

DEVELOPMENT OF AN ETHNOMATHEMATICS-BASED E-MODULE ON THE DORI MPULOR TRADITIONAL HOUSE TO ENHANCE STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY

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ABSTRACT This study was motivated by the low performance of Indonesian students in mathematics, as reflected in the 2022 PISA results, which indicated that Indonesia's average mathematics achievement remained below the OECD average. This condition shows the need for learning materials that can support students' conceptual understanding and mathematical problem-solving ability through contextual and meaningful learning. This study aims to develop an ethnomathematics-based e-module on the Dori Mpulor traditional house to enhance students' mathematical problem-solving ability. The research employed the ADDIE development model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages. The research subjects were 85 junior high school students from three schools in Landak, Sanggau, and Sekadau Regencies. Data were collected through observation, questionnaires, interviews, and mathematical problem-solving tests. The quality of the e-module was assessed based on validity, practicality, and effectiveness. The results showed that the e-module obtained an average validity score of 92.55%, categorized as very valid, and an average practicality score of 90.90%, categorized as very practical. The effectiveness test produced an N-Gain score of 0.76, categorized as high. These findings indicate that the ethnomathematics-based e-module on the Dori Mpulor traditional house is valid, practical, and effective in enhancing students' mathematical problem-solving ability. The e-module also provides contextual learning experiences by connecting formal mathematical concepts with local cultural values.

Keywords: Dori Mpulor traditional house, e-module, ethnomathematics, mathematical problem-solving ability, local culture

ABSTRAK Penelitian ini dilatarbelakangi oleh rendahnya capaian siswa Indonesia dalam matematika, sebagaimana tercermin dalam hasil PISA 2022 yang menunjukkan bahwa rata-rata capaian matematika Indonesia masih berada di bawah rata-rata OECD. Kondisi ini menunjukkan perlunya bahan ajar yang dapat mendukung pemahaman konseptual dan kemampuan pemecahan masalah matematis siswa melalui pembelajaran yang kontekstual dan bermakna. Penelitian ini bertujuan untuk mengembangkan e-modul berbasis etnomatematika pada rumah adat Dori Mpulor untuk meningkatkan kemampuan pemecahan masalah matematis siswa. Penelitian ini menggunakan model pengembangan

ADDIE yang terdiri atas tahap Analysis, Design, Development, Implementation, dan Evaluation. Subjek penelitian adalah 85 siswa SMP dari tiga sekolah di Kabupaten Landak, Sanggau, dan Sekadau. Data dikumpulkan melalui observasi, angket, wawancara, dan tes kemampuan pemecahan masalah matematis. Kualitas e-modul dinilai berdasarkan aspek validitas, kepraktisan, dan efektivitas. Hasil penelitian menunjukkan bahwa e-modul memperoleh skor validitas rata-rata sebesar 92,55% dengan kategori sangat valid dan skor kepraktisan rata-rata sebesar 90,90% dengan kategori sangat praktis. Uji efektivitas menghasilkan skor N-Gain sebesar 0,76 yang termasuk dalam kategori tinggi. Temuan ini menunjukkan bahwa e-modul berbasis etnomatematika pada rumah adat Dori Mpulor valid, praktis, dan efektif dalam meningkatkan kemampuan pemecahan masalah matematis siswa. E-modul ini juga memberikan pengalaman belajar yang kontekstual dengan menghubungkan konsep matematika formal dan nilai budaya lokal.

Kata-kata kunci: rumah adat Dori Mpulor, e-modul, etnomatematika, kemampuan pemecahan masalah matematis, budaya lokal

INTRODUCTION

Mathematics education plays an important role in developing students' ability to reason, think critically, and solve problems in various contexts. However, students' mathematical thinking ability in Indonesia still needs serious attention. The results of PISA 2022 and TIMSS 2019 show that Indonesian students' mathematical thinking ability is still far below the average, with nearly 70% of junior high school students struggling to solve problems that require mathematical reasoning (Susanti et al., 2025). Without sufficient practice, students may not develop the problem-solving ability required for effective performance (Apriani & Sudiansyah, 2024). This condition in mathematics learning is associated with teacher-centered instruction and individual differences in subject mastery, problem-solving ability, aptitude, and other factors (Apriani & Sudiansyah, 2024).

