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Malay Ethnomathematics Module Using *Batik Nagori Kuansing* for Elementary Geometry

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Abstract. *This study aims to develop and examine the effectiveness of a Riau Malay ethnomathematics-based learning module integrating the Batik Nagori Kuansing motif for elementary plane geometry instruction. The study employed a Research and Development approach using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The module's validity was assessed by three expert validators and achieved an Aiken's V index of 0.87, indicating a high level of validity. Practicality was evaluated through teacher and student questionnaires, with results showing highly practical categories, as reflected by teacher responses of 87.84% and student responses of 91.76%. To measure effectiveness, a pretest–posttest design was implemented involving an experimental group and a control group. The results revealed a statistically significant improvement in the experimental group's learning outcomes after using the ethnomathematics-based module, while no significant improvement was observed in the control group. These findings demonstrate that the ethnomathematics-based module integrating Batik Nagori Kuansing motifs is valid, practical, and effective in enhancing elementary students' understanding of plane geometry. The integration of culturally meaningful motifs supports students in connecting abstract geometric concepts with real-life cultural contexts. The developed module is therefore suitable for implementation in elementary mathematics learning.*

Keywords: *learning module, malay ethnomathematics, plane geometry*

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Introduction

Elementary students' cognitive characteristics and their interaction with cultural artefacts form an essential foundation for understanding mathematical concepts, particularly plane geometry (Geary, 1995; Podayeva et al., 2019). Nigora (2025) emphasizes that young learners in the concrete operational stage rely on visual, concrete, and culturally meaningful representations to interpret abstract geometric ideas. For this reason, cultural objects such as traditional patterns, handicrafts, and local motifs can function as meaningful learning resources that strengthen conceptual understanding through contextual experiences (Elia., et al 2018; Sharma & Thatte 2021; Siregar 2024)

Previous studies have explored ethnomathematics within various Indonesian cultural artefacts (Prahmana, 2022), such as *batik* patterns (Khasanah et al., 2025), weaving structures (Dominikus et al., 2023; Jaizul & Putra, 2025), and carving geometries (Sari et al., 2024; Nugraha, 2019). However, no international or national study has specifically developed a plane geometry learning module using *Batik Nagori Kuansing* motifs, particularly one aligned with elementary-level curriculum requirements. This gap indicates the absence of structured teaching materials that systematically integrate local cultural motifs with geometric concepts. Therefore, research addressing this gap is necessary.

Difficulty in understanding the geometry of flat shapes is caused by several factors, one of which is the use of teaching materials that are less contextual and less engaging for students (Prasasti et al., 2020). Johansson (2006) highlights that conventional textbook often presents mathematical content in abstract, decontextualized forms and rely heavily on procedural tasks, which can weaken students' conceptual development and motivation. Teachers generally still use textbooks and student worksheets, which are monotonous and only contain material explanations, example problems, and exercises without any connection to students' daily lives. Culturally relevant mathematics resources have been shown to enhance comprehension and engagement (Gunawan et al., 2023; Putra et al., 2022; Zeynivandnezhad, 2024), thereby justifying the need for contextualized instructional materials. To address these limitations, the development of structured and culturally responsive learning modules becomes essential.

Modules are teaching materials that allow students to learn independently because they are arranged systematically and equipped with self-learning instructions (Firmadani & Syahroni, 2020). Ellizar et al. (2018) states that a learning module is a self-contained instructional package that is systematically designed, covering learning objectives, sequential content, guided activities, and assessments, allowing learners to progress at an individual pace. Learning modules help students understand the material more effectively because they are packed with various elements that support learning, such as illustrations, examples of contextual problems, and explorative activities. However, until now, the module teaching materials developed have remained general in nature nor have they integrated many elements of local culture in mathematics learning (Sintiya et al., 2021). Integrating local cultural elements into mathematics learning is important because it enhances cultural identity, increases relevance, and supports deeper cognitive processing, as emphasized by D'Ambrosio (2018).

One approach to connecting mathematics learning with students' real lives is ethnomathematics. Ethnomathematics is a branch of study that links mathematical concepts with culture in people's lives (Wahyuni & Pertiwi, 2017). D'Ambrosio and Ascher (1994) states that ethnomathematics refers to mathematical practices embedded within cultural systems and daily activities, making it suitable for culturally grounded mathematics instruction. Integrating ethnomathematics in learning allows students to understand mathematical concepts through patterns they encounter in everyday life, including local cultural elements (Firmansyah & Haris, 2019).

This study applies ethnomathematics by integrating *Batik Nagori Kuansing* motifs in plane geometry learning. *Kuantan Singingi* (*Kuansing*) regency is an area rich in local culture, one of which is *Batik Nagori Kuansing*. This *batik* has various motifs that reflect Riau Malay cultural values and can be associated with the concept of plane geometry. For example, the *Takuluak Barembai* motif resembles a triangular shape, the *Konji Barayak* is a parallelogram shape, and the *Baganduang* Boat consists of combinations of squares and triangles (Putri et al, 2022). By integrating these motifs into the mathematics learning module, students can more easily understand the concept of flat shapes while recognizing their regional culture.

