore, teachers need to bridge the gap between mathematics in school and the need for mathematical activities in the field by using contextual mathematical objects (Glory & Dwi, 2021). In this case, Malangan batik is used as an object of elementary mathematics learning. The process of bridging the contextual mathematical objects with mathematical concepts in schools, namely, analyzing the signs and symbols in Malangan batik. The signs and symbols on Malangan batik are then used to understand mathematical concepts (Glory & Dwi, 2021; Marleny et al., 2020; Ulum et al., 2018).

Related studying signs or symbols is inseparable from the concept of semiotics (Font et al., 2010; Godino et al., 2007). *Semiotics* is a term originally used by Charles S. Peirce to study any sign or symbol (Presmeg & Roth, 2018). These symbols are one of the mathematics

languages (Godino et al., 2007). When learning mathematics, it will be complicated to learn and engage in mathematical activities if using symbols or objects that are not clear (Santi, 2011). The most basic questions related to symbols or signs on mathematical objects used, and the role of symbols or signs on mathematical objects in learning activities, is essential in learning mathematics. Semiotics explain the relationship or function between expressions/signifiers and meanings determined by the subject (person or institution) according to specific criteria (Burgos & Godino, 2020).

The research process that explains the relationship between expressions/signifiers and meanings that have been determined in a lesson has been carried out by (Rahmanto et al., 2021). The research entitled "Exploration of Malang Traditional Art for Junior High School Learning Materials" provides some information. There are traditional crafts, namely ceramics and batik, and Malangan Macapat, traditional vocal music, which is the hallmark of Malang. These works of art can be developed into teaching materials for arts and culture subjects in junior high schools. In addition, the results of the research conducted to provide important information below.

> "*Batik Celaket* uses a written batik-making process, which is to carve the night with a canting-colored tool on a piece of batik cloth. If we look at some of the motif samples, it can be seen that almost all the batik celaket uses a geometric pattern of batik motifs. The craftsmen made a stylized design of the main motif that was composed geometrically and performed iteration".

The information provided by this researcher shows that there is a process of associating celaket batik objects as markers that can be interpreted for geometric concepts in mathematics learning. The researcher also stated that the next researcher could continue to do more in-depth research on batik and explore the Malang traditional art for the development of teaching materials in other subjects or different grade levels. It is supported by a search within the last three years which states that there has been no research on markers or semiotics in elementary school mathematics learning using batik. The research to be carried out can be used as a basis for developing mathematics teaching materials in elementary schools. At the same time, they answered teachers' difficulties in elementary schools in linking material between subjects in thematic learning.

Therefore, it is essential to conduct semiotic analysis on Malangan batik cloth for elementary mathematics learning based on the description above. The analysis is conducted according to primary semiotic objects: language, problem situation, concepts, procedures, properties, and arguments. The relationship between mathematical objects is significant in learning. It is by (Godino et al., 2005) state that "…the nature of mathematical concepts, propositions and their relationship to contexts and situation-problems -is crucial in instructional processes". Mathematical concepts, propositions, and their relationship to contexts and problem situations are essential in learning. Some of the opinions above will show the importance of the relationship between mathematical objects and learning mathematics. Knowing the relationship between the Malangan batik cloth object and mathematical concepts increases teachers' confidence in teaching contextual mathematics (Pratiwi et al., 2022). In addition, if students learn mathematical concepts through contextual objects, they will gain much experience solving mathematical problems in everyday life (Wulandari et al., 2021). Based on the

description above, the purpose of this study is to conduct a semiotic analysis on Malangan batik for elementary school mathematics learning.

Methods

The study used an ethnographic approach with a qualitative descriptive type of research. Qualitative descriptive research obtains a comprehensive and in-depth explanation of information (Sugiyono, 2014). At the same time, the selection of ethnography is to describe culture (Ulum et al., 2018). Ethnography was chosen to answer the question of the culture of a group of individuals (Pathuddin et al., 2021). The design of this research is based on the conception of six primary semiotic objects, namely language, problem-situation, concepts, procedures, properties, and arguments. The conception of six mathematical objects by considering the role of different objects in mathematical activities (Burgos & Godino, 2020; Giacomone et al., 2019) is explained below.

1. Language (terms, expressions, notations) in different registers (written, spoken, sign, etc.) and representation.
2. Problem-situation (extra-mathematical application, exercises).
3. Definitions of concepts (eg straight lines, points, numbers, functions).
4. A proposition is a statement about a concept that requires justification.
5. Procedures according are algorithms, operations, and calculation techniques: division, addition, sample space enumeration, or computational probability.
6. Arguments (statements used to justify or validate or explain propositions and procedures, whether the arguments are deductive or otherwise).

