Systematic Literature Review: Ethnomathematics of Traditional Batik Motifs on Students' Mathematical ConceptsUnderstanding Ability

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Abstract

This study aims to determine the mathematical concepts contained in traditional batik motifs, the application of traditional batik in mathematics learning, and the effect of ethnomathematics traditional batik motifs on students' mathematical concepts understanding ability. The research method used is a Systematic Literature Review (SLR). Research steps using Systematic Literature Review are formulating research questions, searching and selecting literature, analyzing qualitative findings, reviewing the literature used, and compiling SLR articles. Based on the PRISMA method selection, 34 articles became the literature in this study. The results of this study show that the mathematical concepts contained in traditional batik motifs include the concepts of plane shapes, solid shapes, points, lines and angles, relationships between lines, equivalence, congruence, symmetry, geometric transformations, number patterns, trigonometric functions, function graphs, equation of the straight line, tangent circles, Pythagoras theorem, and tessellation. The application of traditional batik in mathematics learning can be implemented using a contextual teaching and learning model. Ethnomathematics-based learning of traditional batik motifs can also improve students' mathematical concept understanding ability.

Keywords: *SLR; Ethnomathematics of Traditional Batik; Mathematical Concepts Understanding Ability.*

Abstrak

Penelitian ini bertujuan untuk mengetahui konsep matematika yang terdapat dalam motif batik tradisional, penerapan batik tradisional pada pembelajaran matematika, serta pengaruh etnomatematika motif batik tradisional terhadap kemampuan pemahaman konsep matematika peserta didik. Metode penelitian yang digunakan adalah *Systematic Literature Review* (SLR). Langkah-langkah penelitian menggunakan *Systematic Literature Review* adalah merumuskan pertanyaan penelitian, mencari dan menyeleksi literatur, menganalisis temuan-temuan kualitatif, meninjau ulang literatur-literatur yang digunakan, serta menyusun artikel SLR. Berdasarkan seleksi menggunakan metode PRISMA, terdapat 34 artikel yang menjadi literatur pada penelitian ini. Hasil dari penelitian ini menunjukkan bahwa konsep matematika yang terdapat dalam motif batik tradisional meliputi konsep bangun datar, bangun ruang, titik, garis

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dan sudut, hubungan antar garis, kesebangunan, kekongruenan, simetri, transformasi geometri, pola bilangan, fungsi trigonometri, grafik fungsi, persamaan garis lurus, garis singgung lingkaran, teorema phytagoras dan teselasi. Penerapan batik tradisional dalam pembelajaran matematika dapat diimplementasikan dengan menggunakan model pembelajaran kontekstual. Pembelajaran berbasis etnomatematika motif batik tradisional juga dapat meningkatkan kemampuan pemahaman konsep matematika peserta didik.

Kata Kunci: SLR; Etnomatematika Batik Tradisional; Kemampuan Pemahaman Konsep Matematis.

INTRODUCTION

Mathematics is one of the substantial areas of science to learn. Learning mathematics in school can affect the development of various mathematical abilities of students. Mathematical ability is the cognitive part of mathematics learning, which includes intellectually oriented behaviors (Fachrunnisa & Sari, 2023). The purpose of learning mathematics is to enable students to understand mathematical concepts well. But of course, there are obstacles to achieving this goal. One of the obstacles is that many educators do not use the right approach in the mathematics learning process.

Mathematics is an abstract science. Naturally, if a teacher does not use the right approach in the learning process, students will have difficulty understanding the material. The mathematics learning process requires an approach to be effective (Oktavianti et al., 2022). One approach that educators can use in teaching mathematics is ethnomathematics. Ethnomathematics is defined as mathematics in culture. D'Ambrosio argues that ethnomathematics is mathematics practiced by specific cultural groups, such as indigenous peoples, urban and rural communities, and other groups (Maharani & Maulidia, 2018). The ethnomathematics approach emphasizes contextual teaching and learning (CTL). CTL is a learning concept that invites students to connect the material they are studying with the circumstances that exist in real life (Khikmah & Sabrina, 2021). One of the objects of ethnomathematics is traditional batik (Astuti et al., 2019). Batik is a cultural heritage that characterizes the Indonesian culture (Rizqi & Lukito, 2021).

