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The Urgency of Developing Teaching Modules Based on Ethnomatics Learning for Numeracy Skills

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ABSTRACT

Numeracy is one of the essential foundational skills that students must master, yet the 2018 Programme for International Student Assessment (PISA) survey revealed that Indonesian students ranked 72nd out of 79 countries in numeracy skills, reflecting low mathematical literacy globally. This issue often stems from the presentation of mathematical material that is abstract and less relevant to everyday life contexts. This study aims to develop a teaching module based on ethnomathematics learning that integrates the local culture of Luwu to improve students' numeracy skills. This research employs the research and development (R&D) method with the 4D model, encompassing the stages of Define, Design, Develop, and Disseminate. In the Define stage, a needs analysis and identification of local cultural potential were conducted. In the Develop stage, the module was validated by experts using validation sheets to assess the relevance of the material, completeness of information, and clarity of presentation. The module's practicality was evaluated through questionnaires and observations to assess its ease of use and effectiveness in learning. The results indicate that the teaching module based on ethnomathematics learning is both valid and practical. The module achieved high validity based on expert assessments covering material relevance, completeness of information, and clarity of presentation. The module's practicality was measured through teacher and student responses, reflecting its ease of use and effectiveness in enhancing student engagement in numeracy learning. In conclusion, the teaching module based on ethnomathematics learning has proven effective in improving students' numeracy skills and successfully integrating local cultural values into learning. This study contributes to the development of relevant, meaningful, and contextual teaching materials in mathematics education.

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A. INTRODUCTION

Numeracy is one of the fundamental skills that students must master to navigate the complexities of modern life (Piper et al., 2018). Numeracy is not merely the ability to count but also includes critical thinking, problem-solving, and the application of mathematical skills relevant to daily life (Sa'dijah et al., 2023). This skill is crucial for helping individuals analyze, interpret, and evaluate numerical information in both personal and professional contexts (Alangui, 2017). However, in the context of mathematics education, one of the main challenges is the low numeracy skills among students in Indonesia (Samad et al., 2021). According to the 2018 Programme for International Student Assessment (PISA), Indonesia ranked 72nd out of 79 countries in the mathematics category, reflecting a very low level of mathematical literacy

internationally (Dessemontet et al., 2020). This data highlights that most Indonesian students struggle to deeply understand mathematical concepts, especially in applied contexts.Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text.

This low ranking reflects the widespread difficulty students face in comprehending and applying mathematical concepts in real-life contexts (Yulindra et al., 2023). A key contributing factor is the traditional teaching approach that emphasizes rote memorization over conceptual understanding (Sukarya & Isnurani, 2023). Such an approach hampers students' ability to engage actively in learning and apply mathematical knowledge in complex or practical situations (Pratama & Yelken, 2024).Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text.

To address these challenges, innovative teaching strategies that bridge the gap between abstract mathematical concepts and real-world experiences are essential. The ethnomathematics approach, which integrates cultural elements into mathematics teaching, emerges as a promising solution (Baharuddin et al., 2023). By contextualizing mathematics within the cultural practices and traditions familiar to students, ethnomathematics makes learning more relevant and engaging. For instance, the cultural heritage of the Luwu community, which includes traditional patterns, measurements, and spatial reasoning, aligns naturally with mathematical concepts. Integrating these elements into teaching materials can enhance students' understanding of mathematics while strengthening their connection to their cultural identity.Click or tap here to enter text.Click or tap here to enter text.

One effective medium for implementing ethnomathematics in teaching is through teaching modules (Ula et al., 2024). Teaching modules are tools designed to facilitate learning systematically, covering content, methods, media, and assessments aligned with the applicable curriculum (Sanjaya et al., 2022). When designed with ethnomathematical principles, these modules can transform mathematics education by embedding local cultural values into the learning process. This not only enriches the learning experience but also introduces students to relevant cultural values (Latif & Talib, 2021).Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text.

Although ethnomathematics has been explored in various studies, the practical development of teaching modules that integrate specific local cultures remains limited (Zaini et al., 2023). Many existing teaching modules focus on general content without considering the richness of local cultural contexts (Kertih, 2020). For example, (Widiantari et al., 2022) successfully developed an e-module containing ethnomathematics to improve numeracy literacy and character education. However, this module does not explicitly integrate specific local cultures, making the learning experience more generic. Similarly, (SA et al., 2024) investigated the impact of using student worksheets (LKPD) based on ethnomathematics on students' numeracy literacy, but their study focused more on testing the effects of the teaching tool rather than developing a module that integrates specific cultural elements.Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text. The lack of contextual teaching materials leads to low student engagement in learning, which ultimately affects their numeracy skills (Baharuddin et al., 2021). Therefore, developing teaching modules that integrate local culture through the ethnomathematics approach is a crucial step in addressing these issues.

Click or tap here to enter text.Click or tap here to enter text.Click or tap here to enter text.This study focuses on developing teaching modules based on ethnomathematics learning to enhance students' numeracy skills. The module is designed by integrating elements of local culture, specifically the Luwu culture, which is rich in traditional knowledge and practices, offering unique opportunities to connect mathematical concepts with daily experiences. This module is expected to increase students' motivation to learn, facilitate understanding of mathematical concepts, and introduce Luwu cultural values to students. Thus, this study aims to develop a teaching module based on ethnomathematics learning that can improve students' numeracy skills. Specifically, the objectives of this study are: (1) to design a teaching module based on Luwu culture using the ethnomathematics approach; (2) to test the validity and practicality of the developed module; and (3) to evaluate the effectiveness of the module in improving students' numeracy skills.