Data collection was carried out through observation, interviews, and documentation from January to March 2022. Observations were carried out by observing the Malangan batik which consisted of the Malangan batik, the Malangan mask, and the Malangan *singo* crazy batik. The objects observed were batik images, batik materials, and sizes. The interviews were conducted with informants, namely two elementary school mathematics teachers, and two Malangan batik makers. During the interview, all the information disclosed by the informant was recorded using a voice recorder. At the same time, the documentation is taking pictures of batik and mathematical concepts. Data obtained from observations, interviews, and documentation were then analyzed using triangulation methodology. Methodological triangulation is done by comparing the information obtained from observations, interviews, and documentation. Finally, the data are presented and described to obtain the findings. Elementary mathematics concepts are limited to the concepts of numbers, algebra, geometry, measurement, statistics, and the selection of mathematics.

Results

In a study conducted in January – March 2022. The object of the research is the Malangan batik, the Malangan mask, and the *singo edan* batik as shown in figure 1 below.

(a) (b)

Figure 1. The Malangan mask batik (a) and (b) the *singo edan* batik

The two Malangan batik above were observed with the signs or symbols and meanings. Furthermore, the results of these observations were then strengthened by interviews with two elementary school mathematics teachers and two Malangan batik makers. In this case, the mathematics teacher who teaches at the Muhammadiyah elementary school in Malang City is interviewed about the mathematics material taught in elementary school.

The next step is to obtain the results of semiotic analysis on Malangan batik cloth which includes types of primary semiotic objects. These include language, problem-situation, concepts, procedures, properties, and arguments. Primary object indicators, including language, which includes terms, expressions, notations, and graphics) in various registers (written, spoken, gestures); problem situations (extra mathematical or Intra mathematical applications, exercises); concepts (introduced through definitions or descriptions, such as lines, numbers, functions); a proposition (a statement about a concept); procedures (algorithms, operations, engineering calculations) and arguments (statements used to validate or explain propositions and procedures). The following is a description of the results of the analysis of each primary semiotic object for elementary mathematics learning (concepts of numbers, algebra, geometry, measurement, statistics, and capital selection of mathematics).

Language, the first primary object is the use of language/words/terms/notations/-symbols/graphics. It includes language (terms, expressions, notations, graphics) in various registers (written, spoken, gestural). The results of the analysis of Malangan batik, the Malangan mask batik contains the black, yellow, and red mask symbols, as shown in Figure 2 below.

Figure 2. Black, red, and yellow mask symbols on Malangan batik

The mask symbol above each has a meaning. According to batik makers, "red mask represents the strong character, arrogant, antagonist, and brave; yellow represents the youth value, cheerful, excited, and smart; black stands for wisdom". While in Malangan batik: *singo*

edan, the symbols/expressions found are *singo edan* batik, a lotus flower (yellow, pink, blue, and orange colors), and also a ball symbol, as shown in Figure 3 below.

Figure 3. Symbols of *singo edan* batik, ball, lotus flower on badass *singo edan* batik

In addition, both batiks have a length, width, area, and surface shape, which is part of a flat rectangular shape and has a weight. This element is not written explicitly. However, according to a mathematician in elementary school, he is stated that the elements in batik can then be used as a medium for learning the concept of measurement. Expressions or symbols used in Malangan batik can be used as symbols for mathematical activities. As explained in the mathematical problem situation in the following discussion.

Problem-situation, the second primary object, is mathematical problems. Mathematical situations in the Malangan mask batik and *singo edan* batik are applied in the form of questions whose descriptions are described according to basic mathematical concepts, namely numbers, algebra, geometry, measurement, statistics, and capital selection mathematics. The explanation of the problem situations in each concept is described below.

Number

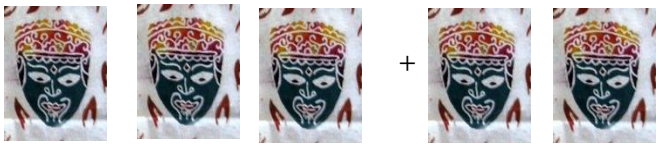
Explanation of situations in the concept of numbers using symbols that have been described in the previous section of the language. The use of symbols of masks, crazy lions, balls, and lotus flowers according to mathematics teachers can be described in the routine questions below.

