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# DEVELOPMENT OF ETHNOMATHEMATICS-FILLED PICTURE STORYBOOKS AS A MEDIUM FOR LEARNING MATHEMATICS IN ELEMENTARY SCHOOLS

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**ABSTRACT**
This study resulted in a product in the form of a picture storybook infused with ethnomathematics as a learning medium for mathematics, specifically on the topic of three-dimensional shapes in fifth-grade elementary school. The novelty of this research lies in the integration of ethnomathematics within the picture storybook, which not only introduces mathematical concepts but also familiarizes students with local cultural richness relevant to mathematics learning in elementary school. This study employed the Research and Development (R&D) method combined with the ADDIE development model. Data collection techniques included interviews, observations, and questionnaires administered to teachers and students. The collected data comprised both qualitative and quantitative data. Data analysis was conducted using qualitative descriptive analysis for qualitative data and descriptive statistical analysis for quantitative data. The validity test results indicated that the material validation achieved a percentage of 80%, categorized as "valid"; design and layout validation reached 98.67%, categorized as "highly valid"; language validation scored 88.75%, categorized as "highly valid"; and ethnomathematics validation attained 96%, also categorized as "highly valid." The practicality test results demonstrated that the developed product was highly practical, with teacher evaluations scoring 90.67% and student evaluations scoring 91.24% in the first cycle. In the second cycle, teacher evaluations reached 93.33%, and student evaluations reached 92%, both categorized as "highly practical." These findings indicate that the ethnomathematics-based picture storybook meets the criteria of validity and practicality, making it suitable for use in *elementary mathematics learning.*
Keywords: development; ethnomathematics; learning media; picture storybook.

***ABSTRAK***
*Penelitian ini menghasilkan sebuah produk berupa buku cerita bergambar bermuatan etnomatematika sebagai media pembelajaran matematika pada materi sifat – sifat bangun ruang di kelas V Sekolah Dasar. Temuan kebaruan dalam penelitian ini adalah integrasi etnomatematika dalam buku cerita bergambar yang tidak hanya memperkenalkan konsep matematika, tetapi juga memperkenalkan kekayaan budaya lokal yang relevan dengan pembelajaran matematika di SD. Penelitian ini menggunakan metode Research and Development yang dipasangkan dengan model pengembangan ADDIE. Teknik pengumpulan data yang digunakan meliputi wawancara, observasi, dan angket yang diberikan kepada guru dan siswa. Data yang dikumpulkan berupa data kualitatif dan kuantitatif. Analisis data dilakukan dengan menggunakan analisis deskriptif kualitatif untuk data kualitatif dan analisis statistik deskriptif untuk data kuantitatif. Hasil uji kevalidan produk menunjukkan pada validasi materi mendapatkan persentase sebesar 80% tergolong "valid"; validasi desain dan layout sebesar 98,67% tergolong "sangat valid"; validasi kebahasaan sebesar 88,75% tergolong "sangat valid"; dan validasi etnomatematika sebesar 96% tergeolong "sangat valid". Hasil uji kepraktisan produk yang dikembangkan sangat praktis dengan penilaian dari guru sebesar 90,67% dan oleh siswa sebesar 91,24% pada siklus pertama; sementara pada siklus kedua, penilaian*

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*dari guru sebesar 93,33% dan oleh siswa sebesar 92% tegolong "sangat parktis". Hasil penelitian ini menunjukkan bahwa buku cerita bergambar bermuatan etnomatematika yang dikembangkan memenuhi kriteria valid dan praktis serta layak digunakan.*
***Kata kunci**: buku cerita bergambar; etnomatematika; media pembelajaran; pengembangan.*



## Introduction

Education and culture are two aspects that cannot be separated in everyday life. Education is a basic need for society, while culture is an integral unit that applies in social life (Ayuningtyas & Setiana, 2019; Rahayu *et al*., 2019). Education contains cultural elements that are passed down from one generation to another, so that it continues to exist even though the times continue to develop. Education is not only a medium for conveying knowledge, but also a place to shape individual character by incorporating cultural elements in the learning process (Sutarto *et al*., 2021). Education provides opportunities for students to learn various sciences, including an understanding of the local culture around where they live (Rahmah, 2013). One aspect of education that is closely related to culture is mathematics, which is integrated in various cultural practices of society (Muhtadi *et al*., 2017). Therefore, an approach is needed that can connect mathematics with students' real lives, such as the ethnomathematics approach (Charmila *et al*., 2016). At the basic education level, especially in elementary schools (SD), the integration between mathematics and daily life is very important to strengthen understanding of mathematical concepts. In this context, ethnomathematics can act as a bridge between culture and education, especially in the field of mathematics (Wahyuni *et al.*, 2013).

