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Research Article

The Validity of an Ethnomathematics Based Student Worksheet Using Sekundang Batik Motifs in Plane Geometry Oriented to Contextual Teaching and Learning (CTL)

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Abstract: Teaching plane geometry often faces challenges due to the abstract nature of geometric concepts, which are often detached from students' real-life contexts. This study is a development research (Research and Development) using a modified 4D model reduced to 3D (Define, Design, Develop) aimed at producing and testing the validity of a Student Worksheet based on ethnomathematics with Batik Sekundang motifs on plane geometry material oriented toward *Contextual Teaching and Learning (CTL)*. Validation was conducted by two mathematics education experts who assessed the feasibility of content/material, media, and language/readability using a Likert scale instrument. The data were analyzed quantitatively in a descriptive manner using percentage formulas to determine the level of validity. The results showed that the student worksheet obtained a validity percentage of 87.50% in content feasibility (very valid), 80.76% in media (valid), and 87.50% in language (very valid), with an overall average of 85.25%, which falls into the very valid category. Based on these results, the ethnomathematics-based student worksheet with Batik Sekundang motifs is declared suitable to be used as a supporting teaching material for contextual and meaningful plane geometry learning for students in South Bengkulu.

Keywords: Batik Sekundang; Contextual Teaching Learning; Ethnomathematics; Geometry; Student Worksheet.

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1. Introduction

Mathematics is a discipline that plays a crucial role in developing students' logical thinking, critical reasoning, and problem-solving skills. However, mathematical concepts taught in schools often appear abstract and disconnected from students' real-life experiences, resulting in difficulties in understanding and applying these concepts in daily practice. This situation makes mathematics learning less meaningful and can foster negative perceptions toward the subject (Utami & Irawati, 2024).

Batik Sekundang is a cultural heritage unique to South Bengkulu, featuring distinctive motifs rich in symbolic meaning. Its motifs, such as taro leaves, lengguai, rafflesia, fern leaves, and bamboo, not only exhibit visual beauty but also contain complex geometric patterns, including squares, triangles, lines of symmetry, and circles. This batik is commonly used in various traditional ceremonies, as well as in official uniforms and school attire, serving as a strong representation of local cultural identity (Purnamayana et al., 2026). The unique motifs and geometric structures of Batik Sekundang offer significant potential to serve as a context for meaningful and contextual mathematics learning. However, the development of Student Worksheets based on ethnomathematics using Batik Sekundang as a context has not yet been

studied, making the need for innovative teaching materials that integrate local culture essential.

To address these challenges, learning approaches that connect students' real-life contexts with mathematical concepts have gained increasing attention. One promising approach is ethnomathematics, which refers to the study of mathematical ideas that emerge and develop within the cultural practices of local communities. Ethnomathematics links mathematical concepts with local culture and students' everyday experiences, thereby making mathematics learning more contextual and facilitating students' conceptual understanding (Ismiasih & Hermanto, 2025; Romadhon, 2024).

Student Worksheets are learning tools designed to guide students through independent, structured activities that focus on problem-solving through the steps of exploration, elaboration, and confirmation. Ethnomathematics-based student worksheet on plane geometry is particularly important because it bridges abstract concepts such as squares, triangles, and circles into concrete visual representations found in local cultural motifs, thereby improving comprehension retention, learning motivation, and relevance to students' daily lives (Romadhon, 2024; Anggreyani, 2024; (Rahmadhani et al., 2024). This integration not only makes learning more relevant but also fosters cultural appreciation while developing basic geometric skills (Noerhasmalina & Khasanah, 2023; Purnamayana et al., 2026).

The use of ethnomathematics-based student worksheet that incorporates local cultural elements demonstrates that such worksheets can transform abstract mathematical concepts into concrete representations, making learning more meaningful for students (Satriani & Yerizon, 2022; Hisni et al., 2022). Previous studies have shown that the development of ethnomathematics-based student worksheet results in products with high validity according to expert reviews of media and content, supporting the improvement of students' understanding of plane geometry. For example, student worksheet based on traditional fabric motifs for plane geometry has been validated by expert review (Romadhon, 2024; Anggreyani, 2024; Rahayu, 2025).

