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DEVELOPMENT OF ETHNOMATHEMATICS-BASED STUDENT WORKSHEETS ON THE ORNAMENTS OF MAIMUN PALACE IN MEDAN

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ABSTRACT

This study aims to develop valid, practical, and effective ethnomathematics-based worksheets using the ornaments of Maimun Palace in Medan for Grade IX students of SMP Sinar Husni in the 2024/2025 academic year. This research uses the Research and Development (R&D) development model of the ADDIE model which includes Analysis, Design, Development, Implementation, and Evaluation. The research subjects were 22 students of class IX-2 SMP Sinar Husni. Validation results indicate high validity indices from material (0.82), media (0.82), and language experts (0.83). Teachers and students rated the worksheets as very good and practical, with average scores of 3.7 and 3.33 out of 4.00 respectively. Student responses fall into the 'very strong' category, with a score of 83.31%. Effectiveness is seen from classical learning completeness of 86.37% and an increase in learning outcomes of 59.37%. The average N-gain value is 0.53 (medium category). Therefore, the developed ethnomathematics-based worksheets can serve as innovative and effective alternative teaching materials to improve students' learning outcomes.

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1. INTRODUCTION

Education quality is a crucial indicator of national development (Suryani *et al*., 2020). The Indonesian government has implemented new policies to improve the quality of education (Mendikbud., 2020); however, disparities still exist, as reflected in the high illiteracy rate and unequal access to education (Anita & Astuti, 2022). Educational reforms have also been driven by economic elites in the hope of providing more comprehensive and equitable access for all segments of society (Syakarofath *et al*., 2020). Nevertheless, international assessments still show that Indonesian students perform poorly, indicating the need for further improvement (Firmansyah *et al*., 2020). Efforts to enhance education quality cannot rely solely on improving facilities, infrastructure, and curriculum (Nugraheni & Jailani, 2020), but must also be supported by effective learning processes.

Learning involves guiding students to actively construct knowledge (Suryani *et al*., 2020). The goal of this activity is to facilitate the development of students' potential to support their optimal learning achievement (Harefa *et al*., 2022). Therefore, the Minister of Education places great expectations on teachers, as national assets, to carry out their duties effectively (Minarni *et al*., 2020). A qualified teacher must carefully design instructional tools before teaching in the classroom to ensure an effective learning process (Nuraini *et al*., 2020). Typically, learning begins with contexts relevant to students' lives and involves real-life environments as sources of problems, so they can more easily grasp the subject matter being studied (Suanto *et al*., 2022). If the learning process is not well designed, the quality of education will decline and may lead to failure.

Student failure in learning often occurs due to teacher-centered instructional approaches (Murtiyasa & Wulandari, 2020). A lack of variety in teaching methods can lead to student boredom and reduced engagement in classroom activities (Mubharokh *et al*., 2021). Although teachers are expected to be active in delivering lessons, the use of conventional methods may actually diminish student involvement in the learning process (Rahmadhani *et al*., 2024). Teachers play a crucial role in motivating students, creating a comfortable classroom atmosphere, and fostering creativity to achieve learning objectives (Faturohman et al., 2020). Mathematics, taught at all levels, requires innovative approaches due to its abstract and complex nature (Dewi *et al*., 2020).

Its significance lies in its relevance to everyday life, as many aspects of our surroundings are closely related to mathematics (Afri & Reflina, 2024). This subject not only contributes to improving the quality of human resources (Lesi & Nuraeni, 2021), but also fosters critical, logical, and systematic thinking skills, as well as problem-solving abilities (Husnah *et al*., 2021). In addition, mathematics contributes to cognitive development that helps shape students' character and behavior (Risanti *et al*., 2021). By understanding mathematical concepts and procedures, students are better able to apply various scientific aspects to real-life situations, thereby enhancing the effectiveness of mathematics learning (Muhtadi *et al*., 2021).