1. Please count the number of red, yellow, and black masks for Malangan batik: Malangan mask batik! (The concept of counting natural numbers)
2. Count the number of *singo edan* batik symbols and balls on poor *singo edan* batik? (the concept of counting natural numbers)

Algebra

In the concept of algebra, use the problem situation as explained below.

1. Count how many masks are on the Malangan batik cloth as shown below (addition concept).

 + = ...

..... + ... = ...

2. Write the arithmetic operation for the image symbol below and determine the result of the arithmetic operation! (Subtraction concept)

..... - ..... = ...

3. In a wedding, everyone needs 3 meters of *singo edan* batik to be used as a wedding uniform. How many meters of batik cloth is needed by 5 family members? (multiplication concept)
4. A shop prepares 100 meters of Malangan cloth: a Malangan mask for the uniforms of 40 Teachers of Muhammadiyah Elementary School in Malang City. How many meters of cloth did each Master get? (division concept)

Geometry

In the geometric concept consisting of flat shapes and spatial shapes, malangan mask batik and *singo edan* batik can be used to understand the concept of flat shapes. Look at the batik cloth which has a length of 2 meters and a width of 1.5 meters below.

1. Please determine the shape of the surface of the Malangan batik cloth above?
2. Determine the shape of the surface of the batik cloth, is it flat or space?
3. If the surface of the batik cloth is flat, state the characteristics!
4. If the surface of the batik cloth is a form of space, state its characteristics!

Measurement

The concept of measurement consists of measuring length, area, weight, volume, and time using standard and non-standard units (length: fathoms, spans, etc.). The results of the analysis on batik cloth found the following problem situations.

1. Measure the length of *singo edan* batik cloth! (standard length measurement)
2. Use the front of your hand and decide how long it is! (non-standard length measurement)
3. At the cloth shop, for every 1 kg of Malangan masked batik, the buyer gets 5 meters of cloth. To get 25 meters of cloth, it takes how many kg of Malangan batik: Malangan mask? (standard weight measurement)
4. The process of making the crazy *singo edan* batik cloth is carried out within 15 days. Meanwhile, the process of sewing clothes using Malangan Batik, and Malangan masks took 13 days. Determine which one takes longer to make batik cloth between the two? (standard time measurement)

Statistics

Based on the results of interviews with mathematicians, it is known that statistical concepts that can use Malangan batik cloth are the calculation of the mean, median, and mode. As for the situations, you can use the questions below.

1. 10 students are asked to give a value in terms of color, artistic aspect, in terms of quality on batik cloth with a value range of 1-10. Everyone is welcome to write down their value in terms of color, art, and fabric quality using the help of table 1 below!

Table 1. Fill in the use of *batik* in mathematics learning

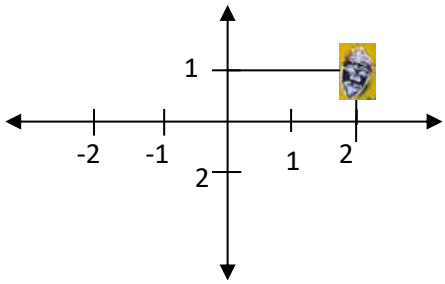
Values	***Singo Edan* Batik**	**Malang mask**
Color		
Art		
quality		

2. Determine the average value in terms of the color of *singo edan* batik and Malangan Mask Batik!
3. Determine the average value of the artistic aspect of the mad *singo edan* batik and the Malangan Malang mask batik!
4. Determine the average value in terms of the quality of *singo edan* batik and Malangan Masked Batik!

Capita Selecta Math

In the capita Selecta of mathematics studied in elementary school, students begin to recognize the coordinate plane and transformations (rotation, dilation, translation). Therefore, the situations that can be applied to the Malangan batik, the Malangan mask, are as follows.

1. Determine the coordinates of the unfortunate mask below.



2. Show the color of the mask that rotates the Malangan batik below.

Concepts, propositions, procedures, and arguments

Concepts are introduced through definitions or descriptions. In *singo edan* batik and Malangan mask, the results of the problem situation analysis have been obtained as described previously. The proposition is a statement about the concept explained in the research about the concept applied in the problem situation. The procedure is a calculation technique used in every problem situation obtained from the analysis results. At the same time, the arguments are in the form of

explanations of propositions and procedures. Furthermore, the results of the analysis of concepts, propositions, procedures, and arguments are described in table 2 below.