Contextual Teaching and Learning (CTL) is chosen as the orientation because this approach emphasizes learning based on real-life contexts through seven main components: constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Ruwaidah, 2022). These components help students connect the learning material to their everyday experiences and local cultural contexts, making them highly suitable for integrating Batik Sekundang motifs as an authentic context in plane geometry lessons. CTL ensures that learning is not only conceptually valid but also actively engages students in the classroom (Fitriyah et al., 2025; Noviastuti, 2023).

Within the broader scope of ethnomathematics, other studies also highlight geometric elements in batik as a potential context for mathematics learning, including the development of visualization skills and conceptual understanding in geometry (Noerhasmalina & Khasanah, 2023; Abdullah, 2025; Rahmawati, 2021). Moreover, phenomenological studies on traditional batik-making communities indicate that the batik-making process implicitly contains mathematical concepts that can be utilized as learning resources (Purnamayana et al., 2026; Rahmadhani et al., 2024).

Although research on ethnomathematics and student worksheet development has been widely conducted, there remains a research gap specifically examining the development of ethnomathematics-based student worksheet on plane geometry using Batik Sekundang motifs a cultural heritage of South Bengkulu with rich artistic value and geometric structure. The integration of Batik Sekundang motifs in student worksheet oriented toward CTL is expected to provide concrete representations of plane geometry concepts while fostering students' appreciation for local wisdom.Based on this background, this study focuses on the development of ethnomathematics-based student worksheet on plane geometry with Batik Sekundang motifs as an innovative, valid, and effective teaching material for use in mathematics learning in schools.

2. Materials and Method

This study is a research and development (R&D) aimed at producing a product in the form of a Student Worksheet based on ethnomathematics using Batik Sekundang motifs for plane geometry material. The development model used refers to the 4-D model (Define,

Design, Develop, Disseminate) proposed by Thiagarajan, Sivasailam, and colleagues (1974), which in this study was modified into 3-D, namely Define, Design, and Develop (Purba, 2025).

The defining stage (Define) was conducted through several preliminary analyses. First, the researcher analyzed the learning outcomes to align with the objectives to be achieved in the plane geometry material. Next, an analysis of student characteristics was conducted to map cognitive abilities, learning styles, and students' cultural backgrounds. The researcher also performed a material analysis to understand the concepts of plane geometry, such as rectangles, rhombuses, and trapezoids. At this stage, the identification of students' needs, selection of relevant teaching materials, and adjustment of plane geometry concepts to students' characteristics and local cultural context were carried out.

In the design stage (Design), activities focused on preparing research instruments and the instructional media design. The researcher developed an initial student worksheet prototype by integrating ethnomathematical activities through Batik Sekundang motifs into learning oriented toward Contextual Teaching and Learning (CTL). The design process included selecting Batik Sekundang motifs relevant to plane geometry material, organizing the format and layout of the student worksheet, and designing learning activities that encouraged students to explore plane geometry concepts contextually while appreciating local culture.

Subsequently, the development stage (Develop) was carried out through expert validation to assess the theoretical feasibility of the student worksheet. Validation was conducted by two mathematics experts using a four-point Likert-scale validation sheet, assessing aspects of content feasibility, media, and language. After the assessment, the researcher revised the student worksheet based on the suggestions and feedback from the validators to improve the technical quality and the substantive content of the plane geometry material as well as the integration of Batik Sekundang motifs. The validation results were analyzed using a descriptive quantitative approach, calculating percentage scores based on the formula proposed by (Riduwan, 2019).

$$\mathbf{P} = \frac{\sum \mathbf{x}}{\sum \mathbf{xi}} \times \mathbf{100\%}$$

Description:

$\mathbf{P} =$ **Validity percentage**

$\sum \mathbf{x} =$ **Total score obtained**

$\sum \mathbf{xi} =$ **Maximum possible score**

The calculation results in percentage form are used to classify the feasibility level of the student worksheet based on the established feasibility criteria as follows:

Table 1. Validity Criteria.