Mathematics learning is essential as it helps students interpret concepts, explain ideas, and solve problems more effectively (Atiyah & Nuraeni, 2022). In solving problems, students must go through the stages of problem formulation and selecting appropriate strategies (Lubis & Lubis, 2024). Students' awareness of their own understanding—including gaps in facts, relationships, and procedures—is a crucial aspect in improving the quality of learning (Atiyah & Nuraeni, 2022). Furthermore, mathematics learning involves various activities such as observing, questioning, experimenting, reflecting, presenting, and creating, all of which contribute to a more effective learning

process (Mainake *et al*., 2021). To make mathematics learning more meaningful, the activities carried out must meet established standards (Nurbayan & Basuki, 2022). Therefore, through mathematics learning, students are expected to achieve the competencies targeted for each learner (Faturohman & Afriansyah, 2020).

Many students perceive mathematics as difficult and intimidating, resulting in low interest and achievement (Narpila, 2020; Hermawati *et al*., 2021). As a result, their interest in learning mathematics significantly decreases (Firnanda & Pratama, 2020). Moreover, the delivery of material remains too teacher-centered, which limits students' ability to fully grasp mathematical concepts (Afriansyah *et al*., 2020). During the learning process, many students face obstacles in understanding the lessons presented by the teacher, further reinforcing their perception that mathematics is a subject filled with difficulties (Ali *et al*., 2022).

Many students often struggle to understand mathematical formulas and frequently make errors in applying them (Mubharokh *et al*., 2021). In addition, challenges such as low conceptual understanding, difficulty in designing problem-solving strategies, and time pressure also contribute to these difficulties (Lubis & Lubis, 2024). These issues are partly due to the lack of visualization of abstract mathematical objects by teachers in the classroom, which makes the learning material feel even more difficult (Lestari & Afriansyah, 2021). Moreover, many teachers tend to rely heavily on presenting examples that are similar to those found in textbooks (Sumartini *et al*., 2020).

Mathematics textbooks often use a thematic approach with story-based problems (Santoso *et al*., 2020), which makes it difficult for students to understand the content (Wahyuni & Wahyuni, 2025). Furthermore, the instructional media used by teachers tend to be monotonous (Ali *et al*., 2022) and lack variety, causing students to feel bored and become passive. Therefore, teachers need to demonstrate creativity so that students enjoy the learning process (Mubharokh *et al*., 2021). This creativity can be reflected in the development of learning media that enhance students' motivation to learn, one of which is through the use of alternative tools suited to the learning context, such as student worksheets (LKPD) (Nuraini *et al*., 2020).

Student worksheets (LKPD) are widely used in the learning process because they help students understand the material. However, the available LKPD still has limitations in explaining key learning concepts (Umaroh *et al*., 2022). In addition, these worksheets are often conventional and fail to enhance student participation in the learning process (Wahyuni & Wahyuni, 2025). Moreover, the existing LKPD tends to be less engaging for students, as it is limited to text and static images, which leads to a decline in students' interest in learning (Umaroh *et al*., 2022).

Interactive and contextual student worksheets (LKPD) can increase motivation and learning effectiveness (Santoso *et al*., 2020). To address this issue, teachers need to provide opportunities that encourage students to be more active and creative during the learning process (Nuraini *et al*., 2020), so that they can better understand the material and are less likely to make mistakes.

One of the methods that teachers can use to support the learning process is the use of Student Worksheets (LKPD). This study aims to develop and evaluate the quality of an ethnomathematics-based LKPD on translation material for Grade IX students at SMP Sinar Husni. The focus of the research includes the development process as well as the assessment of the LKPD's validity, practicality, and effectiveness. This study is considered relevant because it integrates mathematical concepts with local culture, thereby enhancing students' learning outcomes in a contextual and engaging manner.

Based on the previously described problems, the author is interested in developing mathematics teaching materials in the form of ethnomathematics-based LKPD.