B. METHODS

1. Research Design and Stages

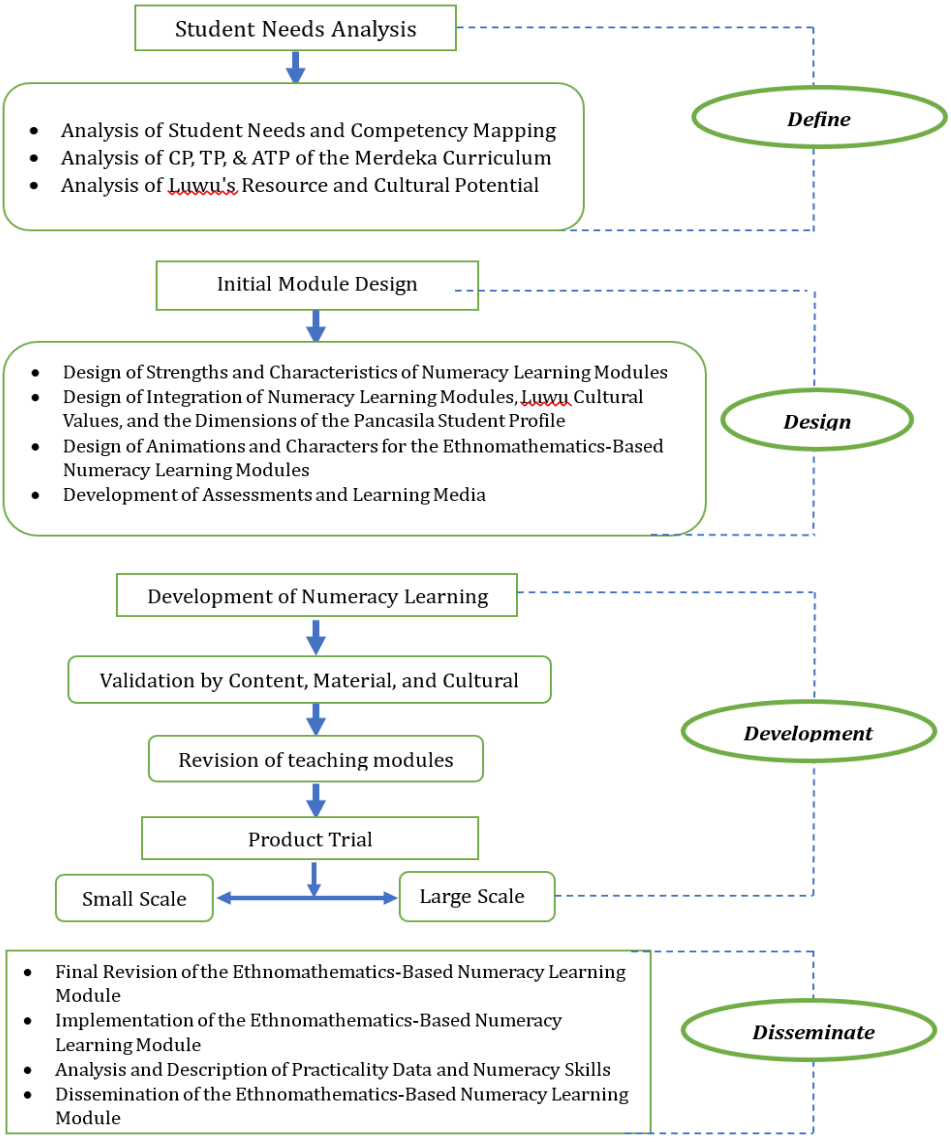

Figure 1. Stages of the 4D Research Model

This research uses the Research and Development (R&D) method with the 4D development model approach (Define, Design, Develop, Disseminate). The primary objective of this research is to produce a product in the form of a teaching module based on ethnomathematics learning designed to improve students' numeracy skills. The 4D model used consists of four stages: Define, Design, Develop, and Disseminate (Ulia et al., 2020), which encompasses needs analysis, module design, development, and dissemination of research results. Through these stages, the development of the teaching module focuses not only on strengthening numeracy skills but also on integrating the cultural values of Luwu into mathematics learning.

a. Define Stage

   The Define stage aims to conduct an in-depth analysis of students' needs in numeracy learning and identify the potential of Luwu culture that can be integrated into the ethnomathematics-based teaching module. In this stage, analysis is carried out by mapping learning outcomes (CP), learning objectives (TP), and learning objectives flow (ATP) in line with the Merdeka Curriculum. This analysis ensures that the teaching module meets the targeted core competencies, including domains such as numbers, algebra, geometry, and data and uncertainty. These competencies are designed to enable students to apply mathematical concepts in real-life contexts, such as calculating the total number of stained-glass panels in the Langkanae Traditional House or estimating the cost of replacing the panels using operations such as addition, subtraction, multiplication, and division.

   In addition, an exploration of Luwu's cultural potential is conducted through observation and documentation of relevant local cultural elements. These elements include the Langkanae Traditional House, Tongkonan, the Maccera' Tasi ceremony, Moriringgo Dance, Rongkong Woven Fabric, Toddopuli, and the structure of the Jami' Mosque. Each cultural element is analyzed to identify its connection with mathematical concepts, such as symmetry in geometric patterns on Rongkong Woven Fabric, length measurements in traditional building structures, or problem-solving in traditional layout arrangements. These cultural potentials provide a relevant learning context close to students' daily lives, thereby enhancing their understanding of numeracy concepts. The output of this stage includes data on students' needs, covering their initial numeracy abilities, learning outcomes relevant to the curriculum, and cultural potentials of Luwu that can serve as the foundation for designing an ethnomathematics-based teaching module. This data forms a critical foundation to ensure that the developed module aligns with curriculum standards while being contextually relevant to the students' cultural environment.

b. Design Stage

   The Design stage focuses on the development of a teaching module design that integrates numeracy learning and Luwu's cultural elements. The module is designed with several key features and characteristics, such as using Luwu's cultural context in mathematical problem design, training students according to numeracy competency levels, and providing digital-based learning media. In this design, mathematical problems are connected to local cultural elements, such as calculating the area of stained-glass panels in the Langkanae Traditional House, analyzing geometric patterns on Rongkong Woven

Fabric, or examining symmetry in the structure of the *Tongkonan*. This cultural context aims not only to improve students' numeracy skills but also to introduce and preserve Luwu's culture. The module is designed to train students across three levels of numeracy competencies: Level 1 (Knowledge), Level 2 (Application), and Level 3 (Reasoning). The Knowledge level focuses on students' ability to understand basic facts, concepts, and procedures of numeracy. The Application level measures students' ability to use their knowledge to solve real-world problems, such as calculating repair costs for traditional house structures or analyzing patterns in woven fabrics. The Reasoning level evaluates students' ability to analyze data, draw conclusions, and solve more complex or novel problems.