This study aims to develop and examine the feasibility of an ethnomathematics-based learning module grounded in Riau Malay culture, specifically using Batik Nagori Kuansing motifs, for teaching plane geometry in elementary schools. The feasibility of the developed module was evaluated in terms of its validity, practicality, and effectiveness in supporting the learning process. Accordingly, this study seeks to answer the research question of how valid, practical, and effective the ethnomathematics-based learning module using Batik Nagori Kuansing motifs is for teaching plane geometry at the elementary school level.

Method

This research uses Research and Development (R&D) method with ADDIE development model, which consists of five main stages: analysis, design, development, implementation, and evaluation (Sriwanti & Sukmawarti, 2022). This R&D develops ethnomathematics-based learning modules by integrating *Batik Nagori Kuansing* motifs into plane geometry material in elementary schools. The main objective of this research is to produce a valid, practical, and effective module to improve students' understanding in learning mathematics while introducing local cultural values.

This study was conducted in a public elementary school in *Kuansing* regency during the 2024/2025 academic year. Different participants were involved at each stage of the ADDIE model: three expert validators during the development stage (material expert, media expert, and linguist); three third-grade students during the one-to-one trial; twenty-seven third-grade students during the limited trial; and two third-grade teachers for the practicality assessment. The selection of participants followed purposive sampling based on curriculum relevance, teacher availability, and classroom feasibility rather than “facilities” in the physical-infrastructure sense.

Several instruments were used in this study to measure the validity and practicality of the developed module. Validation was carried out using a validation sheet, which was filled in by three expert validators, to assess aspects of the suitability of the material, design, and clarity of the language used in the module (Firmadani & Syahroni, 2020). All three experts received the same validation sheet format; and every validator evaluated all the indicators.

In addition, practicality questionnaires were administered to both teachers and students to assess the ease of use of the module during the learning process. The teacher questionnaire consisted of 10 items grouped into three aspects: attractiveness, ease of use, and usefulness. The student questionnaire consisted of 15 items covering the aspects of attractiveness, clarity of presentation, and learning motivation. Interviews were also conducted with teachers and students to obtain feedback on their experience using the module. An observation sheet was used to record students' level of engagement, responses, and learning behaviours during the implementation of the module in classroom activities.

Following the ADDIE model, the analysis stage identified the needs of learners and teachers, the curriculum was analyzed, and an exploration of how *Batik Nagori Kuansing* motifs could be integrated with plane geometry learning was explored. The design stage includes designing the module structure, which includes learning objectives, concept maps, and ethnomathematics-based explorative activities. The general workflow of the ADDIE process used in this study is illustrated in Figure 1, as presented in the original development model by (Branch, 2009).

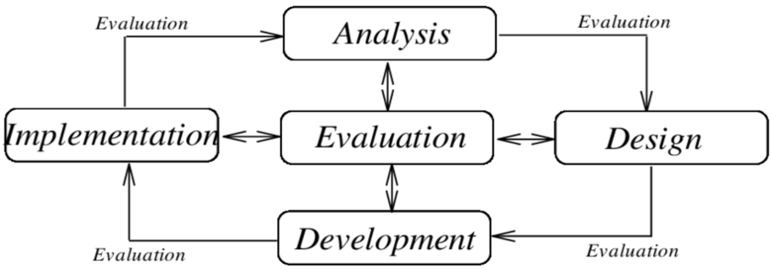


Figure 1. ADDIE research overview (Branch, 2009)

The module was developed using the Canva graphic design application to ensure an attractive appearance and ease of use by students. After the module was designed, the development stage involved expert validation to ensure that the module content was following educational standards and had good readability for elementary school students (Sintiya et al., 2021). After validation and revision based on expert input, the module was tested on learners in small groups. Implementation was carried out in two stages, namely one-to-one trials with three learners and limited group trials with twenty-seven learners.

During the implementation stage, students used the module in learning activities and provided feedback on its appearance, content, and ease of understanding, while teachers evaluated the module's effectiveness in supporting the comprehension of plane shape concepts. Practicality assessments for teachers and students used a Likert-scale questionnaire that measured attractiveness, clarity of presentation, ease of use, and usefulness, with standardized categories and scoring criteria as presented in Table 1.

Table 1. Categories and likert scale scores for teacher and student responses

Category	Likert Rating Score
Excellent	4
Good	3
Fair	2
Poor	1

The data obtained were analyzed quantitatively and qualitatively. Module validity was calculated using Aiken's V coefficient to determine the extent to which the module met the criteria for content and construct validity (Fitria et al., 2017). The minimum validity index required was V > 0.80 for "very valid," following the criteria in Table 2.

Table 2. Expert validation criteria

Validity Level	Mean Score
Very Valid	$V > 0.80$
Valid	$0.40 \leq V \leq 0.80$
Less Valid	$V < 0.40$

(Retnawati, 2016)

To assess the practicality of the developed module, data obtained from teacher and learner questionnaires were analyzed using percentage calculations. The practicality level was determined by comparing the obtained scores with the criteria presented in Table 3. A module was categorized as "practical" if it achieved a minimum score of 62.5%, indicating that it could be easily used and implemented in the learning process.