Ethnomathematics is a field of study that connects mathematics with culture. The term was first introduced by D'Ambrosio (1985), who defined it as "the ways, styles, and techniques used to explain, understand, and interact with the natural and cultural environment within various cultural systems." In the context of education, ethnomathematics serves as an approach to explain mathematical concepts through local cultural practices (Afri *et al*., 2024). The goal of this approach is to make mathematics more meaningful and contextual, and to increase student participation in learning by connecting it to their own cultural background (Hadi, 2018).

Previous studies (Fairuz *et al*., 2020); (Luthfi & Rakhmawati, 2022); (Rahmadhani *et al*., 2024) have shown that ethnomathematics-based student worksheets (LKPD) are valid, practical, and effective in enhancing students' understanding and interest in learning. The development of ethnomathematics-based LKPD integrates local cultural values and practices into mathematics learning activities. According to Marsigit (2017), such worksheets encourage students to understand mathematical concepts through cultural contexts such as ornaments, traditional buildings, or patterns found in local crafts. This approach positions mathematics not only as an exact science but also as a part of cultural heritage. This study aims to develop an ethnomathematics-based student worksheet using cultural ornaments from Maimun Palace, to improve the learning of transformation topics in mathematics. Accordingly, this study is entitled "**Development of Ethnomathematics-Based Student Worksheets on the Ornaments of Maimun Palace in Medan**."

2. METHOD

This study adopts a Research and Development (R&D) approach to design, develop, and evaluate a learning product. According to Sugiono (2015), the R&D method aims to create a product and evaluate the effectiveness of the resulting output. This research implements the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation) as proposed by Lee and Owens (2004), as cited by Khatimah, dkk. (2015), which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

In the analysis stage, curriculum review, student needs assessment, and concept mapping were conducted to determine relevant content for the LKPD. The design stage involved formulating learning objectives and indicators, designing the content and layout of the LKPD, and developing assessment instruments. The development stage included validation by three lecturers and one mathematics teacher, followed by revisions of the product. The implementation stage was carried out through a field trial involving 22 ninth-grade students of class IX-2 at SMP Sinar Husni as a purposive sample, selected from one class due to considerations of ease of management and uniformity of learning conditions. The evaluation stage aimed to assess the quality of the learning process. In this stage, the researcher identified the strengths and weaknesses of the developed LKPD.

The validity of the LKPD was analyzed using a Likert scale. To calculate the validity of the LKPD, the validity instrument was obtained through assessments by validators, namely material experts, media experts, and language experts, using evaluation questionnaires. The average score for each aspect was computed using the following formula (Retnawati, 2016):

$$V = \frac{\sum S}{n(c-1)}$$

Table 1. Validation Criteria for Student Worksheets (LKPD)

No.	Achievement Level	Category	Description
1.	> 0,8	High	Very Valid
2.	0,4 - 0,8	Medium	Valid
3.	< 0,4	Low	Not Valid

Source:(Akbar, 2013)

Next, to determine the practicality of the LKPD, the percentage and responses of each student were first calculated using the following formula (Sugiono, 2015):

$$NR = \frac{Total\ score\ of\ students'\ responses\ for\ each\ aspect}{Total\ possible\ score\ of\ all\ response\ items\ for\ each\ aspect} \times 100\%$$

Table 2. Percentage Criteria of Teacher and Student Response Scores

Score Interval	Criteria
$3{,}25 < x \leq 4{,}00$	Very Practical
$2{,}50 < x \leq 3{,}25$	Practical
$1{,}75 < x \leq 2{,}50$	Less Practical
$0 < x \leq 1{,}75$	Not Practical

Source: (Sudijono, 2010)

To determine the effectiveness of the LKPD, pretest and posttest were administered using story-based questions consisting of two items. The Minimum Mastery Criterion (KKM) was set at 75. Individual mastery is considered achieved when a student obtains a score of 70% or higher, which meets the school's Minimum Mastery Criteria (KKM). The average score was calculated using the following formula (Riduwan, 2011):

$$Individual\ Mastery = \frac{Score\ Obtained}{Maximum\ Score} \times 100\%$$

Then, the following formula is used to determine students' classical mastery in order to evaluate the effectiveness of the LKPD (Riduwan, 2014):

$$Classical\ Mastery = \frac{Number\ of\ Students\ Who\ Mastered}{Number\ of\ students\ present} \times 100\%$$