Students who possess problem-solving ability are able to solve problems comprehensively and apply them to everyday life, ultimately enhancing their understanding of mathematical concepts. Strengthening students' understanding through mathematical problem solving can equip them to think creatively, logically, critically, analytically, and systematically (Surya et al., 2017). Problem solving is a competency demonstrated by students through their ability to understand and select appropriate solution strategies to solve a problem (Susanti et al., 2025). Polya, as cited in Chang (2010), reveals that there are four steps in problem solving, namely understanding the problem, planning a solution, solving the problem according to the plan, and rechecking all the steps that have been carried out. Students who engage in mathematical problem solving are also able to enhance their creativity, strengthening the relationship between problem solving and creative thinking (Hidayat & Evendi, 2022). Creative thinking in mathematics involves both logical and divergent thinking, which are essential components of effective problem solving (Purwasih et al., 2019). Therefore, problem-solving ability is not only essential for understanding mathematical concepts, but also plays a vital role in fostering critical,

logical, and creative thinking abilities that can be applied in various aspects of daily life.

One of the goals of learning mathematics at school is to develop students' thinking ability so they can effectively solve problems, especially mathematical problems (Prameswari & Muniri, 2023). A key factor in students' success in mastering a lesson can be seen from how effectively the teacher delivers the materials (Jawad et al., 2021). Teachers must first understand students' needs in order to develop relevant and meaningful teaching materials. However, many teachers in schools still face difficulties in developing teaching materials (Mahardika et al., 2024). In the digital era, another challenge faced by teachers in mathematics learning is the ability to strengthen their professionalism, one aspect of which is the use of digital media (Khoridah et al., 2025). The integration of technology in mathematics learning can enhance instruction through interactive exploration and communication. Creative and innovative learning media, such as interactive digital teaching materials, can help students improve their problem-solving ability (Satriawan et al., 2020). Teachers can also utilize digital technology as a learning medium by developing interactive teaching materials such as e-modules (Larkin & Calder, 2016). E-modules are electronic versions of printed modules that can be accessed on a computer and designed using appropriate software (Maryam et al., 2019).

In response to these challenges in mathematics learning, transformational efforts are needed to bring mathematics closer to students' real-life contexts and cultures. Culture can be utilized to explore various mathematical concepts as part of a transformational approach that makes mathematics more relevant to the realities and perceptions of society (Rosa & Orey, 2016). Therefore, teachers need to prioritize learning innovation by considering strategies that engage students' interest and reflect their cultural backgrounds through the development of e-modules based on local culture.

However, based on the literature review, the development of ethnomathematics-based teaching materials specifically highlighting the context of the Dori Mpulor traditional house is still limited. The Dori Mpulor traditional house is the cultural context used in this research. The Dori Mpulor house contains various geometric concepts, such as parallel lines, angles, gradients, congruence, similarity, triangles, circles, cylinders, parallelograms, and trapezoids (Ellissi et al., 2024). This shows that the Dori Mpulor traditional house can be used as a context for developing digital teaching materials based on ethnomathematics. Therefore, the ethnomathematics-based e-module on the Dori Mpulor traditional house can serve as an alternative learning medium that is not only engaging but also meaningful for students. This research introduces novelty in the development of an e-module by integrating digital technology, an ethnomathematics approach, and the local cultural context of the Dori Mpulor traditional house as a means to support students' mathematical problem-solving ability. Based on the issues identified in the field, the research

problem in this study is how to develop an ethnomathematics-based e-module on the Dori Mpulor traditional house that is valid, practical, and effective in enhancing students' mathematical problem-solving ability.

METHODS

This research employed a developmental research model following the ADDIE framework, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The strength of this development model lies in its detailed and structured stages, as well as the presence of evaluation and revision at each stage (Firda & Nurhadi, 2023; Nursakti, 2016).