Table 3. Media practicality percentage

Interval % Average Score	Category Score
$81,25 <$ skor ≤ 100	Very Practical
$62,5 <$ skor ≤ 81.25	Practical
$43,75 <$ skor $\leq 62,5$	Less Practical
$\leq 25 <$ skor $\leq 43,75$	Not Practical

In addition to quantitative statistical analysis, interviews with teachers and learners were analyzed descriptively to gain deeper insights into how the use of the module influenced their learning experiences. The interview data provided supporting information regarding students' engagement and teachers' perceptions of the module's cultural relevance. All findings from this study were used as the basis for making final revisions to the module so that it could function as a more effective teaching material and better align with the needs of local culture-based mathematics learning.

The effectiveness of the Malay ethnomathematics-based learning module integrating the Batik Nagori Kuansing motif was determined based on students' learning outcomes measured using a pretest–posttest design. The module was considered effective if it met the criteria which is there is a significant difference between students' pretest and post-test scores after the implementation of the Malay ethnomathematics-based learning module integrating the Batik Nagori Kuansing motif. These criteria are widely used in educational experimental research to evaluate the effectiveness of instructional interventions (Sugiyono, 2019). The hypotheses tested in this study were formulated as follows:

Null Hypothesis (H_0): There is no significant difference between students' pretest and posttest scores after the implementation of the Malay ethnomathematics-based learning module integrating the *Batik Nagori Kuansing* motif.

Alternative Hypothesis (H_1): There is a significant difference between students' pretest and posttest scores after the implementation of the Malay ethnomathematics-based learning module integrating the *Batik Nagori Kuansing* motif.

To test the research hypotheses, a paired sample t-test was used to analyze the differences between pretest and posttest scores within each group. Prior to hypothesis testing, the assumption of normality was examined using the Kolmogorov–Smirnov test. The results of the normality test indicated that all datasets were normally distributed ($p > 0.05$), allowing the use of parametric statistical analysis. The paired sample t-test was selected because it is appropriate for comparing two related measurements obtained from the same participants before and after the learning intervention (Field, 2018).

Results and Discussion

In accordance with the ADDIE development model, this study presents research findings obtained from each stage of developing an ethnomathematics-based learning module using *Batik Nagori Kuansing* motifs. Each stage of the ADDIE model, namely analysis, design, development, implementation, and evaluation, was conducted systematically to ensure the quality of the module. The results from each stage collectively demonstrate the process and outcomes of developing a culturally integrated learning module for plane geometry instruction.

The analysis stage is the first step in this research, which aims to determine the material to be used and understand students' needs for learning modules. In this stage, a needs analysis, learner analysis, and curriculum analysis are carried out. Based on an interview conducted with a third-grade teacher at an elementary school in *Kuansing* regency in 2023, it was found that teachers only utilized the available school-provided teaching materials during learning activities. However, these materials had not integrated the mathematics content with the local wisdom of the *Kuansing* region. As a result, students understood the concept of plane shapes only theoretically without recognizing the cultural elements associated with these geometric concepts. Therefore, teachers are encouraged to consider using additional learning resources that support mathematics learning through a culturally contextualized approach.

In addition, learner analysis is conducted to understand the characteristics of students, including their difficulties and strengths in learning mathematics. From the interview with the class teacher, it was found that students have difficulty in understanding mathematical concepts due to the limited teaching aids or learning media used. Children aged 6–12 years are in the concrete operational stage of development, as proposed by Piaget (Agung, 2019). At this stage, students have begun to understand logical operations, but still need the help of concrete objects to understand abstract concepts. Therefore, a learning model is needed to facilitate their understanding of flat shapes through concrete objects they often encounter in everyday life. Evidence from the need analysis shows that students particularly struggled with identifying and explaining the properties of plane figures, such as recognizing the number of sides, angles, and characteristic attributes of basic shapes. Classroom observations and interviews revealed that students often confused similar shapes (e.g., squares vs. rectangles) and had difficulty locating geometric elements within real objects. The teacher also explained that the lack of engaging and contextual materials contributed to these difficulties, as students were accustomed only to using repetitive worksheets and textbooks. Furthermore, interviews with students indicated that they understood geometry more easily when supported by visual examples, confirming that abstract explanations without illustrations limited their comprehension.

The results of curriculum analysis are the basis for formulating the Basic Competencies (KD) to be achieved in learning, especially in the development of flat building materials. Based on interviews with teachers, it is known that the curriculum currently used is the 2013 Curriculum (K13), which is in the process of transitioning to the Merdeka Curriculum. KD that are relevant in this learning include KD 3.4: Identifying the properties of simple flat shapes and KD 4.4: Solving problems related to the properties of simple flat shapes. Teachers design learning indicators that include students' ability to recognize types of flat shapes and understand their properties. The results of this analysis become a reference in developing modules to suit the needs of students and learning objectives set out in the curriculum (Table 4).

Table 4. Basic competency analysis results

Basic Competency Before Analysis	**Basic Competency After Analysis**
3.4 Identifying the properties of simple plane figures	3.4 Identifying the properties of plane figures through the motifs of *Batik Nagori Kuansing*
4.4 Solving problems related to the properties of plane figures	4.4 Solving problems related to the properties of plane figures

At the design stage, planning is conducted by formulating learning objectives, preparing learning scenarios, designing teaching materials, and developing learning evaluations. This module is developed based on the established steps proposed by (Depdiknas, 2008). These steps include the title, instructions for use, competencies to be achieved, supporting information in the form of concept maps, exercises such as learner activities and Learner Worksheets (LKPD), and an evaluation section at the end of the module to assess learners' understanding.