Learning mathematics with an ethnomathematical approach using traditional batik may affect students' mathematical abilities and motivation in the learning process. One of the mathematical abilities in question is the mathematical concept understanding ability (Andriani, 2020). The ability to understand mathematical concepts is the ability of students to understand concepts and to perform procedures (algorithms) precisely, accurately, and efficiently (Kesumawati, 2008). Therefore, the writing of this article aims to examine: 1) What are the mathematical concepts contained in traditional batik, 2) How is the application of traditional batik in mathematics learning, and 3) How does traditional batik influence students' mathematical concepts understanding ability. Previously, there have been studies that discuss similar topics, namely those conducted by Yolanda and Putra (Yolanda & Putra, 2022). The research only discusses mathematical concepts on batik motifs. However, in this study, there is a novelty in the form of the application of traditional batik in learning mathematics and the effect of traditional batik on students' mathematical concepts understanding ability.

RESEARCH METHODS

The method used in this research is a Systematic Literature Review (SLR). SLR is a research or development method conducted to summarize and evaluate related research findings on a specific topic (Triandini et al., 2022). The systematic review phase used in this study includes 1) Formulating research questions, 2) Searching for systematic review literature, 3) Selecting research articles that fit the topic, 4) Analyzing and synthesizing qualitative findings, 5) Reviewing the literature used, and 6) Compiling SLR articles (Siswanto, 2010).

Researchers used databases such as Google Scholar and OpenAlex to search for literature. Researchers used the keywords "batik ethnomathematics, mathematical concept understanding ability" and restricted to studies published from 2018 to 2023. The search process yielded 200 articles from Google Scholar

and 43 articles from OpenAlex. The exclusion criteria set by the researchers are as follows:

Table 1. Exclusion Criteria

Exclusion Criteria	Explanation	Example
Not on topic	This article is not related to the ethnomathematics of batik motifs.	(Dedi et al., 2021)
Not empirical	This article does not use field research.	(Yolanda & Putra, 2022)
URL not available	The article obtained from PoP does not include a URL	(Wulandari, 2023)
Discussion can't be opened	The article obtained from PoP contained a URL, but the URL can not be opened.	(Zakiyah & Malasari, 2021)
Results and discussion not on topic	This article does not discuss in detail the ethnomathematics of batik motifs, does not include pictures of batik, does not include the name and origin of batik, and does not provide further explanation of the mathematical material contained in batik.	(Farida & Susanto, 2020)
Doesn't pass the bias test	This article does not use a qualitative approach.	(Diantina et al., 2023)

The title and abstract screening process resulted in 100 articles that met the inclusion criteria. In addition, the 100 articles were read in their entirety. At this stage of screening full-text articles, researchers only accept articles whose discussions can answer the research questions and pass the bias test. This selection process resulted in 34 articles suitable for review. More details can be found in the PRISMA diagram below:

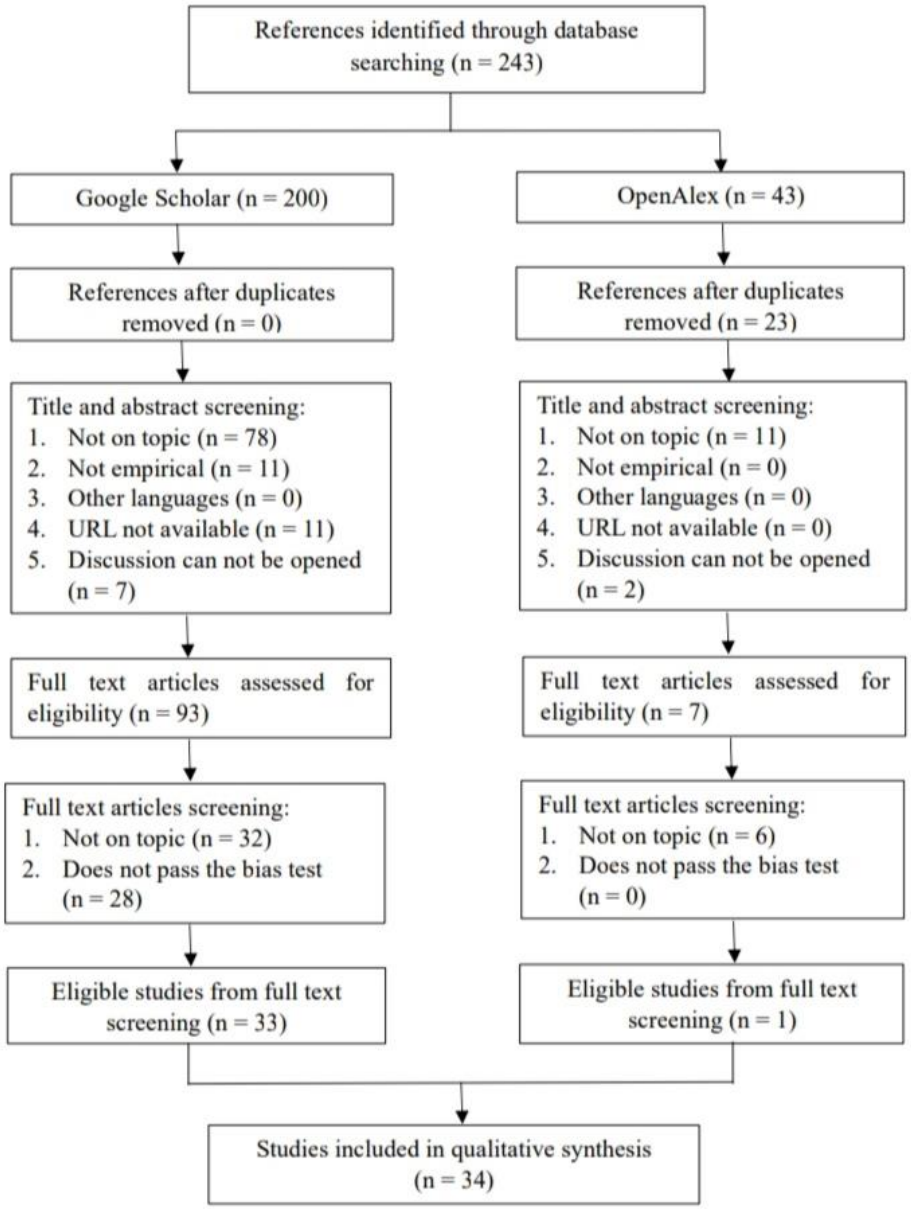

Figure 1. PRISMA Flow Diagram

RESULTS AND DISCUSSION

The research questions in this study include: 1) What are the mathematical concepts contained in traditional batik? 2) How is traditional batik used in mathematics learning? 3) How does traditional batik affect students' mathematical concepts understanding ability? The research findings from the reviewed articles and the number of research questions answered can be seen in the following table:

Table 2. Research Results Related to Ethnomathematics of Traditional Batik Motifs

Name of Researcher and Year of Publication	Research Result	Answer the Question
(Afiyana, 2022)	The results of this study showed that the ethnomathematics approach of Jlamprang batik motifs in contextual teaching and learning can improve the level of students' mathematical concept understanding ability on triangular plane shapes material.	1, 2, 3
(Andelia et al., 2022)	The results of this study showed that in Tanjung Bumi batik there are concepts of geometric transformation, including the concept of translation in the Rhombus batik motif, the concept of reflection in the Triangle batik motif, and the concept of rotation in the square batik motif.	1, 2
(Astuti et al., 2019)	The results of this study showed that there is a concept of number patterns in the motifs of Adipurwo batik. The Geblek motif and the Klanting motif form an arithmetic number pattern with a difference of 6. The Pare Leaf motif and the Clorot motif form an arithmetic number pattern with a difference of 3.	1
(Mulyani & Natalliasari, 2020)	The results of this study showed that Sukapura batik motifs incorporate the concept of geometric transformation, specifically the concepts of reflection and rotation in the Picis Leaf motif, and the concept of translation in the Kolentang motif.	1
(Sa'adah, 2022)	The results of this study showed that Kudus batik incorporates geometry concepts such as plane shapes, solid shapes, and geometric transformation.	1
(Zahroh et al., 2021)	The results of this study showed that mathematical concepts are present in the motifs of Banten batik. These concepts include congruence and circular plane shapes in the Kefakihan batik motif, reflection in the Surosowan motif, congruence and translation in the Pamarican motif, and reflection in	1