Some studies show that the ethnomathematics approach is important because it can connect mathematical concepts with the culture and environment around students, so it has great potential to improve students' understanding and motivation to learn (Khaerani *et al*., 2024). Thus, ethnomathematics can be interpreted as mathematics that grows in a particular cultural context. However, mathematics is often taught as a discipline that is separate from everyday life (Rosa & Orey in Pathuddin *et al*., 2021). As a result, students tend to perceive mathematics as a subject that is difficult to understand and relate to their experiences (Siregar, 2017). In line with Pratiwi & Pujiastuti (2020) mentioned that math is considered a scary and boring subject because it is just counting and playing with numbers or confusing formulas. In addition, learning mathematics in elementary schools tends to use monotonous methods, lack of variety, and do not utilize innovative learning media, so that students have difficulty in understanding mathematical concepts, especially in the material of the properties of spatial shapes that require visual and concrete understanding (Unaenah *et al*., 2020).

The utilization of learning media based on picture storybooks has been proven effective in improving student understanding (Ratnasari & Zubaidah, 2019). According to Rahmah *et al*., (2023) , the use of picture storybooks as learning media can attract attention, especially elementary school students because they really like the look. Farenda (in Rosyana *et al*., 2021) , states that picture storybooks are very

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suitable for use in the learning process because they can encourage students' understanding of the meaning of the stories they read.

Mitchell (in Nurgiyantoro, 2005) says that picture storybooks are books that combine pictures and text because both are interrelated and interdependent on each other. Lukens said that storybooks with pictures are more effective for children's understanding than stories that only contain text because pictures allow children to understand the contents of the story quickly, while text requires gradual understanding (Ratnasari & Zubaidah, 2019). In line with Halim & Munthe (2019) , picture storybooks help students understand new vocabulary and remember new vocabulary. According to Davis, students can use picture storybooks as learning media because they have advantages, namely picture stories are concrete, the pictures are more real, and can encourage the spirit of learning, and can stimulate and enrich students' imagination because the illustrations in storybooks contain stories (Faizah, 2009; Kholifah & Kristin, 2021). The criteria for selecting storybooks are adjusted to Regulation No. 20 BSKAP concerning Book Leveling at level C, which is called a semiannual reader. An intermediate reader is a level of reader who is able to read text fluently in the form of paragraphs in one discourse. The characteristics of books at the seminarian level, namely storybooks at the seminarian level, aim to develop the ability to think logically, master general knowledge, and learn independently. The *approximate grade* at this level is for ages 10-13 although this approach to equivalence does not always work, especially for children with lower or higher reading abilities at the same age

The picture storybook also implements the *local wisdom of* the Banyumas region. Banyumas is one of the regions in Indonesia that is rich in regional specialties (Andarini & Rosmiati, 2021). The local wisdom displayed in the picture story book is related to the traditional food of Banyumas. Traditional food is food that has been passed down from generation to generation as part of tradition (Choeriyah *et al*., 2020). Some examples of Banyumas traditional foods that are favored by tourists and locals include nopia mino, getuk goreng, jenang jaket, lapis jongkong, and others. The variety of shapes produced from Banyumas traditional food can certainly provide an opportunity that there are many mathematical concepts contained in Banyumas traditional food. However, picture storybooks containing ethnomathematics elements are still rarely developed, especially those containing local wisdom, such as traditional Banyumas food. In fact, traditional food has geometric shapes and patterns that can be associated with the concept of building space in mathematics. Therefore, researchers are interested in conducting research on the development of ethnomathematics-filled picture storybooks as a medium for learning mathematics on the material of the properties of building spaces in elementary schools. This book not only serves as an innovative learning media, but also as a means to preserve local culture through education.