The module teaching materials are presented by considering several important aspects. The module development is based on the thematic book for third-grade students used by teachers and supported by various additional references from books and internet sources. This module was designed using the Canva platform with a design format on A4 paper size (21 cm × 29.7 cm) and consists of 47 pages. The module structure includes a cover page with the title "Knowing the Properties of Flat Buildings Based on *Kuansing* Malay Ethnomathematics," a preface, a table of contents, instructions for using the module, a history of flat buildings, a concept map, basic competencies and indicators, learning units 1, 2, and 3, drawing exercises, exploration, reflection, a summary, LKPD, evaluation, and a bibliography. The module design is made interesting by combining material and coloured illustrations to increase the attractiveness for students. The process of preparing the module was carried out using computer equipment to ensure neat and professional results.

This module has gone through the validation stage by experts and was revised based on suggestions from validators to produce a more optimal final product. The development of this module aims to help students understand the concept of flat shapes with a more contextual and engaging local cultural approach. The module is packaged in book form and consists of several main sections. The front cover of the module includes the Riau University logo, the *Tut Wuri Handayani* logo, and the title "Learner Learning Module: Knowing the Properties of Flat Buildings Based on *Kuansing* Malay Ethnomathematics," which is accompanied by an illustration of the *Takuluak Barembai Batik* Motif and an animation of learners learning. The beginning of the module includes a preface that describes the author's gratitude for the completion of the module and a table of contents that systematically presents the overall structure of the module.

Instructions for using the module are included to make it easier for readers to understand and utilize the module content more effectively. In addition, the concept map is presented in the form of inter-concept relationships organized according to the material discussed. The fundamental competencies in this module contain the abilities that need to be mastered by students as a reference in preparing competency indicators, while learning objectives are designed to direct the expected results of the learning process (Figure 2).

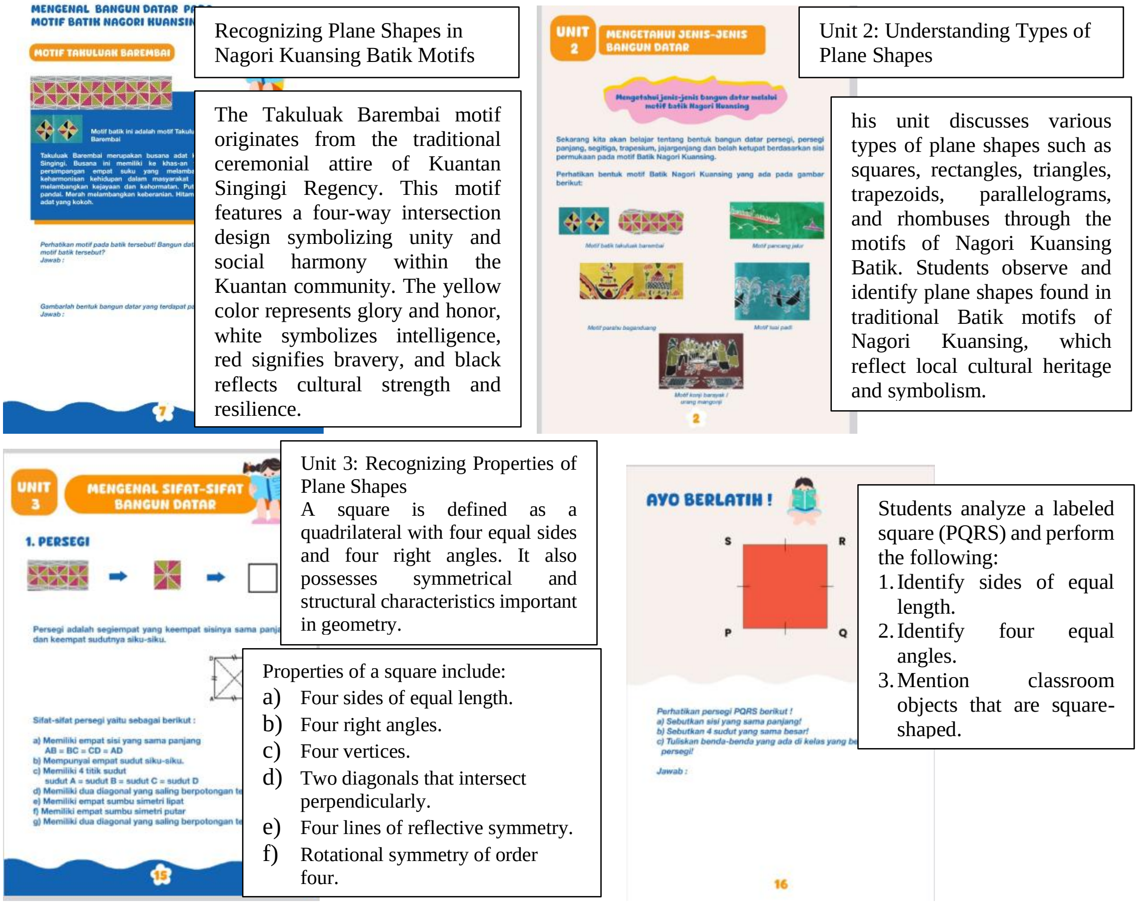


Figure 2. Module content

The learning materials in this module are systematically designed and cover the history of flat shapes, definitions, different types of flat shapes, and their characteristics. To strengthen learners' understanding, practice questions are included in each part of the material to help them apply the concepts they have learned. In addition, this module also contains a summary that aims to help students recall the core material that has been learned, as well as LKPD designed to ensure that students can be more active in understanding the material (Figure 3).