Name of Researcher and Year of Publication	Research Result	Answer the Question
	the Kesatriaan motif.	
(Sutrisno & Saija, 2021)	The results of this study showed that Lampung batik motifs are associated with function graph material. The Siger motif is associated with trigonometric, absolute value, and ln functions. The Sembagi/Cilugam motif is related to line equations and absolute value functions. The Pucuk Rebung motif is related to absolute value functions, while the Payung Agung motif is related to trigonometric, quadratic, absolute value functions, and line equations.	1
(Oktavianti et al., 2022)	The results of this study showed that the Jakarta batik motifs incorporate mathematical concepts, specifically the use of plane shapes such as squares, circles, semicircles, triangles, rhombuses, ellipses, regular pentagons, parallelograms, and trapezoids, as well as solid shapes like blocks and tubes.	1
(Rizqi & Lukito, 2021)	The results of this study showed that in Sidoarjo batik motifs there are mathematical concepts in the form of geometric transformation concepts (reflection), as well as the concept of plane shapes (rhombus and triangle) in Peacock batik motif and geometric transformation concepts (translation, rotation and reflection) as well as plane shapes (triangle and rhombus) in Shrimp and Milkfish batik motifs.	1
(Harahap & Mujib, 2022)	The results of this study showed that the Medan batik motifs incorporate mathematical concepts, specifically geometric transformations such as translation, reflection, and rotation, as well as plane shapes including squares, rectangles, triangles, circles, rhombuses, and regular hexagons.	1
(Sari et al., 2021)	The results of this study showed that the Madura batik motifs incorporate mathematical concepts. Specifically, the Wood Fiber batik motif features	1

Name of Researcher and Year of Publication	Research Result	Answer the Question
	curved lines, the Gentongan batik motif includes the straight lines, rhombuses, and angles, the Tanjung Bumi batik motif contains parallel lines, the Bangkalan batik motif incorporates congruence and triangles, the Simple batik motif features points and symmetry, and the Sampang batik motif includes circles.	
(Sulisawati et al., 2021)	The results of this study showed that the tobacco batik from Jember incorporates a mathematical concept known as geometric transformation, specifically dilation.	1
(Wulandari & Kusumah, 2022)	The results of this study showed that Trusmi batik motifs, which are typical of Cirebon, incorporate mathematical concepts, specifically the Mega Mendung motif uses the concepts of translation and dilation, the Kawung motif uses trigonometric functions and ellipses, and the Paksi Naga Liman motif uses the concept of reflection.	1
(Firdaussa et al., 2021)	The results of this study showed that traditional Banten batik patterns incorporate mathematical principles of geometric transformation, such as translation, rotation, and reflection, as well as the concept of plane shapes, including rhombuses, circles, and squares.	1
(Safitri et al., 2022)	The results of this study showed that mathematical concepts were present in Kawung batik, specifically the concepts of number patterns and arithmetic series.	1
(Syahdan, 2021)	The results of this study showed that Kawung batik motifs use the concepts of congruence and geometric transformation, including rotation, reflection, dilation, and translation.	1
(Nurmanitia et al., 2023)	The results of this study showed that the Kawung batik motifs incorporate mathematical concepts related to plane shapes, such as squares, rhombuses,	1, 2