In addition, assessment instruments are developed to support the learning and evaluation process. These instruments include diagnostic assessments to identify students' initial needs, formative assessments to monitor progress during learning, and summative assessments to evaluate final learning outcomes. The assessment formats are varied, including essay questions, multiple-choice questions, and matching questions, to ensure optimal student engagement. These instruments assess not only students' numeracy skills but also incorporate diverse evaluation methods tailored to students' needs and the learning context. In this stage, Luwu's cultural elements are deeply integrated into the learning design. The cultural context is embedded in teaching materials, such as calculating the number of geometric patterns in Rongkong Woven Fabric, analyzing data from the *Maccera' Tasi* ceremony, or solving measurement problems in the Langkanae Traditional House structure. These elements ensure that the designed module is relevant to students' daily lives while supporting the reinforcement of their cultural identity. The output of this stage is a prototype of the teaching module ready for validation in the next stage.

c. Develop Stage

The Develop stage aims to develop, validate, and test the ethnomathematics-based teaching module designed in the previous stage. The development process begins with module validation by three experts in their respective fields. The content and curriculum expert evaluates the alignment of the materials with learning outcomes (CP) and learning objectives flow (ATP) as per the Merdeka Curriculum, ensuring that each material in the module supports the enhancement of students' numeracy competencies. The ethnomathematics expert ensures that Luwu's cultural elements are appropriately integrated into the learning materials, including examples and mathematical problems. Meanwhile, the construct expert evaluates the module's structure to ensure its completeness in terms of format, content flow, and visual design, making it user-friendly for both students and teachers.

After the validation process, the module is revised based on the experts' feedback. These revisions include key improvements, such as clearer instructions to help students understand the steps for solving mathematical problems. Additionally, data presentation in the module is restructured into more informative tables to enhance clarity. The question formats are also varied, incorporating multiple-choice, matching, and true-false questions alongside essay questions, to provide students with a diverse

and engaging learning experience. This iterative process continues until the module meets the required validity standards.

A limited trial is conducted after revisions to measure the practicality and effectiveness of the module. The trial involves one class of students in Palopo City. During the trial, data is collected through observations, student questionnaires, and teacher interviews. Observations are used to record students' engagement and the ease of using the module during the learning process. Student questionnaires evaluate their responses to the module, covering aspects such as relevance, motivation, and understanding. Teacher interviews provide feedback on the module's effectiveness in helping students grasp numeracy concepts, as well as any challenges encountered during the learning process. The output of this stage is a validated and revised teaching module tested on a limited scale. The module is deemed ready for broader testing in the next stage if it meets the criteria for validity, practicality, and effectiveness. This development process ensures that the module is not only academically relevant but also supports contextual learning based on students' local culture.

d. Disseminate Stage

The Disseminate stage aims to distribute the ethnomathematics-based teaching module to a broader audience, including teachers and other schools, to ensure its standardized and widespread application. This stage begins with large-scale implementation to evaluate its practicality and effectiveness in real learning scenarios. The implementation is carried out over four sessions. During this implementation, the module is used as the main learning resource, integrating Luwu's cultural elements into each session. This activity aims to measure how well the module helps students understand and apply numeracy concepts in the context of local culture.

During the implementation, the module's practicality is assessed through questionnaires completed by students and teachers. These questionnaires are designed to evaluate several aspects, including the ease of using the module in the learning process, its effectiveness in helping students achieve learning outcomes, and the efficiency of teaching time using the module. The data obtained from the questionnaires provide insights into how the module is received by users, from both student and teacher perspectives. Additionally, teacher interviews are conducted to gather further feedback on challenges and recommendations for module improvement.

As part of the dissemination stage, the teaching module that has been tested and improved based on implementation results is then distributed through teacher training programs in other schools. These training sessions aim to familiarize teachers with the module's use, relevant teaching strategies, and the integration of local culture into numeracy learning. Moreover, the research and development results of this module are published in academic journals to introduce the benefits of ethnomathematics-based learning to the wider educational community. This dissemination process ensures that the module is not only effective and practical in teaching but also accessible to more schools, supporting the enhancement of students' numeracy skills through contextual and culturally-based approaches.

2. Research Objects and Indicators

This research involved school students in Palopo City as the main subjects. The study focused on implementing the Teaching Module Based on Ethnomathematics Learning to enhance students' numeracy skills through the context of Luwu's local culture. A limited trial was conducted in a selected class using purposive sampling techniques, where students were chosen based on teacher recommendations to ensure representation of diverse ability levels. This trial aimed to evaluate the practicality and effectiveness of the module before its broader implementation. During the trial, all students participated in learning activities using the developed teaching module. The learning process lasted for four sessions, with each session designed to integrate local cultural elements such as the Langkanae Traditional House, Rongkong Woven Fabric, and *Tongkonan* into numeracy material. Students' activities were observed in detail to identify their level of engagement, ease of understanding, and responses to using the module. Observations were conducted by researchers to record students' activities, including the extent to which the module helped them solve contextual numeracy tasks.

At the end of the sessions, students were given a questionnaire to evaluate their responses to the module. The questionnaire was designed to measure several aspects, including: the relevance of the material to students' real-life experiences, the ease of using the module during the learning process, and students' motivation and engagement during learning. The results from the questionnaire were used as input for improving the module before large-scale implementation. In addition to students, teachers were also involved as primary users of the module to assess its effectiveness and practicality. Teachers were asked to apply the module in their classrooms, observe the learning process, and complete a questionnaire at the end of the implementation. The teacher questionnaire was designed to evaluate several indicators, including: the ease of integrating the module with the teaching methods used, the efficiency of time in using the module during learning, and the impact of the module on improving students' understanding. This research also involved three experts as validators:

a. A construct validation expert, responsible for assessing the structure of the module, including the flow of material presentation and its completeness.
b. A content validation expert, responsible for evaluating the alignment of the material with the learning outcomes (CP) and the flow of learning objectives (ATP) in the Merdeka Curriculum.
c. A cultural expert, tasked with ensuring that the Luwu cultural elements used in the module were contextually appropriate and had relevant educational value.

These three experts not only validated the module but also acted as observers during the limited trial to evaluate the implementation of the module in the classroom. The experts' observations focused on several aspects, such as material clarity, cultural context relevance, and students' ease in understanding the numeracy concepts taught. Feedback from the experts was used to revise and refine the module to meet criteria for validity, practicality, and effectiveness.