This research focused on developing an ethnomathematics-based e-module on the Dori Mpulor traditional house to enhance students' mathematical problem-solving ability. The subjects of this research were 85 eighth-grade junior high school students from three schools in Landak, Sanggau, and Sekadau Regencies. The selection of schools was conducted purposively by considering the availability of digital learning support facilities and the willingness of the schools to participate in the research. A small-scale trial was carried out in one junior high school from each regency, totaling three schools.

The data collection methods used in this study included observation, questionnaires, tests, and interviews. The instruments were developed through several stages, namely preparing the instrument grid based on research indicators, consulting with experts, revising the instruments according to expert suggestions, and applying them in the research process.

Observation sheets were used to analyze the development needs of the ethnomathematics-based e-module, including the learning process, teaching materials, student difficulties, and the use of local cultural contexts in mathematics learning. Validation sheets were used to assess the validity of the e-module in terms of content, language, presentation, media design, and the suitability of the ethnomathematics context of the Dori Mpulor traditional house. Implementation sheets were used to measure the practicality of the e-module based on ease of use, clarity of instructions, attractiveness, and usefulness in learning.

The test instrument was used to measure students' mathematical problem-solving ability. The test was designed in the form of essay questions so that students could demonstrate the stages of understanding the problem, planning a solution, carrying out the strategy, and checking the results. The test items were prepared based on problem-solving indicators and validated by experts before use. Effectiveness data were analyzed using the N-Gain score to determine the improvement in students' mathematical problem-solving ability after using the e-module. Interviews were conducted to confirm and strengthen the results of observations, questionnaires, and tests. Interview data were analyzed descriptively through data reduction, data presentation, and conclusion drawing.

The validation used in this study was content validity, conducted by one lecturer and two mathematics teachers. The practicality of the ethnomathematics-based e-module was assessed by three observers. The effectiveness of the ethnomathematics-based e-module was calculated using the N-Gain test based on the results of students' mathematical problem-solving ability tests. Through this test, the difference between students' pre-test and post-test results was identified. The assessment results were then categorized based on the levels of validity, practicality, and effectiveness, as presented in Tables 1, 2, and 3.

Table 1. Criteria for Validation Assessment Results

Validity Score	Category
$85\% \leq x \leq 100\%$	Very Valid
$70\% \leq x < 85\%$	Valid
$50\% \leq x < 70\%$	Less Valid
$x < 50\%$	Invalid

Table 2. Practicality Assessment Criteria

Practicality Score	Category
$85\% \leq x \leq 100\%$	Very Practical
$70\% \leq x < 85\%$	Practical
$50\% \leq x < 70\%$	Less Practical
$x < 50\%$	Impractical

Table 3. Effectiveness Assessment Criteria

N-Gain Score	Category
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Moderate
$g < 0.30$	Low

The success indicators for developing the ethnomathematics-based e-module were determined based on the aspects presented in Table 4.

Table 4. Success Indicators

Success Aspect	Success Indicator	Success Category
Validity level	Content	Minimum valid

Success Aspect	Success Indicator	Success Category
	Language	
Practicality level	Ease of use of the media	Minimum practical
	Time efficiency	
	Media appearance and appeal	
Effectiveness level	N-Gain	High

Students who are not accustomed to working with PISA-based questions often experience difficulties, which contributes to low PISA scores. One of the main contributing factors is their lack of familiarity with contextual questions that require problem-solving ability. Students tend to be accustomed to routine questions that emphasize memorization of formulas and procedural steps, without seeing the practical relevance of the material in everyday life (Sriwahyuni & Maryati, 2022). Therefore, the test instrument in this study was developed based on mathematical problem-solving indicators.

The indicators for measuring mathematical problem-solving ability, adapted from Sumarmo in Setiani (2023), are presented in Table 5.

Table 5. Mathematical Problem-Solving Ability Indicators

No	Mathematical Problem-Solving Ability Indicators
1	Understanding the problem
2	Planning the solution
3	Carrying out the plan
4	Checking again

FINDING AND DISCUSSION

The development of the ethnomathematics-based electronic module was carried out through the ADDIE development stages, consisting of analysis, design, development, implementation, and evaluation. This development model was selected because it provides systematic stages for designing, validating, implementing, and evaluating instructional media. In this study, the e-module was developed by integrating mathematical concepts found in the traditional Dori Mpulor house with learning activities aimed at improving students' mathematical problem-solving skills.