Table 3. Qualification of LKPD Effectiveness

Achievement Range	Description
80% - 100%	Very Effective
60% - 80%	Effective
40% - 60%	Less Effective
0% - 40%	Not Effective

Source: (Sudijono, 2010)

Finally, to calculate the difference in learning outcomes before and after using the ethnomathematics-based LKPD to improve effectiveness, the following N-gain formula is used (Nismalasari & dkk., 2016):

$$N - gain = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

Table 4. Interpretation of Normalized Gain Scores

Normalized Gain Score (g)	Category
-1,00 < g < 0,00	Decreasing
g = 0.00	Stable
0.00 < g < 0,30	Low
0,30 < g < 0,70	Medium
0,70 < g < 1, 00	High

3. RESULTS AND DISCUSSION

3.1. Results

This study aims to develop an ethnomathematics-based Student Worksheet (LKPD) focused on the ornaments of Maimun Palace as teaching material for the translation topic in class IX-2 at SMP Sinar Husni for the 2024/2025 academic year. The development model applied in this study is ADDIE, which stands for Analysis, Design, Development, Implementation, and Evaluation.

Analysis Stage: Curriculum analysis was conducted based on observations in class IX-2 at SMP Sinar Husni, which has implemented the Merdeka Curriculum. The researcher identified the Competency Standards (KD) and Basic Competency Indicators (IPK) needed for developing the LKPD on the translation material using an ethnomathematics approach, with the ornaments of Maimun Palace in Medan as the contextual basis. The needs analysis revealed a lack of effective learning media, underscoring the urgency of developing contextual teaching materials aligned with students' characteristics. Therefore, an ethnomathematics-based LKPD was developed to improve students' mathematics learning outcomes. Concept analysis was carried out to organize the translation material in a structured manner with an attractive layout and concise, clear presentation to facilitate comprehension. The identified KD and IPK served as references in formulating learning indicators and objectives.

Design Stage: The researcher created a design to develop an ethnomathematics-based Student Worksheet (LKPD) focused on the ornaments of Maimun Palace in Medan. In this stage, the worksheet structure and content were outlined. The main outputs included:

1. Preparing Reference Books

   Reference books and images relevant to the translation material were prepared to support the development of the LKPD.

2. Developing Product Design

   The developed Student Worksheet (LKPD) product was designed according to the translation material and the ethnomathematics approach in learning as determined. The designed LKPD includes several components, such as: cover page, basic competencies, competency achievement indicators, learning outcomes, main topics, learning models, learning objectives, supporting information, instructions for use, materials, student activities, problem-solving practice questions, and bibliography.

Development Stage: At this stage, the previously designed plan is realized into a tangible product. The steps carried out in this stage are as follows:

1. Product Design Development

   Figure 1 below shows the layout of the LKPD after incorporating the design elements.