Table 2. Explanation of concepts, propositions, procedures, and arguments on *singo edan* batik and Malangan mask

Concept	Property	Procedure	Argument
Numbers include natural, positive, negative, odd, even, whole, rational, irrational, real, and complex numbers.	The natural numbers are {1,2,3,...}	• Counting the number of red, yellow, and black masks on Malangan batik: Malangan Mask • Counting lots of *singo edan* batik symbols and balls on poor *singo edan* batik	Explanation of propositions and procedures is reinforced by batik images containing symbols of masks, crazy lions, and balls
Addition, subtraction, division, and multiplication	Addition uses the (+) symbol, subtraction uses the (-) symbol, multiplication uses repeated addition situations and division uses repeated subtraction situations	• Perform addition and subtraction of masks according to the picture • Adding and repeating fabrics and subtracting fabrics according to what is known to be a problem	In addition and subtraction, it is supported by a mask image that leads to arithmetic operations. Meanwhile, multiplication and division present problem situations that lead to applying concepts according to the definition of multiplication namely repeated addition and division as repeated subtraction
Two-dimensional figure	The shape of the fabric surface represents a rectangular flat shape with the elements of length, width, and the characteristics mentioned related to the rectangle	There is no calculation technique for flat shapes. But identifying flat shapes using the surface of batik cloth	Batik cloth is a concrete object to identify the definition, nature, and characteristics of flat shapes
Measurement of length, weight, and time using standard and non-standard units	Measurement of length using a non-standard unit, namely fathoms. Weight measurement uses the standard unit, namely kg. Measurement of length using meters. While the measurement of time using days	• Length measurement technique using fathom size practice • Weight and length measurements are presented in common problem situations. Even though the two are different concepts	• Batik cloth is used directly for the practice of determining length in fathoms, kg weight units, meter length units • The process of making batik can be used to study the unit of time, namely days

Concept	Property	Procedure	Argument
		• The measurement of time can be calculated by comparing the length of the day	
Mean	The mean is the average value of batik cloth	Adding up all the scores obtained by each indicator and dividing by the number of students who scored	Scorecards and batik cloth support learning the concept of the average (mean)
Cartesian coordinate plane	Cartesian plane using the x and y axes	The unfortunate mask is used as a coordinate point. Thus students can find out the coordinates of the Cartesian coordinates	The unfortunate mask on the coordinate plane makes it easier for students to understand Cartesian coordinates
Rotation, dilation, translation	In *singo edan* batik, rotation applies. Rotation of rotation is a change in the position or position of an object by being rotated through a certain center and angle	The Malangan mask on the Malangan batik cloth makes it easier for students to understand and distinguish the concepts of rotation, dilation, and translation.	The mask on the cloth shows the rotation which characterizes the concept of rotation

Based on the results of interviews with mathematics teachers, it was found that the use of Malangan batik cloth, Malangan masks, and poor *singo edan* batik can still be developed for the next level of mathematics. The following is an excerpt of an interview with one of the mathematics teachers at Muhammadiyah Malang Elementary School.

Researcher: In your opinion, can this Malangan batik cloth still be studied again?
Teacher: If you use Malangan batik cloth in learning mathematics, that is enough. However, related to the process of making batik can still be studied again. Not only for learning in elementary school but also for mathematics at the next level.
Researcher: Why is that?
Teacher: After looking at the semiotic analysis, you can examine each stage of the batik-making process. In the process, there are advanced mathematical concepts.
Researcher: Can you give an example?
Teacher: Like the mixing of colors in the process of making batik, it can be studied and linked to several subjects. For example, the size of the color volume in mathematics subjects, while related to color mixtures can be studied in natural sciences and chemistry subjects.
Researcher: Thank you for the information. Lastly, in your opinion, what are the benefits of semiotic analysis on this batik cloth?
Teacher: very useful, batik cloth is not only learned by arts and crafts subjects but can also be learned by other subjects. Thus, placing batik becomes more meaningful and interesting to learn.

As the interview results above, semiotic analysis can be done by describing the six main objects of the Malangan batik cloth. The results of this semiotic analysis are beneficial for

teachers in meaningful mathematics learning. Besides that, it can also help teachers find some next-level mathematical concepts. Thus, the results of the semiotic analysis on the Malangan batik, the Malangan mask, and the *singo edan* batik become the references for teachers to be able to link mathematics and Arts, Culture, and Crafts subjects. In addition, it can be developed in the process of making batik. From the results of interviews with batik makers, it is known that there are six stages of batik making. Each stage indirectly uses mathematical knowledge like mixing colors with a specific size. At the time of the first stage, prepare the cloth. A batik maker must determine the length and width of the cloth. There are many more applications of mathematical knowledge using batik cloth that can be investigated in further research. Thus, mathematical activities using Malangan batik become more meaningful and exciting for students.