3. Data Collection Sources and Techniques

Data collection in this research aimed to evaluate the quality and feasibility of the developed teaching module based on ethnomathematics learning. The data collection techniques were tailored to each stage of the research, involving various complementary methods to ensure the data obtained was relevant and comprehensive. Below is a detailed explanation of the data collection techniques used:

a. Initial Stage: Data was collected through observation, documentation, and interviews. Observations were conducted to understand students' needs and analyze the context of Luwu culture relevant for integration into learning. Documentation involved gathering materials related to cultural elements, such as patterns on Rongkong Woven Fabric or geometric structures in the Langkanae Traditional House, to support the analysis of cultural potential. Interviews were conducted with students, teachers, and local community figures to gain deeper insights into numeracy learning needs and cultural elements potentially included in the module.
b. Planning Stage: In addition to observation, documentation, and interviews, literature reviews were conducted to enrich the theoretical foundation for module development. The literature review covered topics related to ethnomathematics, Luwu's cultural context, and effective numeracy approaches aligned with the Merdeka Curriculum. These techniques were used simultaneously to ensure the module design was based on valid and relevant data.
c. Development Stage: Data collection focused on validating and testing the teaching module. Validation was carried out using instruments evaluated by three experts (content expert, ethnomathematics expert, and construct expert). Validation aimed to assess the alignment of the material with learning outcomes, cultural relevance, and the module's structure. After the module was revised based on the validators' feedback, individual and small-group trials were conducted. Data at this stage was collected through observation and questionnaires. Observations recorded students' engagement during learning with the module, while questionnaires captured students' responses regarding ease of use, material relevance, and learning motivation.
d. Dissemination Stage: Data was collected through questionnaires, observations, and applicability assessments of the module. Questionnaires were distributed to students and teachers to evaluate the effectiveness and practicality of the module on a larger scale. Observations were used to monitor the application of the module in the classroom, record students' participation levels, and measure the time required to complete each activity. Applicability assessments observed the extent to which the module could be used in real learning situations without requiring significant modifications.

Overall, these data collection techniques were designed to complement one another, ensuring that each stage of module development was based on valid and relevant data. The data obtained was not only used to evaluate the module but also to make continuous improvements so that the resulting product met high standards of validity, practicality, and effectiveness.

4. Data Analysis and Conclusion Drawing Technique

The data analysis techniques in this research used a descriptive qualitative and quantitative approach to evaluate the quality and feasibility of the ethnomathematics-based teaching module in improving students' numeracy skills. Qualitative data were obtained through observations and interviews focusing on the implementation of the module in the classroom, including student participation, ease of use, and teacher feedback on the relevance of Luwu culture in the learning materials. Quantitative data were collected through questionnaires completed by experts (content experts, construct experts, and ethnomathematics experts), teachers, and students. The quantitative assessment covered content validity, the module's effectiveness in enhancing students' numeracy skills, and the ease of its application in the learning process.

The results from classroom observations were analyzed qualitatively using coding techniques to identify key themes, such as student engagement levels and the relevance of the learning materials. This qualitative data was used to support quantitative findings, providing a detailed depiction of how the module was received in the classroom. Quantitative analysis utilized percentage formulas to measure the validity, practicality, and effectiveness of the module. Module validity was assessed based on scores from expert validators, while module practicality was evaluated through teacher and student responses regarding ease of use and learning effectiveness. The module's effectiveness was analyzed through assessments of students' numeracy skills, covering the competency levels of understanding, application, and reasoning. The calculation formula used for data analysis is contained in this study:

a. Validity Analysis of Teaching Module

$$Percentage = \frac{(\sum Score\ Given\ by\ Validators)}{\sum Maximum\ Score} x100\%$$

After obtaining validity data from experts, the total score of each indicator is classified according to the criteria listed in Table 1. If the results obtained exceed 60%, then the teaching module is considered valid or suitable for use and can be tested. The module's validity was assessed based on aspects of relevance, completeness, and clarity of material presentation.

Table 1. Product Validity Assessment Criteria (Riduwan, 2016)

Category	Percentage %
Very Valid	80 < N ≤ 100
Valid	60 < N ≤ 80
Fairly Valid	40 < N ≤ 60
Less Valid	20 < N ≤ 40
Not Valid	0 < N ≤ 20

b. Teaching Module Practicality Tool

$$Percentage = \frac{(\sum Score\ obtained)}{\sum Maximal\ \ Score} x100\%$$

The analysis of the practicality of the teaching module was carried out by distributing questionnaires to teachers and students to find out their responses to the modules that had been applied to students. Based on Table 2, if the results obtained are more than 60%, then the teaching module developed is declared practical and feasible to use or implement in the learning process. The practicality assessment included ease of use, time efficiency, and impact on student learning.

Table 2. Product Practicality Assessment Criteria (Riduwan, 2016)

Category	Percentage %
Very Practical	80 < N ≤ 100
Practical	60 < N ≤ 80
Fairly Practical	40 < N ≤ 60
Less Practical	20 < N ≤ 40
Not Practical	0 < N ≤ 20

The module's effectiveness was evaluated by analyzing students' learning outcomes across three levels of numeracy competencies: understanding, application, and reasoning. Learning outcomes were assessed through the average student scores at each competency level. The module was deemed effective if students showed significant improvement in their learning outcomes. The research conclusions were drawn based on the integration of qualitative and quantitative analysis results. Qualitative data were used to clarify and support quantitative findings, for example, by explaining the reasons behind questionnaire results or identifying challenges observed during the study. Through this approach, the research was able not only to evaluate the module's quality but also to provide insights for continuous improvement to ensure the module met the criteria for validity, practicality, and effectiveness. The findings from this analysis are expected to contribute significantly to the development of ethnomathematics-based learning in Indonesia.

C. RESULT AND DISCUSSION

The process of developing an Ethnomatics Learning-Based Teaching Module focused on improving students' numeracy skills involves a series of activities and stages. These stages follow the 4D development model (Define, Design, Development, Disseminate) which includes needs analysis, module design, development, and dissemination of research results. The activity description of each development phase is described in detail as follows:

1. Define Phase

The activities of the Define Phase are focused on analyzing student learning needs and conducting competency mapping. The analysis focused on discussing Learning Outcomes (CP), Learning Objectives (TP), Flow of Learning Objectives (ATP). In addition, the potential resources and culture of Luwu were also analyzed as an effort to embed mathematical concepts and introduce the culture around the students' environment. The main competencies that students must have based on the content domain of the independent curriculum are Data and Uncertainty, Numbers, Algebra, and Geometry. Aspects of learning outcomes are mathematical concepts, such as addition, subtraction, multiplication, and division operations to solve

everyday problems. Learners need to understand and be able to apply number concepts to real contexts, such as calculating the total number of stained glass panels in a traditional house or the cost of replacing glass panels. At a higher mathematical level, thinking uses students' core competencies in an integrated manner in solving mathematical problems, using Data and Uncertainty, Number, Algebra, and Geometry in solving daily life problems. Cultural aspects in the environment around learners such as Langkanae Traditional House, tongkonan, Maccera' Tasi Ceremony, Moriringgo Dance, Rongkong Woven Fabric, toddopuli, jami' mosque building, and others. They have a cultural attachment to traditional houses and local activities that can be used as relevant learning contexts. Results and Outputs of the Define Stage in the form of Student Needs Analysis Data, Learning Outcomes Data, and Luwu Cultural Potential Data which will be the basis for designing teaching modules based on ethnomatics learning in the luwu cultural context.