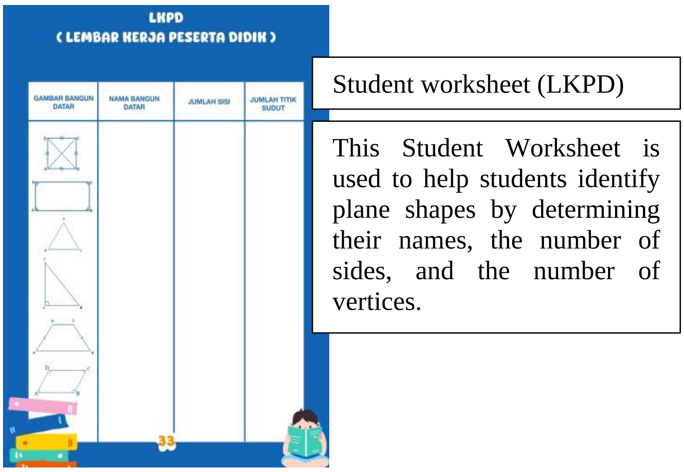


Figure 3. LKPD

The evaluation in this module is used to measure student's level of understanding after completing the learning process. The evaluation is arranged in the form of questions that reflect the competency indicators that have been studied. The end of the module contains a bibliography that lists the reference sources used in the preparation of the module (Figure 4). Thus, this module functions not only as teaching material but also as a medium increase students' interest in learning while preserving the local wisdom of *Kuansing* Regency.

EVALUATION

A. Select the correct answer.
1.Among the plane figures shown below, which one represents a rectangle?

2. On Thursday, Mrs. Deni purchased a piece of Nagori Kaunsing batik fabric featuring a rectangular motif. She bought four packages of plane-figure sets, each containing one set of Suka Bantu cards. The motif on the batik fabric represents which type of plane figure?
a.Triangle
b.Square
c.Rectangle
d. Circle

3. Observe the figures presented below.

Which of the following figures represent a trapezoid?

Figure 4. Evaluation

Near the end of process, this module is tested by a team of validators, consisting of material experts, media experts and linguists. Their aim is to evaluate whether it is possible to create a learning module based on Malay ethnomathematics of *Batik Nagori Kuansing* motif on plane geometry material that can be used for in-school learning activities. To ensure the feasibility and practical usability of the developed module, a media practicality assessment was conducted involving teachers and students as primary users. This assessment aimed to determine the extent to which the module could be applied effectively in classroom settings, focusing on clarity, ease of use, and overall functionality during learning activities.

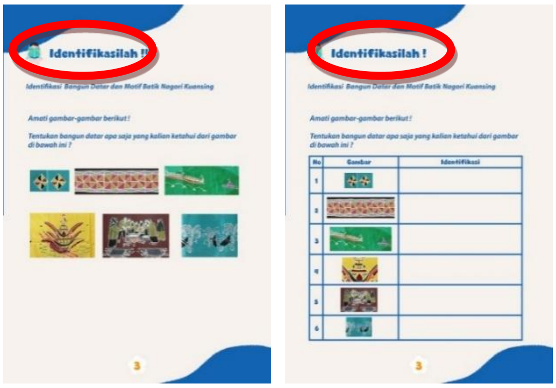
Based on the validation results, several aspects need to be improved to enhance the quality of the module before it is tested. On the cover page, the validator recommended adding ethnomathematics elements by displaying an image of the *Batik Nagori Kuansing* motif to align it with the module content. On the unit 1 page, revisions were made to the sentence in the "Did you know?" box to make it more directed to the ethnomathematics of *Batik Nagori* and added an illustration of the *Batik Nagori Kuansing* motif, as shown in Figure 5.

UNIT 1
INTRODUCTION TO PLANE GEOMETRIC FIGURES
Did You Know?
The *Takuluak Barembai* motif is one of the traditional batik motifs from Nagori Kuansing. Interestingly, this motif contains various plane geometric figures. Plane figures can be found in our surrounding environment, one example of which appears in this Kuansing batik motif.

Takuluak Barembai Motif
The *Takuluak Barembai* is a traditional costume characteristic of Kuantan Singingi Regency. This attire has distinctive features through a four-directional cross motif symbolizing harmony and balance in the life of the Kuantan community. The color yellow represents prosperity and honor. White symbolizes intelligence and wisdom.Red represents bravery. Black symbolizes the strength and firmness of customary traditions.
What Is a Plane Figure?
A plane figure is a two-dimensional geometric shape formed by points or line segments that enclose an area and have a perimeter and area. Plane figures include triangles, squares, rectangles, parallelograms, trapezoids, rhombuses, kites, and circles, along with their respective properties.