Discussion

The study was conducted to analyze the cultural meaning of Malangan batik, namely the *singo edan* batik and the Malangan mask. These two batiks are part of Malang's local wisdom, which is often used as part of the assignments for subjects in elementary schools, especially Arts, Culture, and Crafts subjects. The use of batik in Arts, Culture, and Crafts learning is part of the thematic learning in elementary school. Because they have to carry out thematic learning, the teacher must be able to link at least two subjects, including linking Arts, Culture, Crafts, and mathematics. The implementation of thematic learning accommodates the level of development of elementary school students (Desyandri et al., 2021). At the age stage, elementary school students have reached a unified whole (holistic) and can only understand the relationship between concepts in a simple way (Setyaningrum et al., 2013). In the learning process, students depend on concrete objects and learn from the experiences they have experienced directly.

Understanding related batik tasks and studying mathematics brings the teacher to its difficulties. The teacher's big task is to link the arts, culture, crafts, and mathematics. Of course, the cistern of linking the two cannot be separated from the symbols or markers on batik that can be used in studying mathematics. So, the central role of symbols on batik in learning mathematics becomes very influential. The six types of objects expand the traditional distinction between conceptual and procedural knowledge (Godino et al., 2007). Situations contextualize the use of batik in mathematics. Language represents other entities and is a tool for action in solving mathematical problems. Arguments justify procedures and propositions linking concepts (Pino-Fan et al., 2018). The use of batik cloth and elementary mathematical concepts indirectly position-specific criteria that link expression and meaning in semiotic functions. The mathematical rules set are in the form of habits or agreements and inform the subject implicit in the interpretive process about the terms that must be included in the correspondence between symbols and meanings in a dormant state (Santi, 2011). In this case, the teacher and students make specific rules that use the signs or symbols on the batik. It is to clarify the object implied in the process of meaning about the terms that can be used in the correspondence of the signifies and the signified (Burgos & Godino, 2020).

The results of this study have also revealed in depth the primary semiotic objects consisting of language, problem-situation, concepts, procedures, properties, and arguments (Font et al., 2015). The language analysis results obtained object content in the form of the use of red, yellow, and black masks. According to the batik maker, "the red mask symbolizes a strong, arrogant, antagonistic, and brave character; yellow symbolizes the value of youth, cheerful, passionate, and intelligent; black symbolizes wisdom. The use of this color corresponds to the five characters of the Malang mask character. Five characters represent different colors and personalities of the app. Panji Asmoro wakes up, representing honest, agile, and wise as a prince and is defined by the color black. Sekartaji keeps the beauty features elegant and refined in white and beige colors. Klana represents a strong, arrogant, antagonistic, brave, and valiant character in red. Gungungsari symbolizes purity, gentleness, maturity, and white color, and Ragil Kuning symbolizes the value of being young, cheerful, passionate, and intelligent (Lin, 2020). While in Malangan batik: *singo edan*, the symbols/expressions found are *singo edan* batik, a lotus flower (yellow, pink, blue, and orange colors), and a ball symbol. There is no particular meaning regarding the color difference. except to show the diversity of colors that the Malang region has as a flower city (Rahmanto et al., 2021).

The results of situation-problem analysis, mathematical situations in the Malangan mask batik, and *singo edan* batik are applied in the form of questions whose descriptions are described according to basic mathematical concepts, namely numbers, algebra, geometry, measurement, statistics, and capital selection mathematics. Following the mathematics material that students must teach at the basic education level (Cowan, 2015). Meanwhile, the results of the analysis of concepts, propositions, procedures, and arguments follow from the respective contents of numbers, algebra, geometry, measurement, statistics, and capital selection mathematics which have been described in table 2.

The table describes each material concept from numbers, algebra, geometry, measurement, statistics, and capital selection mathematics. Numbers include natural, positive, negative, odd, even, whole, rational, irrational, real, and complex numbers. Algebra includes addition, subtraction, division, and multiplication. Geometry includes flat shapes. Measurements include measurement of length, weight, and time using standard and non-standard units. Statistics include the concept of the mean, while the capita selection of elementary school mathematics includes Cartesian coordinates and Rotation, dilation, and translation (Cowan, 2015). The results of the analysis of procedures, properties, and arguments are explained according to the analysis of the concepts found. The results of the analysis of procedures, properties, and arguments are explained according to the analysis of the concepts found. The procedure explains the stages of using batik objects. The property delivers object placement in learning. At the same time, the argument strengthens the other five objects (Santi, 2011). The use of batik becomes an object that provides a marker for students to understand the meaning of mathematics. In the learning process, teaching teachers can understand the signs or symbols of batik. However, it is not easy to put the meaning of the corresponding mathematical concept correctly. With semiotic analysis, every semiotic object gives a precise meaning between the sign and the intended meaning in malangan batik (Duval, 2017).

