

## **Development Mathematics Realistic Education Worksheet Based on Ethnomathematics in Elementary School**

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### **Abstract**

Learning mathematics at the elementary school level is an interesting thing to research. This is due to the mathematical material that requires children to reason mathematically. Many learning models are introduced to students, but are not in accordance with the surrounding cultural conditions. Culture is something that is close and real in students' lives so that culture-based learning will be easily accessible to students. This study aims to develop worksheets with a realistic mathematical approach based on ethnomathematics on the material of triangular flat shapes at the elementary school level that are feasible, namely meeting the criteria, being practical, and effective. LKS developed using ethnomathematical elements in the form of Pekalongan batik. This research is a research and development research which includes definition, design, development, and dissemination. The development method used is the 4D method which includes define, design, develop, and distribute. Data collection techniques were carried out using observation, interviews, questionnaires, tests, and documentation methods. The results of this study indicate that LKS with ethnomathematical-based realistic mathematics learning that has been developed is feasible to use because it meets the valid criteria with a validation percentage of 78.1%, meets practical criteria based on interviews with teachers, and meets effective criteria with an average score learning outcomes 80 which are included in the good category.

**Kata kunci:** *realistic mathematics education, ethnomathematics*

## **Pengembangan LKS dengan Pembelajaran Matematika Realistik Berbasis Etnomatematika Pada Siswa Sekolah Dasar**

### **Abstrak**

Pembelajaran matematika di tingkat sekolah dasar merupakan hal yang menarik untuk diteliti. Hal ini disebabkan karena materi matematika yang menuntut anak bernalar secara matematis. Banyak model pembelajaran yang dikenalkan kepada siswa, akan tetapi tidak sesuai dengan kondisi budaya sekitar. Budaya merupakan sesuatu yang dekat dan nyata dalam kehidupan siswa sehingga pembelajaran matematika berbasis budaya akan mudah dipahami oleh siswa. Penelitian ini bertujuan untuk mengembangkan LKS dengan pendekatan matematika realistik berbasis etnomatematika pada materi bangun datar segitiga di jenjang sekolah dasar yang layak yaitu memenuhi kriteria valid, praktis, dan efektif. LKS yang dikembangkan menggunakan unsur etnomatematika berupa batik khas Pekalongan. Penelitian ini

merupakan penelitian *research and development* yang meliputi pendefinisian, perancangan, pengembangan, dan penyebaran. Metode pengembangan yang digunakan adalah metode 4D yang meliputi *define, design, develop, dan disseminate*. Teknik pengumpulan data dilakukan dengan metode observasi, wawancara, kuesioner, tes, dan dokumentasi. Hasil penelitian ini menunjukkan bahwa LKS dengan pembelajaran matematika realistik berbasis etnomatematika yang telah dikembangkan layak digunakan karena telah memenuhi kriteria valid dengan persentase skor validasi sebesar 78,1%, memenuhi kriteria praktis berdasarkan wawancara dengan guru, dan serta memenuhi kriteria efektif dengan rata-rata nilai hasil belajar 80 yang mana termasuk dalam kategori baik.

**Kata kunci:** etnomatematika, pendidikan matematika realistik

## INTRODUCTION

Mathematics is one of the disciplines that has an important contribution to the development of science and technology. Learning mathematics can improve the quality of human resources either directly or indirectly. Learning mathematics has the aim that students (1) have knowledge of mathematics (2) use reasoning (3) solve problems (4) communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems and (5) have an attitude of appreciating usefulness mathematics. However, at this time the objectives of learning mathematics have not been achieved optimally. The process of learning mathematics is not based on things that are realistic, causing low understanding of mathematical concepts in students.

Realistic mathematics learning is learning based on real things found in the context of students' daily lives that can improve understanding of mathematical concepts (Tanjung 2019). In learning, students are not just passive recipients of ready-made mathematical material, but students need to be given the opportunity to construct mathematical concepts through their own experience (Susanto 2013). According to Gravemeijer, there are three main principles in realistic mathematics education, namely guided reinvention and progressive mathematization, didactical phenomenology, and self-developed models (Elpina, Syarifuddin, and Yerizon 2020).