2. Design Stage (Designing)

Design Stage activities are focused on designing the Advantages and Characteristics of Ethnomatics-Based Teaching Modules, integrating Mathematics Learning with Luwu Cultural Values, designing Ethnomatics-Based Teaching Modules, Developing Relevant Diagnostic, Format, and Summative Assessments, and Developing Interactive Learning Media. In general, there are 3 advantages and characteristics of the Ethnomatics Teaching Module offered in the form of (1) Mathematical problem design using the Luwu context, (2) Training students to develop cognitive based on the numeracy competency level based on the quality of education report card, and (3) Digital-based Learning Media and contains information on the introduction of Luwu culture.

Diagnostic, Format, and Summative Assessment designs are based on numeracy competency levels such as Knowledge Level (L1), Simple Comprehension and Analysis Level (L2), and Complex Analysis and Synthesis Level (L3). Knowledge Competency measures students' ability to understand facts, processes, concepts, and procedures of the main elements of numeracy skills. Application competency will measure students' ability to apply knowledge and understanding of facts, relations, processes, concepts, procedures, and methods on number content in the context of luwu culture. Meanwhile, reasoning competency will measure students' ability to analyze data and information, make conclusions, and expand understanding in new situations, including previously unknown situations or more complex contexts, as shown in Figure 2.

Figure 2. Cultural Context in the Content of the Teaching Module

Design of mathematical problems with the theme of Luwu culture (Langkanae Traditional House, tongkonan, Maccera' Tasi Ceremony, Moriringgo Dance, Rongkong Woven Fabric, toddopuli, jami' mosque building) which will be solved through the integration of numeracy main competencies such as Data and Uncertainty, Numbers, Algebra, and Geometry. The Cultural Introduction tubers that are used as content in the teaching module are presented in Figure 2 and Table 3 description.

Table 3. Information on Cultural Recognition in Teaching Module Content

No	Culture	Culture Recognition Information
1.	Langkanae Traditional House	The Langkanae traditional house is a historical building for the Luwu people that was built in 1619. The symbolic meaning contained in the Langkanae traditional house in Palopo City is based on the pattern formed. The symbolic meaning implies a lot about fellow humans. The shape of the pattern that is often found in traditional houses with nature is fire, water, air and soil.
2.	Ma'cera Tasi Traditional Ceremony	Ma'cera Tasi literally means "cleaning the sea." The ceremony aims to invoke safety, blessings and abundance of marine products. Local people believe that by performing this ceremony, they can maintain a harmonious relationship with the sea and get protection from danger.
3.	Moriringgo Dance	Moriringgo dance has a deep meaning related to the life of the Luwu tribe. This dance symbolizes togetherness, strength and harmony. It is often part of traditional ceremonies and celebrations that involve all members of the community, reinforcing a sense of community and cultural identity.
4.	Toddopuli Monument	Toddopuli Monument is one of the historical landmarks located in Palopo, South Sulawesi. The monument has deep historical and cultural significance for the local community. The name "Toddopuli" itself has a deep meaning in the local language, often associated with courage, strength and fighting spirit.
5.	Tongkonan House	Tongkonan is a traditional house of the Toraja people, South Sulawesi, which is more than just a place to live. With its unique shape, Tongkonan reflects the cosmology and philosophy of life of the Toraja people. Its curved roof resembles a boat, a symbol of life's journey, while the high front symbolizes the sky.

No	Culture	Culture Recognition Information
6.	Tomb of Datuk Patimang	The tomb of Datuk Patimang is a highly respected historical and religious site in South Sulawesi, especially in the Tana Luwu region. Datuk Patimang himself was a great scholar who played an important role in the spread of Islam in the region.
7.	Rongkong Woven Fabric	Rongkong woven fabric is a type of traditional fabric originating from North Luwu Regency, South Sulawesi. This fabric is an important part of the cultural heritage of the Rongkong tribe. The making of Rongkong Woven Fabric is done traditionally using non-machine looms (ATBM). The process involves various stages, from yarn spinning, coloring, to weaving.
8.	Old Jami Mosque of Palopo	The Old Jami Mosque of Palopo is the oldest mosque in South Sulawesi, dating back 419 years or four centuries. This mosque witnesses the history of the spread of Islam in Tana Luwu. The mosque is located on Andi Djemma Street, Batupasi Village, North Wara Subdistrict, right in the center of Palopo City and opposite the Palace of the Luwu Kingdom.

From several types of Luwu culture described in Table 3, there are cultural buildings that have the potential to be explored in mathematics learning, particularly related to concepts of geometry, measurement, and symmetry. Each cultural building offers geometric shapes that can be used to understand various aspects of mathematics, such as area, perimeter, volume, and the Pythagorean theorem. By utilizing this traditional architecture, mathematical concepts can be taught in a way that is more relevant and contextual for students, especially in an ethnomathematics-based curriculum. Table 4 below presents the mathematical concepts that can be explored from several cultural buildings in Sulawesi, ranging from the Langkanae Traditional House to the Old Jami Mosque in Palopo.

Table 4. Mathematical Concepts from Cultural Buildings

No	Culture	Culture Recognition Information
1.	Langkanae Traditional House	The Langkanae Traditional House can be explored using two-dimensional and three-dimensional geometry concepts. For example, the triangular shape of the roof can be used to teach the Pythagorean theorem, while the rhombus-shaped walasuji, counting the number of building pillars, measuring the height of the building, or calculating the perimeter, area, and volume of the rooms inside the house provide opportunities for further exploration.
2.	Toddopuli Monument	The Toddopuli Monument has a cylindrical base consisting of several layers. This can aid in studying the concepts of volume and surface area of cylinders, as well as the perimeter and area of circles.
3.	Tongkonan House	In the Tongkonan House, several mathematical concepts can be explored. The distinctive inverted boat-shaped roof, consisting of triangles and trapezoids, can be used to study flat geometry concepts for calculating perimeter and area. In addition, the carvings on the Tongkonan House contain various geometric patterns that reflect mathematical concepts such as symmetry, rotation, and translation.
4.	Tomb of Datuk Patimang	The Datuk Patimang Tomb offers opportunities to explore mathematical concepts such as prisms and cuboids. The main structure of the tomb resembles a rectangular or prism shape with a triangular roof. The geometry of three-dimensional shapes can be applied here, especially in calculating the volume and surface area of the shapes. The triangular roof, which appears to be an isosceles triangle, provides an opportunity to learn about the properties of triangles, such as height, base, and hypotenuse.