Thus, the teacher can minimize the difficulty of connecting symbols on cloth as markers with markers of mathematical concepts. Discussions on the situation linking the study of Malangan batik with mathematical concepts emerged as a didactic teaching strategy (Burgos et al., 2020). Of course, it will still be possible to emerge various meanings from the symbols on batik cloth. It is not limited to cloth objects but can also use the whole procedure of making batik which involves various mathematical activities. It is even known from the batik-making process that mathematical concepts emerge through the knowledge and perspectives of present people and develop naturally in certain cultures without a formal educational process (Pathuddin et al., 2021).

In addition to the explanation above, the procedures and symbols used by students will increase the meaning of batik cloth, not only in the context of culture and local wisdom. But in other scientific contexts. Therefore, it is necessary to design and implement new research cycles (at the same level of education and a higher level). The goal is to encourage the meaning of batik and mathematical activities in everyday life as part of solving mathematical problems. Furthermore, this is a joint task to develop various studies that can improve the quality of learning, especially at the elementary level. The higher the quality of learning at the primary level, will strengthen students' knowledge at the next level.

Conclusion

The results of the semiotic analysis of Malangan batik for elementary school mathematics learning are explained according to six primary objects in semiotics, namely language, problem-situation, concepts, procedures, properties, and arguments. The language analysis results obtained object content in the form of the use of red, yellow, and black masks. In addition, in Malangan batik: singo crazy, the symbols/expressions found are singo crazy batik, a lotus flower (yellow, pink, blue, and orange colors), and a ball symbol. The results of situation-problem analysis, mathematical situations in the Malangan mask batik, and singo edan batik are applied in the form of questions whose descriptions are described according to basic mathematical concepts, namely numbers, algebra, geometry, measurement, statistics, and capital selection mathematics. Concept analysis results are numbers, algebra, geometry, measurement, statistics, and capital selection mathematics. Numbers include natural, positive, negative, odd, even, whole, rational, irrational, real, and complex numbers. Algebra includes addition, subtraction, division, and multiplication. Geometry includes flat shapes. Measurements include measurement of length, weight, and time using standard and non-standard units. Statistics include the concept of the mean, while the capita selection of elementary school mathematics includes Cartesian coordinates and Rotation, dilation, and translation. The results of the analysis of procedures, properties, and arguments are explained according to the analysis of the concepts found. The procedure explains the stages of using batik objects. The property delivers object placement in learning. While the argument strengthens the other five objects.

Through semiotic analysis with its six main objects, placing the expression of the signifier and its meaning becomes transparent and interconnected. Semiotic analysis is a bridge for

teachers to use Malangan batik cloth in learning mathematics. In addition, the findings obtained make learning mathematics more meaningful, engaging, and fun for students. In further research, semiotic analysis research can be carried out on Malangan batik for the next level. Much can be explored more deeply in the relationship between Malangan batik and mathematical concepts at a higher level, including semiotic analysis of the batik-making process.

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Conflicts of Interest

We declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

References

Burgos, M., Castillo, M. J., Beltrán-Pellicer, P., Giacomone, B., & Godino, J. D. (2020). Análisis didáctico de una lección sobre proporcionalidad en un libro de texto de primaria con herramientas del enfoque ontosemiótico [Didactic analysis of a lesson on proportionality in a primary school textbook with ontosemiotic approach tools]. *Bolema: Boletim de Educação Matemática*, *34*(66), 40–68. https://doi.org/10.1590/1980-4415v34n66a03

Burgos, M., & Godino, J. D. (2020). Semiotic conflicts in the learning of proportionality: Analysis of a teaching experience in primary education. *International Electronic Journal of Mathematics Education*, *15*(3), em0588. https://doi.org/10.29333/iejme/7943

Cowan, P. (2015). Teaching handbook mathematics. In *APLIMAT 2015 - Proceeding of 14th Conference on Applied Mathematics*. https://doi.org/10.4135/9781446280591.n15

Desyandri, D., Yeni, I., Mansurdin, M., & Dilfa, A. H. (2021). Digital student songbook as supporting thematic teaching material in elementary school. *Jurnal Ilmiah Sekolah Dasar*, *5*(2), 342-350. https://doi.org/10.23887/jisd.v5i2.36952