This research aims to overcome the problems in learning mathematics in elementary school, especially in the material of the properties of building spaces. Strengthened based on the results of interviews and observations at SDN Pasiraman Kidul and SDN 3 Cikembulan, it was found that the learning media used by teachers were still not varied, so students had difficulty in understanding the material and were less motivated to learn. In addition, the available textbooks have not optimally connected mathematics with local culture, making it less relevant to the learning

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characteristics of elementary school students. Therefore, the development of ethnomathematics-filled picture storybooks is expected to increase student participation and understanding in learning mathematics while introducing local culture to students. With this research, it is hoped that learning mathematics can be more interesting, meaningful, and contextual for elementary students. The integration of local culture in learning media can also help preserve cultural heritage while improving students' logical thinking skills in understanding mathematical concepts.

## Research Methods

This study uses a *Research and Development* (R&D) research design, which aims to produce picture storybooks with ethnomathematics content of traditional Banyumas food as a medium for learning mathematics in grade V elementary school. The model used in the development is the ADDIE model (*Analysis*, *Design*, *Develop*, *Implement*, & *Evaluastion*). The ADDIE model is a model that is very suitable for use because it has a high level of flexibility, so that it can be used or adjusted according to the needs in solving a problem (Wulandari & Wiarta, 2022). Visually it can be seen in Figure 1.

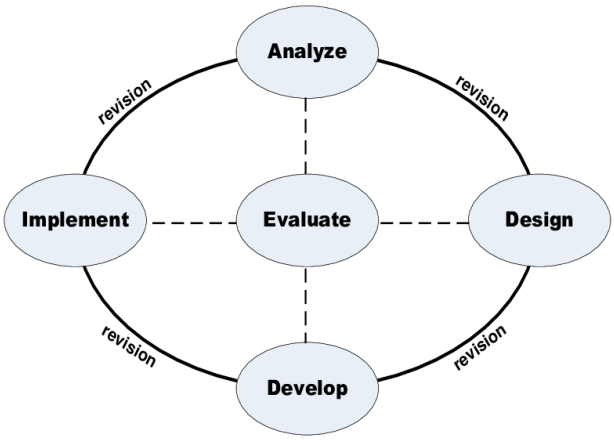


Figure 1. Stages of the ADDIE Development Model

Figure 1. shows that research and development will go through 5 stages and can be described as follows:

*Analysis Stage*

The analysis stage is carried out to determine and analyze the needs or initial information related to everything related to the picture storybook product to be developed. The analysis stage in this research includes:

a. Analysis of Students' Needs for Picture Storybooks

The results of observations made in class V of SDN Pasiraman Kidul show that most students do not like math and prefer to play with their friends. As a result, students are still less active in learning math. Students usually only listen to the teacher explain by lecturing during the lesson. In addition, teachers do not always make connections between math subject matter and everyday life. This causes students to lack understanding and students' ability to understand the material taught is still low. Students usually only use printed books and some visual media, such as "smart steering cards" during flat and spatial building lessons.

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An interview with the fifth grade homeroom teacher showed that Pasiraman Kidul Primary School uses the Merdeka Curriculum. The teacher said that when teaching math, students more often use printed books provided by the government and sometimes use learning media that are suitable for the material being taught. According to the grade V teacher, the use of learning media allows students to actively participate in the learning process and increases their enthusiasm for learning math. However, teachers face problems such as time constraints and lack of preparation to create various learning media. This results in a limited amount of media to be used in mathematics learning in grade V. In the interview, the teacher said that the teacher occasionally relates math subject matter to students' daily lives, for example traditional Banyumas food such as mendoan to introduce right angle material.

b. Picture Story Book Analysis

Based on documentation studies and interviews, the teacher said that learning mathematics on the material of the properties of building spaces does not use picture storybooks as a learning medium, but rather the use of printed math books that contain stories and pictures. Therefore, the use of books whose entire contents are ethnomathematically charged picture stories has never been done. This is because the availability of picture story books containing mathematics learning material in the library is almost non-existent compared to other types of books, such as legend books, science reading series books, and so on.