Name of Researcher and Year of Publication	Research Result	Answer the Question
	and circles.	
(Karimah et al., 2021)	The results of this study showed that Trusmi batik motifs use the concept of geometric transformation including translation, reflection, rotation, and dilation. In addition, there is also the concept of tessellation in Trusmi batik motifs.	1
(Fachrunnisa & Sari, 2023)	The results of this study showed that Jasmine batik incorporates the concept of geometric transformation, specifically translation and rotation in the Eagle and Leaf motifs, as well as reflection in the Jasmine Flower and Leaf motifs.	1
(Yudianto et al., 2021)	The results of this study showed that the traditional Bondowoso batik pattern used geometric concepts such as congruence, points, lines, angles, and flat buildings. Additionally, the pattern also used geometric transformations in the form of translation, reflection, dilation, and rotation.	1
(Amalia et all., 2021)	The results of this study showed that the Jlamprang batik motif, typical of Pekalongan City, incorporates mathematical concepts like plane shapes, tangent circles, symmetry, reflection, and congruence.	1
(Khikmah & Sabrina, 2021)	The results of this study showed that in Jlamprang batik motifs there are mathematical concepts in the form of geometric transformations, namely reflection and translation.	1
(Lubis & Yanti, 2018)	The results of this study showed that the Bengkulu Besurek batik motif contained the concepts of equivalence and congruence.	1
(Ranti, 2022)	The results of this study showed that the Kawung batik motifs contained the concepts of equivalence, congruence, and geometric transformations.	1
(Astriandini & Kristanto, 2021)	The results of this study showed that the Surakarta Palace batik motif contains a mathematical concept, namely the symmetry pattern.	1

Name of Researcher and Year of Publication	Research Result	Answer the Question
(Yanti & Haji, 2019)	The results of this study showed that the Bengkulu Besurek batik motif contains the concept of geometric transformation, including reflection, translation, rotation, and dilation.	1
(Nirmalasari & Sampoerno, 2021)	The results of this study showed that the Cikadu Pandeglang batik motif contains the concept of pythagoras theorem.	1
(Khalisah & Nalim, 2022)	The results of this study showed that the Pekalongan batik motifs contain the concept of equivalence, equation of the straight lines, plane shapes, and geometric transformation.	1
(Ida et al., 2022)	The results of this study showed that Pandeglang Berkah batik motifs contain the concept of plane shapes, angles, equivalence, congruence, and geometric transformation.	1
(Surtini et al., 2022)	The results of this study showed that Banten Batik motifs incorporate concepts of plane shapes and geometric transformations (reflection and translation).	1
(Humaeroh et al., 2022)	The results of this study showed that in the Nusantara batik motifs there is a concept of plane shapes, namely Tumpal batik motifs with triangular shapes, Kawung batik motifs with circular shapes, and Tambal batik motifs with square shapes.	1
(Amirah & Budiarto, 2022)	The results of this study showed that Sekardangan batik motifs contain the concept of geometric transformation concepts (reflection, translation, dilation) and plane shapes concepts (rectangles and triangles).	1
(Susanti & Budiarto, 2020)	The results of this study showed that Jonegoroan batik motifs incorporate concepts of geometric transformations, plane shapes, and trigonometric function graphs.	1

Mathematical Concepts in Traditional Batik Motifs

From the 34 articles reviewed, the mathematical concepts found in traditional batik motifs include the concepts of plane shapes, solid shapes, points, lines and angles, relationships between lines, equivalence, congruence, symmetry, geometric transformations, number patterns, trigonometric functions, function graphs, equation of the straight line, tangent circles, Pythagoras theorem, and tessellation. See the table below for more details:

Table 3. Mathematical Concepts of Traditional Batik Motifs

Name of Researcher and Year of Publication	Batik Motif	Mathematical Concepts
(Afiyana, 2022)	Jlamprang Batik Motif	Plane Shapes
(Andelia et al., 2022)	Tanjung Bumi Batik Motif	Geometric Transformation
(Astuti et al., 2019)	Adipurwo Batik Motif	Number Pattern
(Mulyani & Natalliasari, 2020)	Sukapura Batik Motif	Geometric Transformation
(Sa'adah, 2022)	Kudus Batik Motif	Plane Shapes, Solid Shapes, Geometric Transformation
(Zahroh et al., 2021)	Banten Batik Motif	Plane Shapes, Congruence, Geometric Transformation
(Sutrisno & Saija, 2021)	Lampung Batik Motif	Function Graph
(Oktavianti et al., 2022)	Jakarta Batik Motif	Plane Shapes
(Rizqi & Lukito, 2021)	Jetis Sidoarjo Batik Motif	Plane Shapes, Geometric Transformation
(Harahap & Mujib, 2022)	Medan Batik Motif	Plane Shapes, Geometric Transformation
(Sari et al., 2021)	Madura Batik Motif	Plane Shapes, Line and Angle, Relationships Between Lines, Symmetry
(Sulisawati et	Tobacco Batik	Geometric Transformation