Duval, R. (2017). How to learn to understand mathematics? *Jornal Internacional de Estudos em Educação Matemática*, *10*(2), 114-122. https://doi.org/10.17921/2176-5634.2017v10n2p114-122

Ekowati, D. W., Kusumaningtyas, D. I., & Sulistyani, N. (2017). Ethnomathematica dalam pembelajaran matematika (pembelajaran bilangan dengan media batik Madura, tari khas Trenggal dan tari khas Madura) [Ethnomathematica in mathematics learning (learning numbers with Madura batik media, Trenggal typical dance and Madura]. *Jurnal Pemikiran dan Pengembangan Sekolah Dasar (JP2SD)*, *5*(2), 716-721. https://doi.org/10.22219/jp2sd.vol5.no2.716-721

Ekowati, D. W. & Suwandayani, B. I. (2020). Understanding the concept of π numbers for elementary school pre-service teachers on circle materials. *Jurnal Prima Edukasia*, *8*(1), 12–19. https://doi.org/10.21831/jpe.v8i1.30103

Ekowati, D. W., & Widya, E. (2014). Identification of error in mathematics concepts and its

repairment on the teacher's and student's book of 1 st grade to understand the right concepts of matematics for childrens. *Proceeding of International Conference on Child-Friendly Education 2016, pp. 77-81*. Universitas Muhammadiyah Surakarta.

Font, V., Godino, J. D., & Amore, B. D. (2015). *Onto-semiotic representations in mathematics Education*. *27*(2), 2–7.

Font, V., Godino, J., Planas, N., & Acevedo, J. (2010). The object metaphor and synecdoche in mathematics classroom discourse. *For the Learning of Mathematics*, *30*(1), 15–19. http://www.jstor.org/stable/10.2307/20749432

Giacomone, B., Beltrán-Pellicer, P., & Godino, J. D. (2019). Cognitive analysis on prospective mathematics teachers' reasoning using area and tree diagrams. *International Journal of Innovation in Science and Mathematics Education*, *27*(2), 18–32. https://doi.org/10.30722/IJISME.27.02.002

Glory, M., & Dwi, Y. (2021). Kajian etnomatematika pola batik keraton Surakarta melalui analisis simetri [Ethnomathematical study of Surakarta palace batik patterns through symmetry analysis]. *Mosharafa: Jurnal Pendidikan Matematika [Journal of Mathematics Education]*, *10*(1), 13–24. https://doi.org/10.31980/mosharafa.v10i1.831

Godino, J. D., Batanero, C., & Font, V. (2007). The onto-semiotic approach to research in mathematics education. *ZDM - International Journal on Mathematics Education*, *39*, 127–135. https://doi.org/10.1007/s11858-006-0004-1

Godino, J. D., Batanero, C., & Roa, R. (2005). An onto-semiotic analysis of combinatorial problems and the solving processes by university students. *Educational Studies in Mathematics*, *60*(1), 3–36. https://doi.org/10.1007/s10649-005-5893-3

Lin, P. H. (2020). Creative product design (Case study of Malangan mask). *Journal of Arts and Humanities*, *9*(3), 64–85.

Marleny, A. S., Somakim, Aisyah, N., Darmawijoyo, & Araiku, J. (2020). Ethnomathematics-based learning using oil palm cultivation context. *Journal of Physics: Conference Series*, *1480*(1), 012011. https://doi.org/10.1088/1742-6596/1480/1/012011

Nugrahanto, S. & Zuchdi, D. (2019). Indonesia PISA result and impact on the reading learning program in Indonesia. Proceeding of the International Conference on Interdiciplinary Language, Literature, and Education (ICILLE 2018), *Adavances in Social Science, Education, and Humanities Research*, 373–377. https://doi.org/10.2991/icille-18.2019.77

Pathuddin, H., Kamariah, & Ichsan Nawawi, M. (2021). Buginese ethnomathematics: Barongko cake explorations as mathematics learning resources. *Journal on Mathematics Education*, *12*(2), 295–312. https://doi.org/10.22342/jme.12.2.12695.295-312

Pino-Fan, L. R., Godino, J. D., & Font, V. (2018). Assessing key epistemic features of didactic-mathematical knowledge of prospective teachers: the case of the derivative. *Journal of Mathematics Teacher Education*, *21*(1), 63–94. https://doi.org/10.1007/s10857-016-9349-8