Understanding concepts through realistic mathematics learning using real or real media, one of which is culture. Learning mathematics by involving elements or concepts of regional culture is referred to as ethnomathematics. In its implementation, ethnomathematics is mathematics practiced by cultural groups, labor groups, rural and urban community groups, children of a certain age and other communities (D'Ambrosio 1985).

In the modern era like today where everything is digital-based, it indirectly impacts the consistency of regional culture. The younger generation who should be the cultural heirs who have the duty to preserve culture have minimal knowledge of regional culture and feel indifferent. One solution to introduce local culture is through learning mathematics that involves local culture (Rohayati, S., Karno, W., & Chomariyah 2017). Through ethnomathematics-based realistic mathematics learning, it encourages students to find mathematical concepts in a cultural context. Realistic integration between mathematical concepts and regional cultural elements fosters a sense of cultural love and the achievement of learning goals in mathematics.

One of the cultures in the city of Pekalongan is wearing batik. Pekalongan is one of the batik-producing cities, so Pekalongan is dubbed the city of batik. There are various batik motifs in the city of Pekalongan, one of which is the Rifa'iyah batik motif. Rifa'iyah batik is written batik created and produced by rifa'iyah Islamic community organizations based in Batang district. The pelo ati and kawung beard motifs on rifa'iyah batik contain elements or mathematical concepts of triangular flat shapes. The uniqueness in the manufacturing process and the philosophy that underlies the formation of various rifa'iyah batik motifs are very interesting to study. One of the mathematical concepts contained in the rifa'iyah batik motif is a flat triangle. In Islamic religious philosophy, the triangle symbol is related to the transcendent nature, or what in Arabic is called musalas. This triangle symbol explains the level of understanding of a Muslim towards Islam, namely sharia (worldly), essence (balance between the world and the hereafter) and marifat (prioritizing Heaven) (Dyah 2007). The triangle symbol also means the balance of human life, this meaning is found in the triangle symbol found in the Soko Tunggal mosque. The balance of human life means that humans must always maintain the relationship between human beings (hablum minannas), humans and the universe (hablum minal alam) and maintain the relationship between humans and the Creator or Allah SWT (hablum minallah) (Putra, Wijayanto, and Widodo 2020 ).

Mathematics learning with a realistic mathematical approach based on ethnomathematics with the cultural object of rifa'iyah batik motifs is a solution to improve mathematics learning outcomes. This is in line with Khairida's research (2019) which states that the application of an ethnomathematical-based learning approach can significantly increase students' interest in learning and students' cognitive aspects. In

addition, research conducted by Widyastuti & Pujiastuti (2014) which gives the result that there is a positive effect of learning mathematics with PMRI on students' logical thinking than Direct Instruction for fifth grade elementary school students in cluster II Umbulharjo District, Yogyakarta City.

Furthermore, to carry out mathematics learning Mathematics with an ethnomathematical-based realistic approach to mathematics requires learning tools, especially in the form of Student Worksheets (LKS) that use an ethnomathematical-based realistic approach to mathematics. Student worksheets are one of the teaching materials that are often used by teachers to support mathematics learning. The use of worksheets in learning mathematics can increase student involvement and activeness in the teaching and learning process (Darmodjo and Kaligis 1992). Student worksheets or worksheets contain material, practice questions, practicum, and instructions and steps in finding material concepts. Learning mathematics using worksheets has various benefits, including making it easier for teachers to manage learning and directing students in discovering the concepts of the material being studied, besides that worksheets can also monitor student learning success and develop student process skills in learning mathematics. The process of learning mathematics with worksheets requires student collaboration in completing assignments. A good LKS is a realistic LKS. Realistic in question is the media used to introduce the concept of the material. With the ethnomathematics-based worksheets, it is very possible to present realistic mathematics learning with cultural artifacts as learning media. However, currently there is no LKS with realistic mathematics learning based on ethnomathematics with the theme of Pekalongan batik. Therefore, it is necessary to develop mathematics worksheets with a realistic mathematical approach based on ethnomathematics with the theme of Pekalongan batik, which can be applied to triangular flat shapes.

The purpose of this research is to develop mathematics worksheets with a realistic mathematical approach based on ethnomathematics on proper triangular shapes at the elementary school level. Based on the background of the problem, the researcher is interested in conducting research with the title "Development of LKS with a realistic mathematical approach based on ethnomathematics for elementary school students".