No	Culture	Culture Recognition Information
5.	Old Jami Mosque of Palopo	The Old Jami Mosque in Palopo also contains several mathematical concepts worth exploring. The main building of the mosque resembles a rectangular prism with a pyramid-shaped roof. This enables learning about the volume and surface area of both prisms and pyramids. The base of the mosque is square-shaped, allowing for the calculation of perimeter and area in two-dimensional shapes, which can be applied to the floor or foundation of the building.

The Table 4 above shows that each cultural building holds educational value that can be utilized to introduce and deepen students' understanding of mathematical concepts. Concepts such as symmetry, geometric transformations, measurements, and calculations of both 2D and 3D shapes become easier to comprehend when connected to architectural elements that students are familiar with in their everyday lives. This not only enriches the learning experience in mathematics but also fosters an appreciation for local culture.

3. Stage Develop (development)

In general, develop activities are carried out in several series, namely the development of ethnomatics-based teaching modules, expert validation (content, construct, ethnomatics), data analysis of construct, content, and cultural validation results, revision of ethnomatics-based teaching modules, development trials (limited), and data analysis of limited trials of ethnomatics-based teaching modules. The development stage begins by ensuring that the draft of the ethnomatics teaching module is ready for validation. Some of the main considerations in compiling are the characteristics and characteristics of the ethnomatics teaching module, namely problems in the context of Luwu culture, assessment design based on numeracy skills, and the availability of Digital-based media. Digital-based Learning Media will provide an overview of mathematical concepts for each culture that is lifted and equipped with cultural introduction information.

Expert validation was carried out with Mr. Rio Fabrika Pasandaran, S. Pd., M.Pd as a validator who is an expert in the field of mathematics content and independent curriculum while Mrs. Shindy Ekawati, S. Pd., M.Pd as a validator who is an expert in ethnomatics. Some revisions to the teaching module are: (1) The Teaching Module must be equipped with instructions for working on problems briefly and completely, (2) Presentation of data in tabular form should be more informative (3) Presentation of the problem model is more varied not monotonous in the form of descriptions but can be with multiple choice models, matching, true or false. The developed module has gone through a validation process by numeracy experts. The aspects assessed include the suitability of the material with numeracy indicators, including relevance, completeness, and clarity. Suggestions from the experts were used as the basis for making revisions, which were carried out continuously until the module was declared valid and ready to be tested in schools. Furthermore, the module was tested to obtain data related to its practicality, including ease of use, learning effectiveness, and student participation. The detailed module validity assessment can be seen in Table 5 below.

Table 5. Results of the Recapitulation of Validity Assessment of the Module

Indicator Numeration	Assessed Aspects	V1	V2	Average (%)	Category
Competencies in the Number Domain					
Knowing Competence (L1)	Relevance	4	5	90%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Applying Comptence (L2)	Relevance	4	5	90%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	5	5	100%	Very Valid
Reasoning Competence (L3)	Relevance	4	5	90%	Very Valid
	Comprehensiveness	3	4	80%	Valid
	Clarity	4	3	80%	Valid
Overall Average Competency in Number Domain				87%	Very Valid
Competency in the Algebra Domain					
Knowing Competence (L1)	Relevance	4	4	80%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Applying Competence (L2)	Relevance	3	4	70%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Reasoning Competence (L3)	Relevance	3	4	70%	Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Valid
Overall Average Competency in Algebra Domain				81%	Very Valid
Competency in the Geometry Domain					
Knowing Competence (L1)	Relevance	5	5	100%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	5	5	100%	Very Valid
Applying Competence (L2)	Relevance	5	5	100%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Reasoning Competence (L3)	Relevance	4	5	90%	Very Valid
	Comprehensiveness	4	4	80%	Valid
	Clarity	4	4	80%	Valid
Overall Average Competency in Geometry Domain				89%	Very Valid
Competency in the Data and Uncertainty Domain					
Knowing Competence (L1)	Relevance	5	4	90%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Applying Competence (L2)	Relevance	3	4	80%	Very Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Very Valid
Reasoning Competence (L3)	Relevance	3	4	70%	Valid
	Comprehensiveness	4	4	80%	Very Valid
	Clarity	4	5	90%	Valid
Mean Data and Uncertainty Domain Competency				83%	Very Valid

Table 5 displays the results of the recapitulation of the validity assessment of the teaching module based on ethnomatics learning, showing that the majority of aspects are rated valid to very valid. The numeracy competencies assessed cover various domains, such as number,

algebra, geometry, and data and uncertainty, with a focus on relevance, comprehensiveness, and clarity. Overall, the module was rated as highly valid in the aspects of relevance and clarity, while the comprehensiveness aspect of some competencies received valid ratings. Full details of the assessment results can be seen in Table 6 below.

Table 6. Results of Validity Aspect Assessment Based on Numeracy Ability Indicators

Aspects Assessed	Validator Average 1	Validator Average 2	Total Average (%)	Validity Category
Relevance	4,00	4,50	85 %	Very Valid
Comprehensiveness	4,00	4,00	80 %	Very Valid
Clarity	4,16	4,83	90 %	Very Valid
The Overall Average			85 (%)	Very Valid

Based on the assessment results from the validators, this module is assessed in several aspects such as relevance, comprehensiveness, and clarity. The results of the module validity assessment get an average score of 85% which indicates that the module based on ethnomatics learning towards numeracy skills is in a very valid category. These results indicate that the module as a whole meets the criteria of high validity, both in terms of material relevance, completeness of information, and clarity of presentation, making it suitable for use in ethnomatics learning towards numeracy skills.

4. Implementation Stage

The Implementation Stage focuses on the Application of Ethnomatics-Based Teaching Modules in schools, Analysis and Description of Practicality Data, description of student numeracy data, and Dissemination and Publication of Ethnomatics-Based Teaching Modules. Overall, students will be taught using the Teaching Module based on Ethnomatics learning carried out for 4 meetings. During the learning process students will be observed activities related to the utilization of Teaching Modules Based on Ethnomatics learning and see the extent of numeracy skills. At the end, students will be given a questionnaire to see students' responses to the teaching module provided to be used as a consideration for improving the Teaching Module. The practicality test is carried out by involving teachers and students in learning activities, with assessments that include ease of use, effectiveness in learning, and implementation time from the user's perspective. The data obtained from this test will be used as a basis for improving the module to make it more effective when implemented. The results of the module practicality assessment can be seen in Table 7 below.