Description	Criteria
$\mathbf{81\% < V \leq 100\%}$	Very Valid
$\mathbf{61\% < V \leq 80\%}$	Valid
$\mathbf{41\% < V \leq 60\%}$	Moderately Valid
$\mathbf{21\% < V \leq 40\%}$	Low Validity
$\mathbf{0\% < V \leq 20\%}$	Not Valid

(Riduwan, 2019)

The student worksheet is considered valid if the assessment scores from the experts fall at least within the "valid" category. Feedback and suggestions from the validators are used as the basis for making improvements and refinements to the product.

3. Results and Discussion

Result

The development of ethnomathematics-based student worksheet using Batik Sekundang from South Bengkulu for plane geometry material was conducted using the 4D development model, beginning with the defining stage (Define). At this stage, curriculum analysis and student characteristic analysis were carried out, indicating the need for contextual and

meaningful mathematics learning for plane geometry in Phase C. Therefore, the material development focused on rectangles, rhombuses, and trapezoids, integrated with the local cultural context.

Batik Sekundang from South Bengkulu was chosen as the main context because its motifs contain various plane shapes, such as rectangles, rhombuses, and trapezoids, which can be identified concretely. Utilizing batik motifs as a learning context supports the implementation of Contextual Teaching and Learning (CTL) by connecting mathematical concepts with cultural objects that are familiar to students in their daily lives.

Next, in the design stage (Design), the student worksheet draft and research instruments were prepared. The student worksheet was designed to facilitate students in exploring local culture through activities such as observing, identifying, and analyzing plane shapes present in Batik Sekundang motifs. Consequently, mathematics learning is expected to become more meaningful, contextual, and relevant to students' real-life experiences. The details of the developed student worksheet design are presented in Table 2.

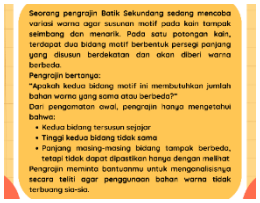
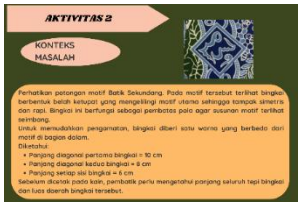
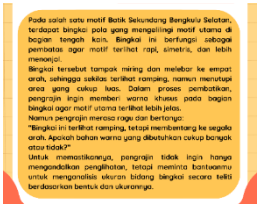
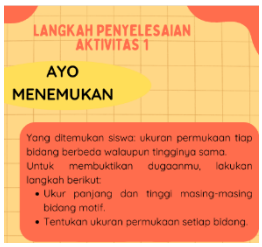
Table 2. Description of the LKPD Structure Design Based on Batik Sekundang South Bengkulu.

Student Worksheet Section	Design Description
Introduction	Includes the cover page, student worksheet identity, learning objectives, and instructions for use as an introduction to the learning activities.
Contextual and Conceptual Exploration	Presents an introduction to Batik Sekundang from South Bengkulu and the exploration of plane geometry concepts (rectangles, rhombuses, and trapezoids) linked to the batik motifs.
Learning Activities and Reflection	Contains learning activities based on contextual problem-solving using the CTL syntax, as well as student self-reflection to assess understanding and learning experiences.

After the ethnomathematics-based student worksheet design using Batik Sekundang motifs was fully developed, the next stage was validity testing through expert evaluation to assess the theoretical and pedagogical appropriateness of the student worksheet. This process focused on the clarity of the plane geometry material presentation and its integration with the Contextual Teaching and Learning (CTL) approach.

Based on the feedback from the validators, the developed student worksheet was revised in several components prior to the final validity assessment. These revisions included improvements in language phrasing, reorganization of the material presentation flow, and clarification of the learning activities. The specific changes made are described as follows:

Table 3. Design Changes in the Student Worksheet Presentation.