The first stage was the analysis stage. At this stage, student analysis, curriculum analysis, and material analysis were conducted. The student analysis aimed to identify students' learning characteristics and difficulties in solving mathematical problems. Based on the results of preliminary observation and interviews with mathematics teachers, students still experienced difficulties in understanding contextual problems, identifying important information, determining appropriate solution strategies, and rechecking their answers. These findings indicate that students need learning materials that are not only digital and interactive but also contextual and close to their daily lives.

The curriculum analysis was conducted by referring to the learning outcomes in the Merdeka Curriculum for Phase D. The material selected in this study was similarity, particularly the similarity of triangles and quadrilaterals. This material was considered suitable because several parts of the traditional Dori Mpulor house contain geometric concepts that can be connected to similarity, proportion, angles, lines, and plane figures. Previous research on the Dori Mpulor traditional house found various geometric concepts, including parallel lines, intersecting lines, angles, gradients, congruence, polygon similarity, triangles, circles, cylinders, parallelograms, and trapezoids. Therefore, the use of the Dori Mpulor house as an ethnomathematical context is relevant for helping students understand geometry through real cultural objects.

The second stage was the design stage. At this stage, the researchers designed the structure, storyline, interface, learning materials, practice questions, evaluation questions, and admin features of the e-module. The e-module was designed to be accessible through laptops and mobile devices, allowing students to learn flexibly. The main features of the e-module consisted of ethnomathematics-based learning materials, visual representations of the Dori Mpulor traditional house, interactive exercises, evaluation tests, and an admin dashboard.

Each feature of the e-module was designed to support the indicators of mathematical problem-solving skills. The contextual problems related to the traditional Dori Mpulor house were used to train students to understand the problem by identifying known information and the questions being asked. The explanation of concepts and worked examples helped students plan solution strategies. The interactive exercises guided students to carry out the planned solution steps, while the evaluation questions and feedback encouraged students to recheck their answers. Thus, the e-module was not only designed as a digital reading material but also as a structured learning tool that guides students through the stages of mathematical problem solving. The results of this development are presented in Figure 1 below.

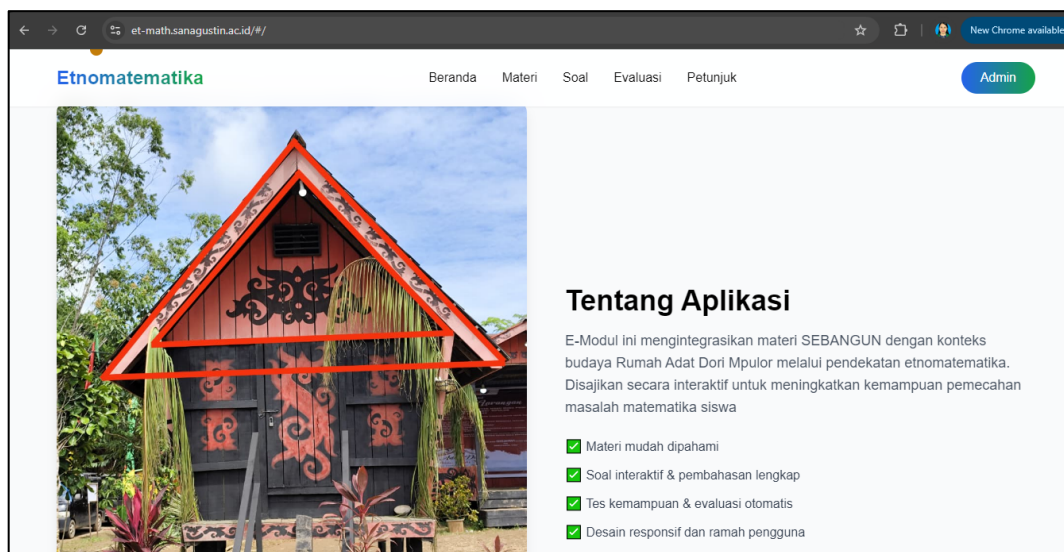


Figure 1. ethnomathematics-based e-module (student version)