## **RESEARCH METHODS**

The type of research used is research and development. Researchers developed ethnomathematical-based math worksheets using rifa'iyah batik motifs. LKS development uses a 4D model developed by Thiagarajan (1974) which includes define, design, develop, and disseminate. This model was chosen because the steps of the 4D model are quite simple but detailed and systematic. In the first stage, namely the define stage, a needs analysis was carried out in developing LKS, namely conducting an ethnomathematical study of rifa'iyah batik, analysis of the 2013 curriculum at the elementary school level. In the design stage, the design of the ethnomathematics-based mathematical worksheets was carried out with a realistic mathematical approach. Furthermore, at the develop stage, an expert assessment is carried out to produce products that are suitable for use as a mathematics learning tool. Finally, in the disseminate stage, the product development result (LKS) is disseminated. At this stage, the effectiveness of the product being developed is also measured.

The research was conducted at SDIT Ulul Albab Pekalongan City. The object of the research was the VD class students which consisted of 11 students. This is because SDIT Ulul Albab is still conducting limited face-to-face learning. Data collection techniques were carried out by questionnaires, interviews, and tests. Questionnaires are used to determine the validity of the worksheets that have been developed. Validation was carried out by three experts. Interviews were used to determine the practicality of the LKS and were conducted on two teachers who had used the LKS. Meanwhile, the test is used to determine the effectiveness of the LKS. The form of the question used is a description of 5 questions.

The data analysis technique was carried out by descriptive analysis. Descriptive analysis was carried out on the product validation data and the value of students' mathematics learning outcomes. LKS is said to be effective if the average value of students' mathematics learning outcomes is included in the good category.

## **RESULTS AND DISCUSSION**

The LKS developed has gone through 4 stages according to the 4D model which includes define, design, develop, and disseminate. In the define stage, the researcher conducted an analysis of the 2013 curriculum at the elementary school level. Curriculum

analysis includes syllabus analysis, lesson plans, and observations of mathematics learning at the elementary school level. Based on the results of the curriculum analysis, the results of the triangular flat shape material, namely the circumference and area of the triangular flat shape as the material used for research. In addition to curriculum analysis, researchers conducted an ethnomathematical study on rifa'iyah batik. There are many rifa'iyah batik motifs produced, but the peloati motif is chosen as a cultural object or artifact. This is because the pelo ati motif has a shape that resembles a flat triangle.

At the design stage, the researcher made a Student Worksheet (LKS) learning device which contained the principles of realistic mathematics learning, namely guided reinvention, didactical phenomenology, and self-developed models. Guided reinvention means that in learning students are given the opportunity to rediscover mathematical concepts such as the process that was previously discovered. This means that students are not immediately given a concept, but find a concept. On the principle of didactical phenomenology, it means that the situation given to students is based on phenomena that exist in real life that are close to students and then brought into formal mathematics. Meanwhile, the principle of self-developed model means that students are given the opportunity to develop their own model into formal knowledge.

The worksheet developed is on triangle material which includes the area and circumference of a triangle. The ethnomathematical elements used are rifa'iyah batik with pelo ati and kawung beard motifs. The results of the ethnomathematical worksheet design that have been made on the material around the triangle are as follows.

Satuan Pendidikan	: SD/MI
Kelas/Semester	: 1V/II
Mata Pelajaran	: Matematika
Pokok Bahasan	: Bangun Datar Segitiga
Sub Pokok Bahasan	: Keliling dan Luas segitiga

✦ **Kompetensi Dasar**  
3.9 Menjelaskan dan menentukan keliling dan luas daerah bangun datar persegi, persegi panjang, dan segitiga.