*Design Stage*

The picture storybook *design* stage refers to the stages of book development (Trimansyah, 2020) , which is limited to the prewriting stage as an initial design. The pre-writing stage includes developing a theme, collecting materials to support new ideas, determining a title, determining characters and characterizations, compiling a synopsis, and creating a *storyboard*. In this design stage, the ethnomathematics content of traditional Banyumas food used in the story content of the picture story book was also determined. The design of this picture storybook was assisted by the use of the Canva *website* and an illustration application called *Paint Tool Sai 2*. The following is a draft format of a picture storybook with ethnomathematics content of traditional Banyumas food.

Table 1. Draft Picture Storybook Format

| Book Format | Book Format Description |
|---|---|
| The beginning | a. Front cover page<br>b. Title page<br>c. Preface<br>d. Character introduction |
| Contents | a. Story content<br>b. Banyumas traditional food<br>c. Properties of space |
| Closing section | a. Practice question<br>b. Bibliography<br>c. Author profile<br>d. Back cover page |

e-ISSN 2746-5594
p-ISSN 2746-5608

*Development Stage*

The development stage is the stage of realizing the *storyboard* that has been made previously into a picture storybook product with ethnomathematics content of traditional Banyumas food. The illustrated storybook is printed with a size of 20.5× 23 cm in a rectangular shape in a horizontal position (Resmini, 2010). The choice of paper type uses 260 gram *art paper* with a total of 54 pages consisting of the front book cover, book identity, preface, character introduction, story content with a total of 46 pages, author autobiography, bibliography, and back cover. At this stage, a validity questionnaire was also made for product testing validators. Validators in this research and development, namely material experts, Indonesian language and literature experts, design and layout experts, and ethnomathematics experts.

*Implementation Stage*

The implementation stage is carried out if the product has met the validity in accordance with predetermined criteria. At the implementation stage, the product is used directly by students in the learning process. The implementation stage was carried out for two cycles, the first cycle was carried out at SDN Pasiraman Kidul and the second cycle was carried out at SDN 3 Cikembulan. This is because this development process aims to determine the practicality of illustrated storybooks with ethnomathematics content of traditional Banyumas food. The purpose of the implementation activity is to determine the practicality of the picture storybooks that have been developed through the practicality test (Afrilia & Sukartiningsih, 2024).

*Evaluation Stage*

The evaluation stage is carried out using formative evaluation. One of the objectives of this evaluation is to measure and assess the development products made based on the questionnaire results of the experts' validation and student response questionnaires after the usage trial to determine the validity of the product. Improvements are made according to the evaluation or needs that have not been met by the product (Nurhayati *et al*., 2021). This evaluation is carried out so that the ethnomathematics-fueled picture storybooks developed are truly valid and practical for use in wider schools.

Data analysis in this research and development used quantitative descriptive analysis techniques and qualitative descriptive analysis. The data collected for this study consisted of scores and feedback or suggestions. Qualitative descriptive analysis technique is used to analyze the input or suggestions generated by grouping qualitative data of questionnaire responses, input, criticism, comments and suggestions for improvement which are then used to revise the developed learning media. Quantitative descriptive analysis techniques are used to analyze data obtained through questionnaires and convert them into scores with a *Likert* scale. The formula used for validation, namely:

$$Persentase = \frac{jumlah\ skor\ yang\ diberikan\ validator}{jumlah\ skor\ maksimal} \times 100\%$$

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Furthermore, the score of each subject is converted into a percentage which is converted to the level of achievement with a scale of 5 (*Likert* scale). The percentage of results obtained can be categorized by paying attention to Table 2, as follows:

Table 2. Validity Test Categories

| Score (%) | Category |
|---|---|
| 81 - 100% | Very High |
| 61 - 80% | High |
| 41 - 60% | Simply |
| 21 - 40% | Low |
| 1 - 20% | Very Low |

Based on Table 2, the results of expert validation can be declared feasible to proceed to the trial stage or implementation stage, if the minimum percentage is more than equal to 61% (Mawardi in Sari & Wardani, 2021). Meanwhile, to determine the practicality of the media developed, it was carried out through a student response test questionnaire. The practicality calculation will be calculated through the formula, as follows:

$$Skor\ Kepraktisan = \frac{jumlah\ skor}{jumlah\ skor\ maksimum} \times 100\%$$

The formula is used to see the practicality score obtained from students' responses to the use of ethnomathematics-loaded picture storybooks. Riduwan and Akdon revealed that the scores obtained were then analyzed according to the categories that can be seen in Table 3 (Apsari & Rizki, 2018).