Table 7. Recapitulation of Practicality Assessment Results of the Module

Indicator Numeration	Assessed Aspect	P1	P2	Average	Category
Competency in the Number Domain					
Knowing Competence (L1)	Ease of Use	5	5	100%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Applying Competence (L2)	Ease of Use	4	5	90%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical

Indicator Numeration	Assessed Aspect	P1	P2	Average	Category
Reasoning Competence (L3)	Ease of Use	4	4	80%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Overall Average Competency in Number Domain				90%	Very Practical
Competency in Algebra Domain					
Knowing Competence (L1)	Ease of Use	5	4	90%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Applying Competence (L2)	Ease of Use	4	4	80%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Reasoning Competence (L3)	Ease of Use	4	4	80%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	4	5	90%	Very Practical
Overall Average Competency in Algebra Domain				87%	Very Practical
Competency in Geometry Domain					
Knowing Competence (L1)	Ease of Use	5	5	100%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Applying Competence (L2)	Ease of Use	5	5	100%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	4	5	90%	Very Practical
Reasoning Competence (L3)	Ease of Use	4	5	90%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Overall Average Competency in Geometry Domain				91%	Very Practical
Competency in the Data and Uncertainty Domain					
Knowing Competence (L1)	Ease of Use	5	4	90%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	5	5	100%	Very Practical
Applying Competence (L2)	Ease of Use	4	4	80%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	4	5	90%	Very Practical
Reasoning Competence (L3)	Ease of Use	4	4	80%	Very Practical
	Effectiveness in Learning	4	4	80%	Very Practical
	Implementation Time	4	4	80%	Very Practical
Overall Average Competency in the Data and Uncertainty Domain				84%	Very Practical

Table 7 presents the recapitulation of the practicality assessment of the teaching module based on ethnomatics learning, which is measured based on three main aspects: ease of use, learning effectiveness, and implementation time. The module was rated as highly practical on various competencies in the domains of number, algebra, geometry, and data and uncertainty, with the aspect of implementation time consistently receiving a very practical rating. Overall, the average assessment ranged from 84% to 92%, with the Very Practical category for almost all competencies. To see the overall results, details can be seen in Table 8 below.

Table 8. Results of Practicality Aspect Assessment Based on Numeracy Ability Indicators

Aspects Assessed	Validator Average 1	Validator Average 2	Total Average (%)	Validity Category
Relevance	4,42	4,42	88 %	Very Valid
Comprehensiveness	4,00	4,00	80 %	Very Valid
Clarity	4,66	4,92	96 %	Very Valid
The Overall Average			**88** (%)	**Very Valid**

Based on the calculation results in the table above, the practicality of the teaching module based on ethnomatics learning, which is assessed based on numeracy indicators, includes several aspects such as ease of use, learning effectiveness, and implementation time. The practicality assessment shows an average score of 88%, which is classified in the Very Practical category. This indicates that the module is not only easy to use and effective in the learning process, but also supports efficient implementation and is in accordance with the time allocation in the classroom. The evaluation of students' numeracy skills covers four main domains, namely number, algebra, geometry, and data and uncertainty. Each domain is assessed through three competency levels: knowing (L1), applying (L2), and reasoning (L3). This assessment is used to measure the extent to which students can understand and apply numeracy concepts in each domain. The average score per domain is presented in Figure 3 below.

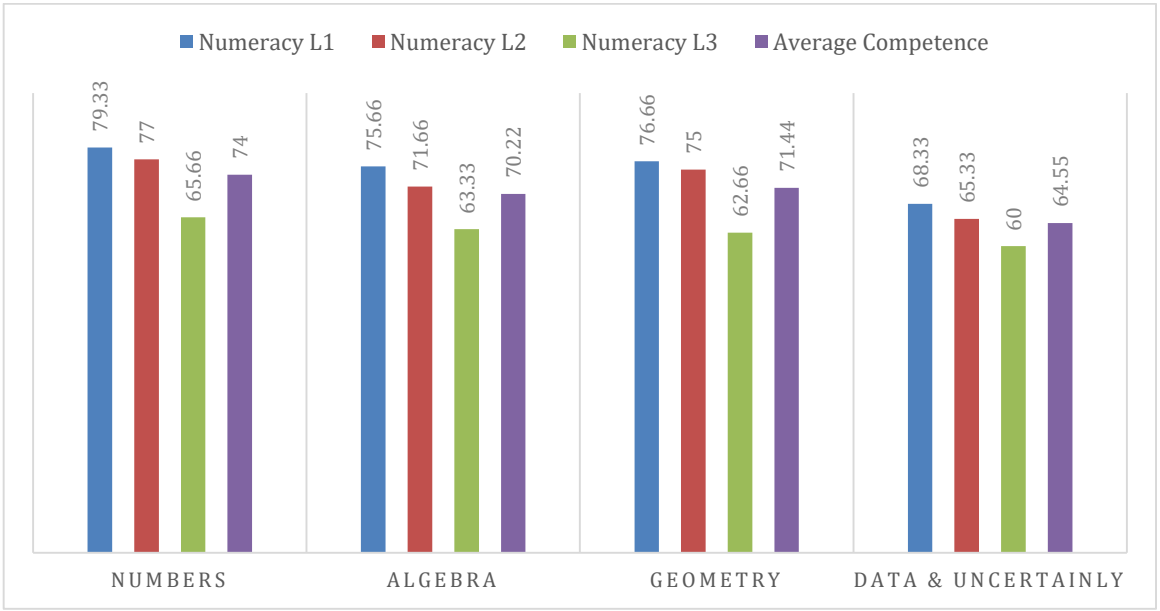

Figure 3. Overview of Students' Numeracy Competence

From Figure 3, it can be seen that students' numeracy skills vary in each domain and competency level. The number domain obtained the highest mean of 74.00, followed by geometry at 71.44, algebra at 70.22, and the data and uncertainty domain with the lowest mean of 64.55. When viewed from the competency level, students showed the best performance at the knowing level (L1) with an average of 75.00, while the reasoning level (L3) had the lowest average of 62.91. These results indicate that students have a fairly good basic understanding but need to improve their skills in application and reasoning.