Name of Researcher and Year of Publication	Batik Motif	Mathematical Concepts
al., 2021)	Motif	
(Wulandari & Kusumah, 2022)	Trusmi Batik Motif	Geometric Transformation, Trigonometric Function, Plane Shapes
(Firdaussa et al., 2021)	Banten Batik Motif	Plane Shapes, Geometric Transformation
(Safitri et al., 2022)	Kawung Batik Motif	Number Pattern
(Syahdan, 2021)	Kawung Batik Motif	Equivalence and Congruence, Geometric Transformation
(Nurmanitia et al., 2023)	Kawung Batik Motif	Plane Shapes
(Karimah et al., 2021)	Trusmi Batik Motif	Geometric Transformation, Tessellation
(Fachrunnisa et al., 2023)	Jasmine Batik Motif	Geometric Transformation
(Yudianto et al., 2021)	Bondowoso Batik Motif	Point, Angle, Line, Plane Shapes, Equivalence and Congruence, Geometric Transformation
(Amalia et all., 2021)	Jlamprang Batik Motif	Plane Shapes, Reflection and Symmetry, Tangent Circles, Equivalence and Congruence
(Khikmah & Sabrina, 2021)	Jlamprang Batik Motif	Geometric Transformation
(Lubis & Yanti, 2018)	Besurek Batik Motif	Equivalence and Congruence
(Ranti, 2022)	Kawung Batik Motif	Equivalence and Congruence, Geometric Transformation
(Astriandini & Kristanto, 2021)	Surakarta Palace Batik Motif	Symmetry
(Yanti & Haji, 2019)	Besurek Batik Motif	Geometric Transformation
(Nirmalasari & Sampoerno, 2021)	Cikadu Pandeglang Batik Motif	Pytagoras Theorem
(Khalisah &	Pekalongan	Equivalence, Equation of the Straight

Name of Researcher and Year of Publication	Batik Motif	Mathematical Concepts
Nalim, 2022)	Batik Motif	Lines, Plane Shapes, Geometric transformation
(Ida et al., 2022)	Padeglang Berkah Batik Motif	Angle, Plane Shapes, Equivalence and Congruence, Geometric Transformation
(Surtini et al., 2022)	Banten Batik Motif	Plane Shapes, Geometric Transformation
(Humaeroh et al., 2022)	Tumpal Batik Motif, Kawung Batik Motif, Tambal Batik Motif	Solid Shapes
(Amirah & Budiarto, 2022)	Sekardangan Batik Motif	Plane Shapes, Geometric Transformation
(Susanti & Budiarto, 2020)	Jonegoroan Batik Motif	Geometric Transformation, Plane Shapes, Graphs of Trigonometric Functions

Based on this table, the most common mathematical concepts found in traditional batik designs are the concept of plane shapes and the concept of geometric transformations. The reason is that almost every traditional batik motif has elements in the form of regular plane shapes. In addition, the pattern of repetition of motifs carried out during the traditional batik making process also results in many geometric transformation concepts.

The Application of Traditional Batik in Mathematics Learning

From the 34 articles reviewed, there are studies that only examine the mathematical concepts in traditional batik motifs without implementing them in classroom mathematics learning. There are only 3 studies that implement the ethnomathematics traditional batik motifs in classroom learning, can be seen in the Table 4.

Based on this table, ethnomathematics of traditional batik motifs can be implemented in mathematics learning for elementary, junior high, and high school

students. Ethnomathematics can increase student's motivation and responsiveness. Ethnomathematics can also minimize student's boredom with learning mathematics (Sa'adah, 2022). Thus, ethnomathematics-based learning can be an interesting learning alternative for students.