Table 3. Practicality Criteria

| Score (%) | Category |
|---|---|
| 81 - 100 | Very Practical |
| 61 - 80 | Practical |
| 41 - 60 | Practical enough |
| 21 - 40 | Less Practical |
| 0 - 20 | Not Practical |

## Results and Discussion

*Presentation of Trial Data*

The presentation of trial data comes from the results of expert validation and student response questionnaires from grade V SDN Pasiraman Kidul and SDN 3 Cikembulan. The results of the validation assessment and student practicality are as follows:

*Results of Expert Validation (Expert Judgement)*

Expert validation aims to obtain eligibility criteria or validity of the ethnomathematics-fueled picture storybook developed. Expert validation in this study consisted of 4 experts, namely material experts, Indonesian language and literature experts, design experts, and ethnomathematics experts. The following validation results obtained from the four experts are described in Table 4.

e-ISSN 2746-5594
p-ISSN 2746-5608

Table 4. Validation Test Data

| Validator | Persentase | Kriteria |
|---|---|---|
| Material expert | 80% | Valid |
| Indonesian language and literature expert | 88,75% | Very valid |
| Design and *layout* expert | 98,67% | Very valid |
| Ethnomathematics expert | 96% | Very valid |
| **Average number** | **90,85%** | **Very valid** |

Source: Processed from the results of the validation questionnaire

Based on Table 4, the validation results of the four experts, an average score of 90.85% was obtained, which showed an interpretation of "very valid". Thus the ethnomathematics-fueled picture storybook developed meets the validity criteria. However, there were several suggestions and comments from the experts for further revision so that the ethnomathematics-fueled picture storybook of traditional Banyumas food developed would be better. The next step after being validated, ethnomathematics-loaded picture storybooks are used in learning activities in elementary schools, so that a percentage of the practicality of ethnomathematics-loaded picture storybooks is obtained through student response questionnaires.

*Practicality Test*

Product trials were carried out in two cycles to determine the criteria for the practicality of illustrated storybooks with ethnomathematics content of traditional Banyumas food as a medium for learning mathematics and to compare the practicality scores in the two cycles. In the first cycle, the trial was conducted in the fifth grade of SDN Pasiraman Kidul with a total of 14 students. Product trials were carried out *offline* in learning activities. After the learning activities have been completed, students are given a student response questionnaire to determine the practicality of the picture storybook that has been developed. The data from the trial at SDN Pasiraman Kidul are described in Table 5 as follows:

Table 5. Data on the results of Practicality by Students

| No. | Aspects | Total Score Aspect | Maximum Score | Percentage (%) | Ket. |
|---|---|---|---|---|---|
| 1. | View | 314 | 350 | 89,71% | SP |
| 2. | Expediency | 257 | 280 | 91,79% | SP |
| 3. | Ease | 128 | 140 | 91,43% | SP |
| 4. | Language | 129 | 140 | 92,14% | SP |
| 5. | Ethnomathematics | 130 | 140 | 92,86% | SP |
| Total Score | | | 958 | | |
| Maximum Score | | | 1050 | | |
| Practicality Score | | | 91,24% | | |
| Criteria | | | Very Practical | | |

Source: Processed from respondents' practicality questionnaire data

Based on Table 5, the results of the practicality test by students obtained a percentage of 91.24% and an assessment from the teacher of 90.67%. with the

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p-ISSN 2746-5608

category "very practical". These results show that illustrated storybooks with ethnomathematics content of traditional Banyumas food used as mathematics learning media on the material of properties of building spaces can attract students' attention so as to encourage students' interest in learning mathematics. Students are very enthusiastic in learning mathematics with the existence of learning media in the form of ethnomathematics-filled picture storybooks. Based on student response questionnaires, in addition to increasing students' interest in learning mathematics, the picture storybooks developed also make students recognize the culture around them. However, in the first cycle trial, there were evaluations that needed to be improved regarding the illustrations of ethnomathematics-loaded picture storybooks and learning activities using ethnomathematics-loaded picture storybooks as learning media.