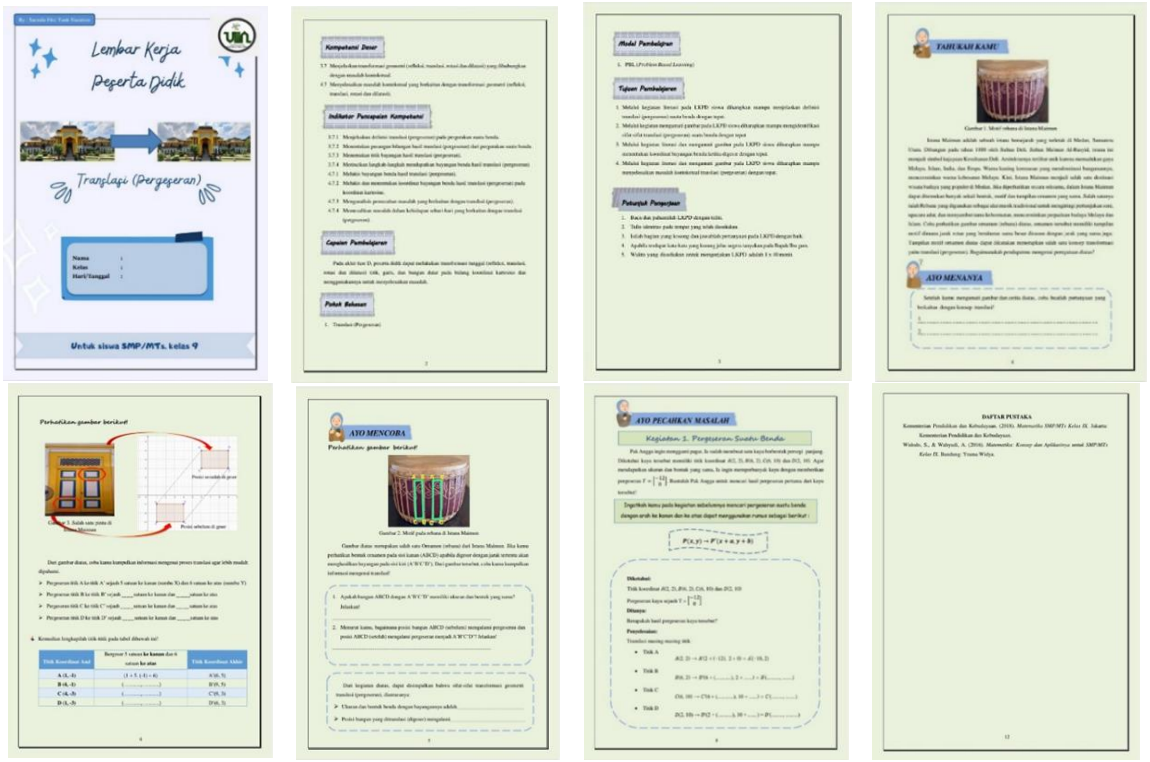

Figure 1. LKPD Design After Revision

2. Revision

Based on the validation results from each validator, the suggestions and feedback were collected, processed, and implemented to optimize the usability of the learning device. The improvements made include: (1) the insertion of basic competencies, competency achievement indicators, learning outcomes, and main topics on page 2 of the LKPD (suggestions from the content expert); (2) the addition of learning models, captions for images on pages 6 and 7, and markers for each angle on page 9 of the LKPD (suggestions from the media expert); and (3) the addition of the word “rattan” to clarify the story sentence, an explanation of the function of the rebana as an ornament, and a lead-in sentence on page 4, as well as improvements to the wording of questions on page 5 of the LKPD (suggestions from the language expert).

3. Validation

Next, the LKPD product was validated by three experts: a content expert, a media expert, and a language expert, as well as one mathematics teacher serving as a content expert. The results are as follows:

Table 5. Validation Results from Experts for the LKPD

No.	Evaluator	Average Score	Category
1.	Content Expert	0.82	Very Valid
2.	Media Expert	0.82	Very Valid
3.	Language Expert	0.83	Very Valid
	Average	**0.82**	**Very Valid**

The validation results from the content expert, media expert, and language expert indicate that the LKPD has a high level of validity, with an average Aiken’s index of 0.82.

Implementation Stage: An assessment was conducted to evaluate the practicality and effectiveness of the developed LKPD. The following are the results of the tests related to its practicality and effectiveness:

1. Product Trial

To determine the practicality of the LKPD, the responses from teachers and students were collected and analyzed.

Table 6. Responses from Teachers and Students Regarding the LKPD

No.	Evaluator	Average Score	Category
1.	Teacher Response	3.7	Very Practical
2.	Student Responses	3.33	Very Practical
	Average	**3.51**	**Very Practical**

Based on the average results above, the teacher questionnaire indicated a very high level of practicality with an average score of 3.7, covering aspects of ease of use and assistance, thus no revisions were necessary. Meanwhile, the student responses also showed a very high practicality with an average score of 3.33, based on content feasibility, presentation, language, and appearance, resulting in a student practicality percentage of 83.31%. When combined with the teacher responses, the overall average score was 3.51, indicating that the LKPD is classified as highly practical.