Figure 5. Before revision (left) and after revision (right)

Revisions were also made on page 3 in the "Identify!" section. The validator suggested removing the exclamation mark in the section title. Additionally, a table was added to the Batik motif image to improve its neatness and clarity (Figure 6).

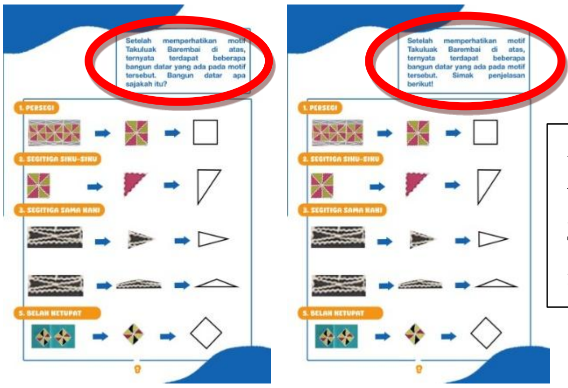


IDENTIFY!
Identification of Plane Geometric Figures in Nagori Kuansing Batik Motifs.

Observe the figures below.Identify the plane geometric figures that can be recognized from each image.

Figure 6. Before revision (left) and after revision (right)

On page 8, the question sentence "What are the flat shapes?" was revised. It was changed into the command "Listen to the following explanation!" to provide clearer instructions for students. This revision was intended to improve students' understanding of the learning activities (Figure 7).



After examining the *Takuluak Barembai* motif above, several plane geometric figures can be identified. The explanation below describes these figures.

Figure 7. Before revision (left) and after revision (right)

Based on the results of the validation conducted by the three validators, a recapitulation of the validation outcomes was obtained. The recapitulation presents the overall assessment of the developed module. These results are summarized and presented in Table 5.

Table 5. Validation results

No	Aspect	Score	Validity
1	Module cover design and content	0,84	Highly Valid
2	Module usage and benefits	0,94	Highly Valid
3	Alignment between content in the module	0,88	Highly Valid
4	Accuracy of content in the module	0,88	Highly Valid
5	Compliance with language rules	0,77	Valid
6	Communicative and clear	0,88	Highly Valid
Average		**0,87**	**Highly Valid**

The results in Table 5 show that the developed module meets a high level of content and design validity. All six evaluated aspects achieved scores above the minimum threshold of 0.40, with five aspects categorized as "Highly Valid." This consistent pattern of high scores demonstrates that the module aligns well with curriculum demands, presents accurate and coherent content, and applies appropriate instructional and visual design principles. The average score of 0.87 further confirms that the module is suitable for classroom implementation without major revisions.

This research proceeded to the individual trial stage, which was carried out after the validators declared the product valid. This trial involved three students selected with the class teacher's permission to evaluate the module's initial practicality before conducting a limited trial. The implementation of this trial took the form of an open interview conducted on December 2, 2024. The first researcher initiated the session with an introduction and presentation of the module content, and then guided learners in using it independently. After the module was used, the first researcher asked reflective questions related to their experience in learning using this module. The responses given by the learners showed high enthusiasm, and they felt happy because of the attractive and colourful appearance of the module. One of the students stated that this module was more interesting compared to the worksheets they usually used, and they had never learned with a module like this before. Based on the interview results, the ethnomathematics-based module integrating the *Batik Nagori Kuansing* motif met the practicality criteria and was feasible to be applied in learning without requiring further revision.

At the implementation stage, the module that has been declared feasible is tested for practicality by assessing classroom teachers and student responses using a questionnaire. Teacher responses to the module were obtained through 10 statement items, while student responses were measured with 15 statement items. In the teacher's practicality test, the first researcher explained the module's content to the third-grade teacher. The questionnaire results presented in Table 6 show that the average percentage of teacher assessment reached 87.8%, which is included in the efficient category. Teachers stated that the material in the module is relevant to learning needs and can help achieve learning objectives. The interesting presentation and integration of local culture in the module are also considered to create a more enjoyable learning atmosphere for students. Both practitioners have validated this module product without revision, so it can be concluded that the module based on the Malay ethnomathematics of *Batik Nagori Kuansing* motif is feasible to be applied in third-grade mathematics learning.

Table 6. Teacher response to the module

Assessment Aspect	Percentage	Category
Attractiveness	84,37%	Highly Practical
Ease of Use	91,66%	Highly Practical
Usefulness	87,50%	Highly Practical
Average	87,84%	Highly Practical

Furthermore, the limited trial stage was carried out involving 27 students of class III A on December 3, 2024, to ensure the effectiveness of using the module, evaluate the feasibility of the product, and get feedback from students. The implementation of the trial followed the lesson plan that had been prepared previously. Students were invited to recognize the plane geometry contained in the *Batik Nagori Kuansing* motif, with a discussion-based learning approach and exploration. After explaining the material, students are given time to do the exercises independently before being discussed together. Evaluation is done through multiple-choice questions, short answers, and story problems designed to relate geometry concepts to everyday life. The evaluation results presented in Table 7 show that students can understand the concepts taught and show improvement in linking geometry material with local culture.