Material Description Before Revision	Validators Suggestions	Material Design After Revision
	The validator suggested that the visual design of the student worksheet be adjusted to the characteristics of Phase C students. The use of overly dark colors should be avoided and replaced with brighter colors, engaging illustrations, and a simple, child-friendly layout, in order to enhance visual appeal, learning comfort, and student engagement in the learning process.	
	The validator emphasized that the concepts and formulas for the area of plane shapes should not be presented directly to students. Instead, the concept of area should be developed gradually through learning activities, allowing students to construct their understanding independently before being introduced to the formal area formulas.	
	The validator suggested that the problems presented should be genuinely contextual and aligned with the accompanying illustrations.	
	The Batik Sekundang motif illustrations should include clear markings on the parts of the motif that are the focus of the mathematical study, so that students do not experience ambiguity in understanding the problems and can carry out accurate mathematical modeling.	
	The presentation of the Contextual Teaching and Learning (CTL) syntax in the LKPD needs to be made more explicit and structured, with clear emphasis on each step of the learning activities (such as "Let's Observe," "Let's Listen," "Let's Practice," and "Let's Discuss"), specifying what students are expected to do, the competencies being practiced, and the mathematical concepts being constructed, in order to make the learning flow more directed and meaningful.	

After the design revision stage, the developed LKPD was subsequently tested for formal validity. This validity test included three main components: content/material feasibility, quality of instructional media, and language and readability aspects, in accordance with the validation instruments used by the experts.

Content/Material Feasibility Aspect

The content/material feasibility aspect includes the alignment of plane geometry material with the intended learning outcomes and learning objectives sequence, the accuracy of the plane area concepts presented, the suitability of the Batik Sekundang motifs from South Bengkulu with the mathematics material, and the integration of learning activities based on the Contextual Teaching and Learning (CTL) approach. A summary of the validation results for the content/material feasibility aspect is presented in Table 4.

Table 4. Validation Results for the Content/Material Feasibility Aspect.

Aspect	Maximum Score	Average Score	Percentage (%)	Category
Content/Material Feasibility	48	42	87,50	Very Valid

The validation results indicate that the developed student worksheet falls into the "very valid" category in terms of content feasibility. This suggests that the presentation of plane geometry material, integrated with the ethnomathematics context of Batik Sekundang motifs from South Bengkulu, has been designed in a structured, logical manner and is aligned with the established learning outcomes.

Media Aspect

The media aspect includes the cover design, content layout, arrangement of elements, illustrations and images, font usage, as well as the suitability of colors and overall appearance of the LKPD. A summary of the validation results for the media aspect is presented in Table 5.

Table 5. Validation Results for the Media Aspect.

Aspect	Maximum Score	Average Score	Percentage (%)	Category
Media	52	42	80,76	Valid

The validation results indicate that the media components of the LKPD have met the validity criteria. This suggests that the visual design and overall presentation are able to support the learning process. Nevertheless, further refinement is needed in the sequencing of learning activities, particularly in guiding students to construct the concept of area through the context of Batik Sekundang motifs gradually before using formal formulas, in order to better facilitate students' thinking in a contextual manner.

Language and Readability Aspect

The language and readability aspect includes language clarity, conformity with standard Indonesian language rules, clarity of instructions, and consistency in the use of mathematical terms. The validation results for the language aspect are presented in Table 6.

Table 6. Validation Results for the Language and Readability Aspect.

Aspect	Maximum Score	Average Score	Percentage (%)	Category
Language and Readability	16	14	87,50	Very Valid

Based on these results, the language used in the LKPD is considered easy to understand, communicative, and in accordance with the applicable Indonesian language standards.

Summary of Overall Validation Results

Table 7. Summary of Validation Results.

Aspect	Percentage (%)	Category
Content/Material Feasibility	87,50	Very Valid
Media	80,76	Valid
Language and Readability	87,50	Very Valid
Overall Average	85,25	Very Valid

Based on this summary, the ethnomathematics-based student worksheet using Batik Sekundang motifs from South Bengkulu falls into the "very valid" category, and is therefore deemed suitable to be used as a teaching material.

Discussion

The development of the Student Worksheet (LKPD) based on ethnomathematics with the context of Batik Sekundang motifs from South Bengkulu for plane geometry, oriented towards Contextual Teaching and Learning (CTL), underwent validation by experts. This validation process aimed to assess the feasibility of the product from three main aspects: content feasibility, media quality, and language appropriateness, as recommended in educational development research (Akker, 1999). Expert validation is an essential stage to ensure that the developed LKPD aligns with curriculum requirements, the characteristics of Phase C students, and the principles of contextual learning.