This ethnomathematics based e-module presents real-time data based on student responses to evaluation questions. These responses are then summarized and automatically stored within admin feature. The e-module also incorporates an attractive interface, capturing students' attention and encouraging them to participate in the learning process. By optimizing ethnomathematics-based material for the Dori Mpulor traditional house, along with features such as practice questions and evaluation questions, this e-module can increase student engagement and interest throughout the learning process.

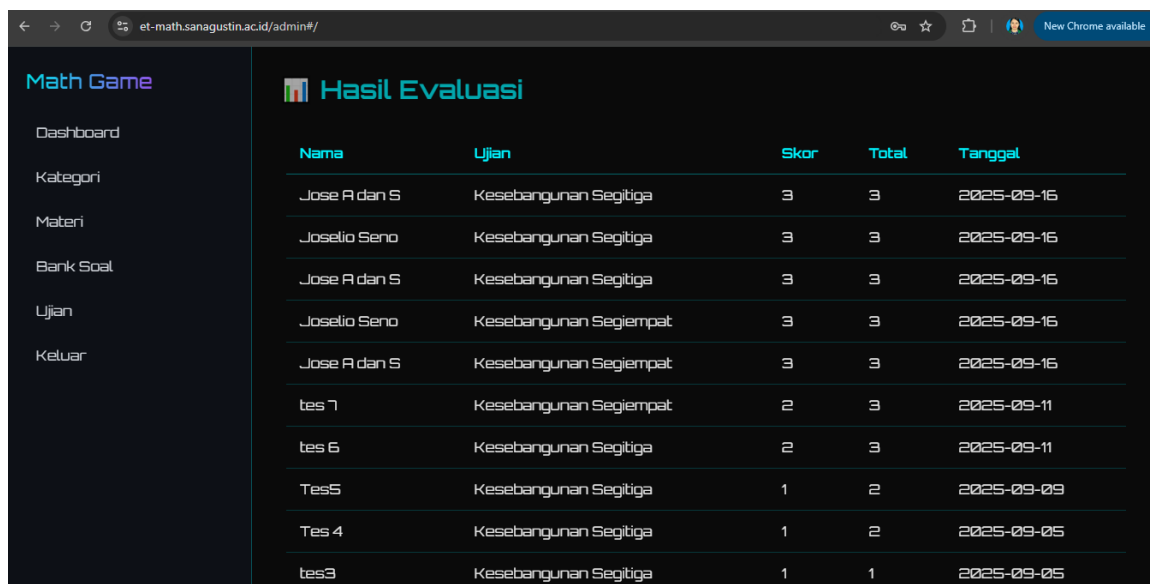


Figure 2. ethnomathematics-based e-module (admin version)

The third stage in development of the e-module is the development stage. At this stage, the researchers tested the validity of the content by involving three validators: two mathematics teachers and one information systems lecturer. The mathematics teachers served as subject matter experts, while the information systems lecturer

acted as media expert. The developed learning media was evaluated and revised to meet the required standards. Based on the suggestions from the validators, several revisions were made before the e-module was implemented. The material experts suggested improving the clarity of the relationship between the traditional Dori Mpulor house and the concept of similarity. Therefore, the researchers revised the learning materials by adding contextual explanations, relevant illustrations, and problem-solving questions related to the indicators of understanding the problem, planning a solution, carrying out the solution, and checking the result. Meanwhile, the media expert suggested improvements in layout consistency, font readability, navigation buttons, image presentation, and learning instructions. Based on these suggestions, the researchers revised the visual design, simplified the instructions, and optimized the navigation system to make the e-module easier to use. After the revision process, the e-module was then validated and tested for practicality and effectiveness. The e-module based on ethnomathematics of the Dori Mpulor traditional house was evaluated based on three main aspects: validity, practicality, and effectiveness. The results of the validity test are presented in Table 6 below.