After evaluating the first cycle, the product was tested in the second cycle at SDN 3 Cikembulan with 15 students as respondents. The practicality score data in the second cycle is described in Table 6 below.

Table 6. Data on Practicality Results by Students in the Second Cycle

| No. | Aspects | Total Score Aspect | Maximum Score | Percentage (%) | Ket. |
|---|---|---|---|---|---|
| 1. | View | 344 | 375 | 91,73% | SP |
| 2. | Expediency | 271 | 300 | 90,33% | SP |
| 3. | Ease | 141 | 150 | 94,00% | SP |
| 4. | Language | 139 | 150 | 92,67% | SP |
| 5. | Ethnomathematics | 140 | 150 | 93,33% | SP |
| Total Score | | | 1035 | | |
| Maximum Score | | | 1125 | | |
| Practicality Score | | | 92,00% | | |
| Criteria | | | Very Practical | | |

Source: Processed from respondents' practicality questionnaire data

Based on Table 6, the practicality test results in Table 6 show an increase in the number of scores in each aspect. The increase in each aspect also affected the practicality value in the second cycle which increased by 92% and 93.33% of the assessment by the teacher with the criteria "very practical". The average percentage of practicality of ethnomathematics-loaded illustrated storybooks of traditional Banyumas food in the first cycle and the second cycle was 91.62%, meaning that ethnomathematics-loaded illustrated storybooks are practically used in learning mathematics in grade V on the material of the properties of building spaces after making improvements in the first cycle. Based on student response questionnaires in the second cycle, some students liked the picture storybooks developed because they contained cultures close to students. Picture stories can attract students' attention because of their appearance which is very popular among children (Apriliani & Radia, 2020). Learning through children's storybooks is more in line with the developmental stage of elementary school children because they are in the concrete operational stage (Tristaningrat *et al*., 2022). The following is a

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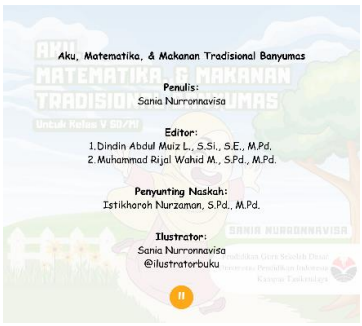
presentation of an illustrated storybook with ethnomathematics content that has been developed.


Page 1 Cover




Page 2 Book Identity


Page 3 Preface


Page 4 - 5 Character Introduction

Page 6 - 51 Story Contents

Page 38 Example of Story Content


Page 52 Bibliography


Page 53 Author Identity


Page 54 Back Cover

Figure 1. Presentation of Picture Storybooks with Ethnomathematics as Mathematics Learning Media

Based on Figure 1, here are some of the advantages and disadvantages of picture storybooks. The advantages of this ethnomathematics-filled picture storybook include the following: 1) Appropriate design and attractive colors; 2) Linking mathematics with local culture; 3) Facilitate students' understanding of concepts; 4) Increase students' literacy and motivation; 5) Support character-based learning. While the shortcomings include: 1) Limited generalization of concepts; 2) Production and availability.

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## Conclusion and Suggestion

The ethnomathematics-filled picture storybook that has been developed can be said to be valid and practical based on the results obtained through material expert validation obtaining an average score of 80% which is in the "valid" category, the results of *design* and *layout* expert validation of 98.67% are classified as "very valid", linguistic expert validation of 88.75% is classified as "very valid", and ethnomathematics expert validation of 96% is classified as "very valid". The developed product is also considered very practical based on the results of the practicality test. In the first cycle, the teacher gave an assessment of 90.67%, while students assessed 91.24%. In the second cycle, the assessment increased, teachers by 93.33% and students 92%, all of which were included in the "very practical" category.

Based on the results of the study, it can be suggested as follows: (1) learning media for ethnomathematics-loaded picture storybooks are expected to be used by teachers in teaching activities so that learning is more varied; (2) ethnomathematics-loaded picture storybooks are expected to be used by students for self-study in the library and at home; (3) ethnomathematics-loaded picture storybooks are expected to introduce local culture-integrated mathematics concepts to students; (4) for further research, it is hoped that more respondents and several cycles can be used, so as to produce learning media based on ethnomathematics-loaded picture storybooks that can be widely used.

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