Pratiwi, E., Nanna, A. W. I., Kusnadi, D., Aras, I., Kurniati, D., & Sepeng, P. (2022). Self-confidence attitude of novice primary teachers reflection on teaching mathematics. *Jurnal Elemen*, *8*(1), 1–15. https://doi.org/10.29408/jel.v8i1.4022

Presmeg, N., & Roth, W. (2018). *Signs of signification: Semiotic in mathematics education research.* Springer. http://link.springer.com/10.1007/978-3-319-70287-2

Purnamasari, R., & Purnomo, H. (2021). Implementasi kurikulum 2013 pada pembelajaran tematik integratif di sekolah dasar [Implementation of the 2013 curriculum on integrative thematic learning in elementary schools]. Didaktik: Jurnal Ilmiah PGSD STKIP Subang, *7*(1), 163-174. https://doi.org/10.36989/didaktik.v7i01.169

Putri, E. D. S., Surachman, Sunaryo, & Rofiq, A. (2020). The effect between product design and iconic product in attractiveness on cultural identity with buying decision (Study on batik consumer Malang)…. *PalArch's Journal of Archaeology of Egypt*, *17*(4), 3223–

3240. https://archives.palarch.nl/index.php/jae/article/download/3932/3882

Rahmanto, K. D., Iriaji, ., Rini, D. R., & Prasetyo, A. R. (2021). Exploration of Malang traditional art for junior high school learning materials. *KnE Social Sciences*, *2021*, 309–314. https://doi.org/10.18502/kss.v5i6.9217

Regina, B. D. (2018). Mengeksplorasi motif batik elephant Thailand menggunakan teknik shibori oleh siswa SD Ban Krua Bangkok [Exploring Thai elephant batik motifs using shibori technique by ban krua bangkok elementary school students]. *(JP2SD) Jurnal Pemikiran dan Pengembangan Sekolah Dasar 6*(2), 127-135. https://doi.org/10.22219/jp2sd.v6i2.7151

Salamah, U. (2014). Model pembelajaran tematik [Thematic learning model]. *Jurnal Pendidikan Dasar Islam*, *XI*(1), 119–132. https://doi.org/10.14421/jpai.2014.111-08

Santi, G. (2011). Objectification and semiotic function. *Educational Studies in Mathematics*, *77*(2–3), 285–311. https://doi.org/10.1007/s10649-010-9296-8

Setyaningrum, R. W., Husamah, & Ekowati, D. W. (2013). Model pembelajaran pendidikan karakter pada pembelajaran tematik di SD Muhammadiyah 9 Kota Malang [Character education learning model in thematic learning at Muhammadiyah 9 elementary school, Malang City]. *Jurnal Pemikiran dan Pengembangan Sekolah Dasar (JP2SD)*, *1*(1), 46-53. https://doi.org/10.22219/jp2sd.v1i1.1529

Sudarmin, S., Sumarni, W., Rr Sri Endang, P., & Sri Susilogati, S. (2019). Implementing the model of project-based learning : integrated with Ethno-STEM to develop students' entrepreneurial characters. *Journal of Physics: Conference Series*, *1317*(1), 012145. https://doi.org/10.1088/1742-6596/1317/1/012145

Sugiyono. (2014). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D. [Educational research methods quantitative, qualitative, and R&D approaches]*. Alfabeta.

Sutisna, A. P., & Subarjah, H. (2016). Meningkatkan pemahaman matematis melalui pendekatan tematik dengan RME [Improving mathematical understanding through thematic approaches with RME]. *Jurnal Pena Ilmiah*, *1*(1), 31–40.

Syahputra, R., & Soesanti, I. (2016). Application of green energy for batik production process. *Journal of Theoretical and Applied Information Technology*, *91*(2), 249–256.

Ulum, B., Budiarto, M. T., & Ekawati, R. (2018). Etnomatematika Pasuruan: Eksplorasi geometri untuk sekolah dasar pada motif batik Pasedahan Suropati [Pasuruan ethnomathematics: Geometry exploration for elementary schools on Pasedahan Suropati batik motifs]. *Jurnal Kajian Pendidikan dan Hasil Penelitian*, *4*(2), 686-696. https://doi.org/10.26740/jrpd.v4n2.p686-696

Wulandari, N. P., Ekowati, D. W., Novitasari, D., Hamdani, D., & Gunawan, G. (2021). Spatial reasoning profile of the students with good number sense ability. *Journal of Physics: Conference Series*, *1933*(1), 012077. https://doi.org/10.1088/1742-6596/1933/1/012077