Based on the evaluation by two expert validators, the developed LKPD obtained an average validity percentage of 85.25%, falling into the "very valid" category. Specifically, the content/material feasibility aspect scored 87.50% (very valid), the media aspect 80.76% (valid), and the language and readability aspect 87.50% (very valid). These results indicate that the LKPD meets the feasibility criteria as a supplementary teaching material for mathematics learning in Phase C of elementary school.

This level of validity was achieved through the application of the 4D development model, modified into 3D: define, design, and develop. In the define stage, an analysis was conducted on the Phase C elementary school learning outcomes and student characteristics for plane geometry, particularly rectangles, rhombuses, and trapezoids. The design stage focused on preparing the LKPD design based on contextual activities, utilizing Batik Sekundang motifs from South Bengkulu as learning resources. Finally, the develop stage involved expert validation and product revision based on the feedback received.

Content/Material Feasibility Aspect

The plane geometry material in the LKPD has been arranged in alignment with the Phase C learning outcomes and objectives. Mathematical concepts are not presented directly in the form of formulas, but are constructed through contextual activities and problems derived from Batik Sekundang motifs. Students are guided to observe, measure, and discuss elements of plane geometry in the batik motifs, enabling them to independently construct an understanding of area concepts. This approach aligns with the main principles of CTL, which emphasize the connection between learning material and students' real-life experiences. These findings are consistent with previous studies (Marfera et al., 2022; Lestari & Fadiana, 2025) which indicate that ethnomathematics-based LKPD integrated with CTL can support meaningful and contextual mathematics learning. Furthermore, (Afni et al., 2025) highlight that utilizing local cultural contexts from Bengkulu in mathematics LKPD can strengthen the

relevance of the material to students' lives and support the achievement of learning objectives in elementary schools.

Media Feasibility Aspect

The LKPD is considered to have a visual design suitable for the characteristics of Phase C students. Based on validator feedback, the LKPD design was revised to be more cheerful, proportionate, and not dominated by dark colors. The page layout is systematically organized from cultural exploration, concept introduction, core activities, to self-reflection. Additionally, mathematical objects in the Batik Sekundang motif illustrations were clearly marked to help students focus on the parts of the motif being analyzed mathematically. These results are in line with findings by (Romadhon, 2024) and supported by (Syam & Pujiastuti, 2023), who state that visual clarity and geometric shape representation in batik motifs play an important role in supporting students' understanding of mathematical concepts.

Language Feasibility Aspect

The LKPD uses simple, communicative Indonesian language appropriate for the cognitive development of Phase C students. Learning instructions are clearly and sequentially organized, avoiding ambiguity. Mathematical terms are introduced gradually through contextual activities, making it easier for students to understand the material. These findings are consistent with (Setiawan & Hakim, 2025), who note that the use of communicative language in CTL-based LKPD can enhance students' engagement in the learning process.

Overall, the validation results indicate that the ethnomathematics-based LKPD using Batik Sekundang motifs from South Bengkulu for plane geometry has met the feasibility criteria in terms of content, media, and language. Therefore, this LKPD is suitable to be used as a supplementary teaching material for mathematics learning oriented towards Contextual Teaching and Learning (CTL) for Phase C elementary school students, and is relevant to the spirit of the Merdeka Curriculum, which emphasizes contextual learning and local wisdom.

6. Conclusion

The development of the ethnomathematics-based student worksheet using Batik Sekundang motifs from South Bengkulu for plane geometry, oriented towards Contextual Teaching and Learning (CTL), resulted in a product with a very high level of validity, with an overall average score of 85.25%. Validator assessments showed that the student worksheet met the criteria for content feasibility (87.50%), media feasibility (80.76%), and language feasibility (87.50%). The development process was conducted using the 4D model modified into 3D, consisting of the define, design, and develop stages.

Based on expert validation results, the developed student worksheet is deemed suitable to be used as mathematics teaching material for Phase C elementary school students. The student worksheet integrates the local cultural context of Batik Sekundang from South Bengkulu into plane geometry learning through the CTL approach, thereby supporting contextual mathematics learning that aligns with the learning outcomes of the Merdeka Curriculum.

Suggestions for future research include conducting practicality and effectiveness tests of the LKPD through direct classroom implementation, developing the LKPD in a digital format, and expanding the application of local cultural contexts as learning resources for mathematics in elementary schools.

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