✦ **Indikator**  
3.9.6 Menganalisis cara menghitung dan menentukan keliling segitiga  
3.9.7 Menganalisis cara menghitung dan menentukan luas segitiga

✦ **Tujuan Pembelajaran**  
1. Siswa dapat menemukan konsep keliling segitiga  
2. Siswa dapat menyelesaikan masalah sehari-hari terkait menentukan keliling segitiga  
3. Siswa dapat menyelesaikan masalah sehari-hari terkait menentukan luas segitiga

✦ **Petunjuk Belajar**  
1. LKS terdiri dari beberapa kegiatan yang terkait menentukan keliling segitiga  
2. Setiap kegiatan harus dilakukan secara berurutan sesuai langkah-langkah yang terdapat di LKS  
3. Siswa diberikan kebebasan menggunakan berbagai cara untuk menyelesaikan setiap kegiatan

Figure 1. Title of Learning Materials and Learning Objectives in LKS

The main topics and sub-topics are written in the LKS. In addition, LKS also contains basic competencies, indicators, learning objectives, and learning instructions.

Tahukah kamu ?



Gambar 1. Nyah Pratin



Gambar 2. Kawung Jenggot



Gambar 3. Pelo Ati

**Batik rifa'iyah merupakan salah satu jenis batik tulis di kota pekalongan. Batik ini mempunyai banyak motif yang mengandung unsur berbagai macam bangun datar, salah satunya bangun datar segitiga. Motif tersebut antara lain kawung jenggot, nyah pratin, dan pelo ati. Setiap motif mempunyai makna tersendiri. Seperti motif nyah pratin yang memiliki makna prihatin. Biasanya motif nyah pratin digunakan ketika ada orang yang meninggal dunia.**

Figure 2. Knowledge of Rifa'iyah Batik

In the “Did you know?” As shown in Figure 2, it is introduced to the batik motifs in Pekalongan which contain a triangular shape. This section aims to provide students with an overview of the typical Pekalongan batik motifs and their meanings

**A. Keliling Segitiga**

*Guided Reinvention & Didactical Phenomenology*

**Kegiatan 1 Menentukan Konsep Keliling Segitiga**

**Alat dan Bahan**

1. 1 lembar kain motif batik pelo ati
2. Penggaris
3. Alat tulis

**Langkah-Langkah**



Figure 3. Principles of Guided Reintervention and Didactical Phenomenology

In each material there are principles of guided reinvention and didactical phenomenology as shown in Figure 3, which is contained in the material around the triangle. This principle is the principle of realistic mathematics education.

*Self Developed Model*

5. Berdasarkan langkah 1 sampai 4, tentukan rumus dari keliling segitiga.

Jawab:

6. Apakah rumus tersebut berlaku untuk jenis segitiga yang lain (segitiga sama sisi, segitiga sama kaki, ataupun segitiga sembarang)? Jelaskan!


Figure 4. Principle of Self-developed Model

In addition to the principles of guided reinvention and didactical phenomenology, the principle of self-developed model is also contained in each material. This principle and the previous principle appear in every activity. Figure 4 shows the principle of the self-developed model in Activity 1.

**Ayo Berlatih 1**

**Kerjakan soal berikut dengan baik dan benar dengan cara kalian sendiri.**

1. Perhatikan gambar motif kawung jenggot di bawah ini.



Panjang sisi alas segitiga pada batik motif kawung jenggot tersebut adalah 10 cm dan keliling segitiga tersebut adalah 64 cm. Jika segitiga pada motif tersebut merupakan segitiga sama kaki, maka berapakah panjang kedua sisi lain yang ada pada segitiga?

Figure 5. Practice Questions on LKS

At the end of each material, there is a “Let's practice” section as shown in Figure 5. This section contains practice questions for each material.



The next stage is the development stage. At this stage, validation of the LKS and revision of the LKS are carried out based on suggestions from the validator. The validity of the LKS that has been developed is carried out by two material experts with mathematics expertise and a media expert with mathematics education expertise and one media expert. After the validity scores of each validator are known, then the percentage of each aspect is calculated and categorized based on Table 1 (Ardiansyah, Sari, and Hamidah 2021).

Table 1. Criteria for Eligibility Level of Teaching Materials

Score Percentage	Criteria for Validity/Eligibility
$25\% \leq P < 50\%$	Not feasible
$50\% \leq P < 70\%$	Decent enough
$70\% \leq P < 85\%$	Worthy
$85\% \leq P \leq 100\%$	Very Worthy

The percentage of expert validation scores on LKS that have been developed from each validator are as follows:

Table 2. Expert Validation Results

Validator	Aspects of Completeness of LKS Components	Aspects of Presentation Accuracy	Aspects of the Suitability of LKS with Ethnomathematical-based realistic learning	Aspects of Feasibility of the Language Used	Percentage
Validator 1	76%	75%	80%	84%	78,5%
Validator 2	84%	70%	76,7%	76%	76,7%
Validator 3	88%	75%	76,7%	76%	78,9%
Average	82,67%	73,3%	77,78%	78,67%	78,1%

Based on the validation results from the three experts in Table 2, it is known that each LKS has an average score of more than 70%. Based on Table 1, each aspect is included in the feasible category. In addition, the average total percentage of 78.1% is also included in the feasible category.