Table 7. Student response to the module

Assessment Aspect	Percentage	Category
Attractiveness	91,66%	Highly Practical
Ease of Use	93,25%	Highly Practical
Usefulness	90,37%	Highly Practical
Average	91,76%	Highly Practical

After completing the evaluation, students filled out a questionnaire to assess the practicality of the module. The results showed that the average percentage of module practicality based on student responses reached 91.76%, which was included in the very practical category. Therefore, it can be concluded that this product is very feasible to use in learning. The evaluation stage was conducted to measure the level of product practicality based on the perceptions of students and teachers. This evaluation includes students' comfort in using the module, ease of navigation, and suitability of the material to the learning needs. The results of the limited trial showed that students' responses to the module reached 91.76%, while the teacher's response was 87.84%. The results concluded that this module is practical.

The effectiveness of the Riau Malay ethnomathematics-based learning module integrating the *Batik Nagori Kuansing* motif was examined to determine its impact on students’ learning outcomes in plane geometry. The effectiveness analysis was conducted using a pretest–posttest design involving an experimental group and a control group. Before the treatment, the experimental group obtained a mean pretest score of 67.41**,** while the control group obtained a mean pretest score of 67.00, indicating that both groups had relatively equivalent initial abilities. After the learning intervention, the experimental group's mean post-test score increased to 82.93, whereas the control group showed only a slight increase to 67.67 as presented on Table 8.

Table 8. Descriptive statistics of pretest and posttest scores

Group	Test	N	Mean	Standard Deviation
Experimental	Pretest	27	67.41	7.12
Experimental	Posttest	27	82.93	6.53
Control	Pretest	30	67.00	6.51
Control	Posttest	30	67.67	5.53

Prior to hypothesis testing, a normality test was conducted using the Kolmogorov–Smirnov test. The results showed that all datasets (experimental pretest, experimental post-test, control pretest, and control post-test) had significance values greater than 0.05. Therefore, the data were normally distributed and suitable for parametric statistical analysis. To determine whether there was a significant improvement in learning outcomes, a paired sample t-test was conducted for both groups as presented on Table 9.

Table 9. Paired sample t-test results

Group	Comparison	Mean Difference	t-value	df	Sig. (2-tailed)
Experimental	Pretest – Posttest	-15.52	-11.73	26	0.000
Control	Pretest – Posttest	-0.67	-0.75	29	0.459

The paired sample t-test results indicate a statistically significant difference between pretest and post-test scores in the experimental group ($p < 0.05$). In contrast, the control group did not show a significant difference between pretest and post-test scores ($p > 0.05$). The significant improvement observed in the experimental group demonstrates that the use of the ethnomathematics-based module integrating *Batik Nagori Kuansing* motifs effectively enhances students' understanding of plane geometry. The cultural patterns embedded in the Batik motifs help students visualize and contextualize abstract geometric concepts, leading to more meaningful learning experiences. Meanwhile, the absence of significant improvement in the control group indicates that conventional instruction alone was insufficient to produce comparable learning gains. Based on these findings, it can be concluded that the Riau Malay ethnomathematics-based learning module using *Batik Nagori Kuansing* motifs is effective in improving elementary students' learning outcomes in plane geometry.

Therefore, the Malay ethnomathematics–based module integrating the *Batik Nagori Kuansing* motif can be effectively applied in classroom learning, particularly for enhancing students' understanding of plane geometry. The geometric patterns embedded in the *Batik* motifs such as triangles, squares, rectangles, parallelograms, and composite shapes help students identify and describe the properties of plane figures more concretely. By using this module, students are able to relate geometric attributes such as sides, vertices, and angles to culturally meaningful visual forms, leading to improved conceptual comprehension. Modules as structured teaching materials also support a more focused learning process, enabling students to engage with geometry content more systematically and allowing learning objectives in the plane-geometry domain to be achieved more effectively.

However, there are still many opinions that mathematics and culture are two independent aspects and are not related to each other. Culture is an element that cannot be separated from education and daily life because education and culture have a close relationship where culture reflects the life of society as a whole. In contrast, education is a basic need for individuals in society (Amirah & Budiarto, 2022). Therefore, innovation is needed in learning, such as developing ethnomathematics-based learning modules that integrate cultural elements (Medyasari et al., 2019).

In this research, a module based on Malay ethnomathematics was developed as mathematics teaching materials, including references, example questions, and solution guides prepared based on the community environment. This module uses a Malay ethnomathematics approach, which integrates Malay culture into mathematics teaching. Module development is carried out using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation (Branch, 2009). At the analysis stage, researchers analyzed the elementary school curriculum, which showed that class III still used the 2013 Curriculum. Therefore, the modules developed were adapted to this curriculum. In addition, analysis of the characteristics of class III students from a public elementary school, aged 9-12 years shows that they are in the concrete operational cognitive development stage (Agung, 2019) and prefer learning with visual media, so the module was developed with illustrations and pictures to increase students' understanding and introduce Malay culture.