After undergoing validation and revisions by experts in content, media, and language, the field trial of the ethnomathematics-based LKPD was conducted in class IX-2 at SMP Sinar Husni from May 5th to 8th, 2025, involving 22 students. The trial included a pre-test, the use of the LKPD, a post-test, and questionnaires completed by both the teacher and students. In terms of effectiveness, only 6 out of 22 students (27%) met the Minimum Competency Criteria (KKM) on the pre-test, whereas after using the LKPD, the number increased to 19 students (86.37%). This significant improvement demonstrates the positive impact of the ethnomathematics-based LKPD.

Table 7. Student Assessment Results from Pre-test and Post-test

Respondents	Pre-test	Post-test	N-gain
Total Score	1274	1762	11,668
Average	57,90	80,09	0,5303
Highest Score	78	100	
Lowest Score	20	60	

The average score increased from 57.90 to 80.09, with an N-gain of 0.5303, which falls into the moderate category. This indicates that the ethnomathematics-based Student Worksheet (LKPD) is effective in improving students' learning outcomes in the topic of translation.

The final phase**, evaluation,** consists of formative and summative assessments. Formative evaluation is conducted during the early development process and aims to improve the product based on feedback and suggestions from validators. In contrast, summative evaluation is carried out after the implementation phase, involving both educators and students as assessors. Therefore, the developed Student Worksheet (LKPD) can be considered feasible and appropriate for use in the learning process.

3.2. Discussion

Ethnomathematics is a study that connects mathematics with culture. Ethnomathematics-based learning allows students to recognize and relate mathematical concepts to everyday life, making the learning process more engaging and meaningful Surat (2018). This aligns with the opinion of Marsigit (2017), who states that this approach encourages students to actively discover concepts and creates a conducive classroom atmosphere. This study aims to develop ethnomathematics-based student worksheets (LKPD) using the ornaments of Maimun Palace in Medan, as well as to evaluate their validity, practicality, and effectiveness. The development follows the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages.

At the analysis stage, the researcher conducted a needs assessment by interviewing a mathematics teacher at SMP Sinar Husni. It was found that the learning process was still conventional, with students relying heavily on the teacher, and that students' understanding of translation material was low due to the abstract nature of the presentation. By utilizing local cultural ornaments such as the ornaments of Maimun Palace, which contain elements of translation, the learning process can be made more contextual. The design stage involved developing a systematic and engaging student worksheet (LKPD) that integrates cultural elements, academic content, communicative language, and appropriate assessment tools aligned with the Merdeka Curriculum for Grade IX SMP/MTs.

At the development stage, the product was refined and validated by experts to assess its feasibility and completeness. Products that did not meet the criteria were revised based on the feedback provided. In the implementation stage, the LKPD was applied through direct classroom instruction and teacher training, and it proved effective in enhancing student engagement and understanding. The evaluation stage involved tests, questionnaires, and observations, which indicated that the LKPD was effective in improving students' learning outcomes. This evaluation serves as the basis for continuous improvement to ensure that the quality of learning becomes increasingly relevant and meaningful.

4. CONCLUSION

This study reports the development of an ethnomathematics-based Student Worksheet (LKPD) using the context of the Maimun Palace ornaments for teaching translation material, based on the ADDIE model. Validation and testing results indicate that the LKPD is highly valid, practical, and moderately effective in improving learning outcomes. This indicates that integrating cultural elements into mathematics instruction holds promise for contextualized and meaningful learning. Nonetheless, the primary limitation of this study lies in the limited scale of the trial, which may restrict the extent to which the findings can be generalized. Future studies should consider wider implementation and explore digital adaptations to align with current educational technologies.

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