Teaching modules based on ethnomatics learning in the context of Luwu culture play a crucial role in improving students' numeracy skills. The designed module not only supports the learning process of numeracy concepts, but also facilitates students in accessing, understanding, and applying numerical knowledge with a structured and culturally relevant approach. The module is designed to improve numeracy competencies in four domains: Number, Algebra, Geometry, and Data and Uncertainty. In the number domain, learners' knowing competence (L1) is emphasized on basic understanding of numbers, place value, and types of numbers. This is important because a strong understanding of the basic concepts of number is the foundation for applying competence (L2), where students can use their knowledge to solve real problems, such as calculations in the context of everyday shopping. In addition, the reasoning competency (L3), which requires students to analyze numerical data in new situations, strengthens their critical thinking skills in facing more complex mathematical challenges.

In the algebraic domain, the ethnomatics teaching module encourages students to understand and apply algebraic concepts in relevant and contextual ways. The knowing competency (L1) here includes an understanding of variables and basic equations. When students step up to applying competence (L2), they learn to set up and solve equations in everyday situations, such as area or volume calculations involving geometric objects. At a higher level, the reasoning competency (L3) gives students the opportunity to analyze situations involving algebra in complex contexts, helping them understand the interrelationships between variables and make accurate predictions.

In the geometry domain, the ethnomatics teaching module introduces students to the shapes, properties and sizes of objects in an interesting and contextualized way. The knowing competency (L1) teaches students to recognize various shapes and their characteristics. Furthermore, the applying competency (L2) encourages students to perform calculations related to the area and perimeter of objects they encounter in their environment, such as calculating the area of land for agricultural activities. At the reasoning level (L3), students are invited to analyze and solve geometry problems in more complicated contexts, such as building design, which equips them with practical skills needed in everyday life. Finally, the data and uncertainty domain invites students to understand and analyze data in an integrated way. The knowing competency (L1) helps students understand different types of data and how they are presented. In the applying competency (L2), students learn to use the data they collect to make decisions, such as in surveys or analyzing research results. The reasoning competency (L3) provides opportunities for students to analyze data in complex contexts, helping them evaluate different information to draw conclusions about trends or patterns in society. Through this teaching module, students not only learn math, but also develop critical and analytical thinking skills that are invaluable in a changing world.

The results showed that the ethnomatics learning-based teaching module developed to improve students' numeracy skills has excellent validity. The assessment was conducted based on several aspects, including relevance, comprehensiveness, and clarity, covering four numeracy competency domains: number, algebra, geometry, and data and uncertainty. The average validity assessment for each domain showed values between 81% and 89%, with highly valid categories for most aspects. Thus, the module obtained an average score of 85%, which indicates that the module meets high validity criteria. This reflects the good quality of

the module in terms of material relevance, completeness of information, and clarity of presentation. Thus, this module is suitable for use in the ethnomatics learning process to improve students' numeracy skills. These results are in line with (Supriyadi et al., 2024) that module development is successful in improving numeracy and character education through ethnomatics content.

Meanwhile, the results of the practicality assessment of the teaching module based on ethnomatics learning show that this module is very practical to use. The assessment was conducted based on three main aspects: ease of use, learning effectiveness, and implementation time. The results show that the module gets an average score of 88%, which is included in the very practical category. This shows that the ethnomatics-based teaching module is not only effective, but also easy to use in the context of daily learning. This is also supported by (Widada et al., 2019) that with a high practicality value, ethnomatics-based modules can be implemented easily in the classroom. This module is considered very effective in various competency domains, including number, algebra, geometry, and data and uncertainty. The implementation time aspect consistently received high ratings, indicating that the module can be implemented well within the allotted time. By integrating ethnomatics, students are able to develop logical and systematic thinking skills and apply mathematics in everyday life. This is in line with the findings of Fajriyah & Suryaningsih (2021) that with an approach that integrates ethnomathematics, students can develop critical and analytical thinking skills and apply mathematics in real situations.

Overall, these results confirm that the teaching module based on ethnomatics learning is not only effective in improving students' numeracy skills, but also relevant to the needs of classroom learning. This module facilitates the application of mathematical concepts in a more contextual manner and close to students' daily lives. The success of this module in the aspects of validity, practicality, and efficiency of implementation time shows that the ethnomatics approach is able to make a positive contribution to improving the quality of mathematics learning. With all these findings, this study provides strong empirical evidence that the development of teaching modules based on ethnomatics learning is not only valid in terms of content, but also practical for use in the classroom. The module is expected to contribute significantly in improving students' numeracy skills, in line with the broader educational goal of integrating local values in formal learning. The success of this module may encourage further development in a more contextualized, and relevant mathematics learning approach, so that students can learn in a more meaningful and enjoyable way.

D. CONCLUSION AND SUGGESTIONS

Based on the research results, the ethnomathematics-based teaching module developed has been proven to have a significant positive impact on improving students' numeracy skills. The module was validated by experts with an average score of 85%, indicating high quality in terms of material relevance, completeness of information, and clarity of presentation. Furthermore, the module was deemed highly practical, with an average score of 88%, reflecting its ease of use, learning effectiveness, and time efficiency. The module covers four main domains of numeracy: numbers, algebra, geometry, and data and uncertainty, with a structured and culturally relevant approach. Each domain is designed to support students in

understanding, applying, and analyzing numerical concepts while developing critical and analytical thinking skills.The research demonstrates that the development of this module not only successfully meets the needs of numeracy learning but also supports the integration of local cultural values, such as incorporating Luwu's cultural context into the teaching materials. This culture-based approach provides a more meaningful, relevant, and contextual learning experience, which can enhance student engagement in learning.

However, this study has several limitations. First, the research sample was limited to students from one location, Palopo City, making the findings not yet generalizable to other regions with different cultural backgrounds. Second, the study was conducted over a relatively short duration of only four sessions, so the long-term impact of the module on students' numeracy skills has not been analyzed. Third, the module's influence on students' motivation and interest in learning has not been thoroughly explored, which could be a significant area for future research. For future studies, it is recommended that this module be tested in more diverse locations with larger sample sizes, so the findings can be more representative and widely generalizable. Additionally, long-term studies should be conducted to evaluate the module's sustained impact on students' numeracy skills, including its influence on the development of numerical skills over an extended period. Similar modules could also be developed and applied to other subjects or within different cultural contexts, expanding the benefits of the ethnomathematics approach in various aspects of education. Furthermore, a more in-depth analysis of students' motivation and interest in learning should be conducted to evaluate the module's impact on non-cognitive aspects, such as student engagement in learning and changes in their attitudes toward mathematics. Thus, this teaching module is expected to continue to be refined and implemented more widely, making a significant contribution to improving students' numeracy skills through a more contextual, meaningful, and culture-based learning approach. This research also provides a strong foundation for the development of ethnomathematics-based teaching materials that can be applied in various regions and educational levels.

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