The last stage is the disseminate stage. Worksheets that have been validated and declared feasible are then distributed, one of which is given to SD IT Ulul Albab to then be tested for practicality and effectiveness. After the worksheets were used, two teachers who had applied the worksheets in class revealed that the worksheets were interesting because they used objects that were close to students' daily lives, namely Pekalongan batik. Then, LKS supports students to actively carry out activities and build their knowledge because in LKS there is an "Activity" section that asks students to do triangle

concept activities. In addition, worksheets are easy to apply. This shows that the LKS meets the practical.

After students carry out mathematics learning with a realistic learning model based on ethnomathematics, students are asked to work on a learning outcome test consisting of 5 questions. The test scores of students' mathematics learning outcomes were then categorized based on Arikunto's (2007) category. The following is the categorization of students' mathematics learning outcomes test scores, in table 3 below:

Table 3. Categorization of Student Mathematics Learning Outcomes Test Scores

Interval	Category	Frequency
$85 \leq X \leq 100$	Very well	6
$70 \leq X < 85$	Well	3
$55 \leq X < 70$	Enough	2
$40 \leq X < 55$	Not enough	0
$X < 40$	Less once	0

Meanwhile, the description of student learning outcomes test scores can be seen in Table 4.

Table 4. Description of the Value of Mathematics Learning Outcomes

	Score
Average	80
Maximum Value	95
Minimum value	55
Standard deviation	12.64911

Based on Table 4, it is known that the average score of students' mathematics learning outcomes is 80. This value is in the good category. So that the developed worksheets meet the effectiveness criteria.

Based on the explanation of the results of the study, it can be concluded that the ethnomathematics-based LKS learning device product by carrying the Pekalongan batik motif culture is valid, practical, and effective. This means that LKS with ethnomathematical-based realistic learning is feasible to use. Sholihah et al (2021) stated that in Jetis Sidoarjo batik there are geometric concepts such as the concept of straight lines, curves, triangles, quadrilaterals, and the concept of symmetry. Likewise in the Pekalongan batik pattern, one of which contains the concept of a triangle so that batik can be used as a medium of learning, especially in elementary schools. At the elementary level, students are introduced to the basic concepts of triangles. This introduction process should use objects that are close to students' lives and involve the cultural context that exists in the student's environment so that students do not feel that the concepts introduced

are difficult or abstract. Through realistic mathematics learning students can explore their knowledge through ethnomathematical problems. The results of this study are in line with the results of research by Widodo (2014) which strengthens the opinion that realistic mathematics learning and ethnomathematics-based learning are effectively applied in mathematics learning. In addition, the results of this study are also in line with research conducted by Rosida & Taqwa (2018) which concluded that learning tools with an ethnomathematical approach based on local culture are effective in terms of learning outcomes and research by Irawan et al (2022) regarding the ethnomathematics of Javanese traditional batik as a learning medium. mathematician who concluded that batik can be used as a medium for learning mathematics, especially in geometry transformation material and can also be used as a medium to instill character education in students.

## CONCLUSION

Realistic mathematics learning model based on ethnomathematics in elementary schools can be implemented with the help of worksheets that contain guided reinvention, didactical phenomenology, and self-developed models with ethnomathematical-based materials in the form of batik typical of Pekalongan. The worksheets that have been developed have been valid, practical, and effective in terms of students' mathematics learning outcomes so that the worksheets are feasible to use.

Based on the results of the study, the researchers suggested that SD/MI teachers could use a realistic mathematical approach based on ethno-mathematics with a batik theme to optimize students' mathematics learning outcomes on triangle material. For further research, it can be explored more deeply the use of a realistic mathematical approach based on ethno-mathematics with the theme of batik for other materials.

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