At the design stage, the researchers prepared the validation questionnaire and the teacher and student response instruments. The module draft was then developed and evaluated by three experts. Aiken's V was applied to measure inter-rater agreement, and the calculation produced an average index of 0.87, which according to Retnawati (2016) falls into the highly valid category ($V > 0.80$). The module is considered highly valid not only because of the V index but also because it met all six assessment aspects in the validation rubric: design quality, usefulness, alignment with the basic competencies, content accuracy, linguistic appropriateness, and communicativeness. "Meets" refers to the module achieving the minimum validity standard for each aspect ($V > 0.40$), with five aspects categorized as Highly Valid. Thus, both the numerical validity coefficient and the fulfilment of rubric criteria confirm the module's high validity.

After expert validation, a one-to-one trial was conducted with three third-grade students from a public elementary school. Based on the open interviews, students responded positively to the module. The implementation phase continued with limited trials involving students and teachers. The results showed that the module achieved a high level of practicality, with student responses reaching 91.76% and teacher responses 87.84%, both categorized as highly practical according to the practicality criteria.

The evaluation stage consisted of gathering teachers' perceptions regarding the feasibility and usability of the module. This evaluation measured teachers' immediate reactions such as perceived usefulness, clarity, ease of implementation, and appropriateness for teaching plane geometry rather than learning outcomes or long-term impact. Teachers reported increased student enthusiasm and noted that the integration of local cultural motifs made the learning process more engaging and meaningful. Therefore, the module was considered feasible and ready for use in classroom instruction.

This statement aligns with research by Putri et al. (2022), which states that the ethnomathematics module supports the implementation of the 2013 Curriculum with a scientific approach. Through this module, students understand mathematical concepts and gain insight into local culture (Putri, 2017). Ethnomathematics-based modules also make learning activities easier for students because they find it easier to understand the material and are actively involved in the learning process (Hayu et al., 2023). In addition, using this module increases students' interest in mathematics and helps them understand concepts more contextually. Students assess that this module is practical to use in learning because the material and questions presented are explicit and well-structured.

Based on the results of this research, the Malay ethnomathematics-based module with the *Batik Nagori Kuansing* motif developed has become a complete, feasible, and efficient learning medium for use in the mathematics learning process. For teachers, this module can be a breakthrough in increasing students' interest and understanding of mathematics in a more contextual and culture-based way. Meanwhile, this module provides an interesting and enjoyable learning experience for student because they can study mathematics with a new approach closer to their culture. In this way, this module not only helps improve students' understanding of mathematics but also participates in preserving the local culture of the *Kuansing* Regency.

In this study, effectiveness does not merely refer to statistical improvement in students' test scores but also reflects the quality of meaningful learning experiences facilitated by the integration of local culture. An instructional module is considered effective when it enables students to understand mathematical concepts more deeply, relate abstract ideas to real-life contexts, and actively engage in the learning process. The integration of *Batik Nagori Kuansing* motifs provides cultural advantages by transforming plane geometry from an abstract subject into a familiar and visually meaningful experience rooted in students' cultural environment. This finding is consistent with previous studies showing that ethnomathematics-based learning enhances conceptual understanding, motivation, and contextual reasoning by connecting mathematics with students' cultural identities (Hayu et al., 2023; Prahmana, 2022; Putri et al., 2022). Compared to conventional instruction, which often emphasizes procedural learning, culturally responsive modules promote deeper cognitive processing and sustained learning outcomes. Therefore, the effectiveness demonstrated in this study highlights not only improved achievement but also the pedagogical strength of integrating local cultural wisdom into elementary mathematics learning.

Conclusion

This study aimed to develop and evaluate a Malay ethnomathematics-based learning module integrating the *Batik Nagori Kuansing* motif to support elementary students' understanding of plane geometry. The results indicate that the developed module meets the criteria of validity, practicality, and effectiveness. In terms of validity, expert judgment using Aiken's V produced an overall index of 0.87, which falls into the highly valid category. This result confirms that the module content, design, language, and alignment with learning objectives are appropriate for third-grade elementary mathematics instruction. The practicality of the module was demonstrated through positive responses from both teachers and students. Teacher responses reached an average of 87.84%, while student responses reached 91.76%, both categorized as highly practical. These findings indicate that the module is easy to use, attractive, and useful in supporting classroom learning activities. The effectiveness of the module was confirmed through a pretest–posttest analysis involving an experimental group and a control group. The experimental group showed a statistically significant improvement in learning outcomes after using the ethnomathematics-based module ($p < 0.001$), while the control group did not demonstrate a significant increase ($p > 0.05$). This result indicates that the integration of *Batik Nagori Kuansing* motifs into plane geometry learning effectively enhances students' conceptual understanding compared to conventional instruction. The use of culturally meaningful visual patterns helps students connect abstract geometric concepts with real-life cultural contexts, thereby strengthening both mathematical understanding and cultural awareness.

This study has certain limitations because the implementation was conducted in only one school and focused solely on plane geometry material. Therefore, future research is recommended to expand the implementation to multiple schools and different grade levels. In addition, further studies should integrate other mathematical topics and examine the long-term impact of ethnomathematics-based modules on students' academic achievement and cultural appreciation.

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