Table 6. Results of the Validity Aspect of the Ethnomathematics

No	Validator	Percentage
1	Material Expert I	92.31%
2	Material Expert II	88.46%
3	Media Expert	96.87%
	Average	92.55%
	Category	Very valid

Based on Table 6, the developed e-module was declared highly valid and appropriate in terms of content, including criteria for material presentation, language, and visual design. Furthermore, the e-module was also considered appropriate from a technical perspective, including suitability, ease of use, presentation, and layout. These results were obtained from the validation questionnaire scores provided by the validators after one revision.

These findings are in line with previous studies showing that ethnomathematics-based digital learning media can support meaningful mathematics learning. Mahardika et al., (2024) found that an interactive ethnomathematics based e-module could provide students with new learning experiences through cultural contexts, attractive visuals, audio, and video. Similarly, Muntazhimah et al., (2025) reported that ethnomathematics-based e-worksheets were feasible and effective for improving junior high school students' mathematical problem-solving skills. These studies support the finding that the integration of digital media and local

culture can make mathematics learning more contextual, meaningful, and relevant to students' experiences.

The fourth stage in the development of the e-module is the implementation stage. At this stage, the researchers conducted a field test to assess the practicality and effectiveness of the ethnomathematics based e-module of the Dori Mpulor traditional house. Furthermore, 85 students participated to assess the effectiveness of the media. Effectiveness was measured using the N-Gain score through a pretest and post-test. Currently, the researchers are analyzing data from the practicality questionnaire and the pretest and post-test outcomes.

Table 7. The result of the Practical Aspects of Ethnomathematics based E-Module

No	Teacher	Total Score	Percentage	Criteria
1	I	37	84%	Practical
2	II	43	97.72%	Very Practical
3	III	40	90.90%	Very Practical
Average		40	90.90%	Very Practical

The analysis results presented in Table 7 indicate that the average score for the practicality of the ethnomathematics based e-module met the criteria of being very practical. The developed e-module was considered very practical in terms of effectiveness, interactivity, and efficiency. The results of the effectiveness test are presented in Table 8 below.

Table 8. Results of the Test of the Effectiveness Aspects of Ethnomathematics Based E-Modules

No	Score	Average
1	Pretest Score	55.88
2	Posttest Score	89.41
Percentage		76
Criteria		High

Table 8 shows that the effectiveness test results with an N-Gain score are in the high category. This test was conducted on eighty-five students using a pretest and post-test. The developed ethnomathematics-based e-module for the Dori Mpulor traditional house has fulfilled three main aspects: validity, practicality, and effectiveness. The validity aspect obtained an average percentage of 92.55%, categorized as very valid. The practicality aspect recorded an average percentage of 90.90%, categorized as very practical. The effectiveness aspect demonstrated an

average N-Gain score of 0.76 with a percentage of 76%, included in the high category.

The final stage in the development of e-module is the evaluation stage. At this stage, the researchers evaluated the e-module based on the results of validity, practicality, and effectiveness tests. The ethnomathematics based e-module proved to be an effective, interactive, and contextual digital tool in supporting the mathematics learning process. This medium not only facilitated students' meaningful understanding the concept of similarity but also enhanced their problem-solving skills by connecting mathematical material with local cultural contexts (Batkunde & Nifanggelyau, 2024) (Wulansari et al., 2023).

CONCLUSIONS AND RECOMMENDATIONS

Based on the research findings, it can be concluded that the ethnomathematics-based e-module on the Dori Mpulor traditional house was successfully developed as a valid, practical, and effective digital learning tool to enhance students' mathematical problem-solving ability. The e-module integrates mathematical concepts with local cultural contexts, making the learning process more contextual, meaningful, and relevant to students' daily lives.

The results indicate that the e-module can support students in understanding problems, planning solution strategies, carrying out problem-solving procedures, and checking their answers. Therefore, this e-module can be used as an alternative teaching material in mathematics learning, especially to connect formal mathematical knowledge with local wisdom. It is recommended that teachers and learning media developers continue to explore ethnomathematics in other cultural contexts and test its implementation in broader learning settings.

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