Table 4. The Application of Traditional Batik in Mathematics Learning

Name of Researcher and Year of Publication	Batik Motif	Application in Mathematics Learning
(Afiyana, 2022)	Jlamprang Batik Motif	Applied to class VII A at SMP NU Karangdadap Pekalongan when learning triangle material
(Andelia et al., 2022)	Tanjung Bumi Batik Motif	Applied to class XII IPA 4 at SMAN 1 Ketapang when learning geometric transformation material
(Nurmanitia et al., 2023)	Kawung Batik Motif	Applied to class IV at SDN 1 Kiringan Klaten when learning the material of the perimeter and area of plane shapes

Based on the articles reviewed by the researchers, traditional batik can be implemented in learning mathematics through contextual teaching and learning (CTL). CTL is a learning method that connects the learning materials with real-life situations (Abi, 2017). In its application, contextual teaching and learning can include objects related to the student's environment, including traditional batik. The components of the CTL model (Ruwaidah, 2022), which include:

1) Constructivism

   Constructivism is an approach to learning that focuses on the active, creative, and productive shaping of understanding based on meaningful learning experiences that have occurred previously.

2) Inquiry

   Inquiry is an approach to learning that focuses on the process of search and discovery. This activity begins with observation of phenomena and then continues with meaningful activities so that students can produce findings independently.

3) Questioning

   Asking questions reflects the curiosity that exists in every individual. In CTL learning, educators not only provide information, but also encourage learners to find information independently.

4) Learning community

   Learning community is the result of learning from interdisciplinary cooperation with various parties, such as friends, other groups, and various sources of information, not only from the teacher. The concept of learning community in CTL suggests that learning outcomes are achieved through synergistic cooperation with related parties.

5) Modelling

   Modeling is learning that uses concrete examples that students can imitate. Learning is more effective when props are used.

6) Reflection

   Reflection is a process of reviewing or reconstructing learning experiences that students have had. At the end of the contextual learning process, educators provide opportunities for students to recall and review the material they have learned.

7) Authentic assessment

   Authentic assessment is a way for educators to obtain information about student learning processes and outcomes through various assessment techniques. Authentic assessment is used to help educators determine the level of understanding and the impact of learning experiences on students. In essence, contextualized learning emphasizes the learning process rather than student learning outcomes.

The Effect of Ethnomathematics of Traditional Batik Motifs on Students' Mathematics Concept Understanding Ability

From the 3 articles that implement ethnomathematics of traditional batik motifs in classroom mathematics learning, there is only 1 article that examines the effect of traditional batik ethnomathematics on students' mathematical concept understanding ability, namely the research conducted by Afiyana (Afiyana, 2022) which examines the ethnomathematics of Jlamprang batik motifs. The results showed that after using contextual learning with an ethnomathematical approach to Jlamprang batik motifs on triangular flat building material, the students' concept understanding ability increased from the post-test results compared to the pre-test results. The pre-test results showed that the overall concept understanding ability was 47.27%, while the post-test results showed that the overall concept understanding ability was 65.38%.

Based on this, it is evident that using traditional batik motifs in ethnomathematics can help students understand mathematical concepts. Sarwoedi et al.'s previous research has shown that an ethnomathematics approach to mathematics learning activities is highly effective in improving students' mathematical understanding. This is supported by the fulfillment of all the indicators of the student's ability to understand the concepts (Sarwoedi et al., 2018). Therefore, it can be concluded that learning activities utilizing the ethnomathematics approach of traditional batik motifs can positively impact students' ability to understand concepts.

CONCLUSION

Based on the results and discussion above, traditional batik motifs incorporate mathematical concepts such as plane shapes, solid shapes, points, lines and angles, relationships between lines, equivalence, congruence, symmetry, geometric transformations, number patterns, trigonometric functions, function graphs, equation of the straight line, tangent circles, Pythagoras theorem, and tessellation. Using traditional batik in teaching and learning mathematics can be facilitated through contextualized learning models. The study suggests that

learning traditional batik motifs through ethnomathematics can enhance students' understanding of mathematical concepts. The findings have positive implications for educators and other stakeholders. This research aims to increase educators' awareness of the various mathematical concepts present in traditional batik motifs, the application of traditional batik in mathematics learning, and the effect of traditional batik ethnomathematics on students' understanding of mathematical concepts. The research is expected to serve as a reference for educators in implementing ethnomathematics-based learning, particularly those related to traditional batik motifs. Further research can examine the effect of traditional batik motifs on students' mathematical concept understanding abilities in the context of ethnomathematics. Currently, there is a lack of research on this matter.

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