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Local Wisdom Literacy: Promising Context Integration in Algebra Learning

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ABSTRACT

This study provides a contextual and humanistic alternative in algebra learning, which offers pedagogical value and cultural significance. Indonesian students' mathematical literacy skills, particularly in algebra, are still relatively low, as shown by the results of PISA 2022. A significant contributing factor is the limited relevance of teaching materials to students' real-life contexts. This study introduces an innovative approach by developing algebra teaching materials based on local wisdom—referred to as local wisdom literacy—as a meaningful context for improving mathematical literacy among seventh-grade junior high school students. The novelty of this study lies in the integration of traditional Timorese cultural practices, such as weaving patterns, local measurement systems, and indigenous numerical reasoning, into formal algebra instruction. Using the ADDIE development model, this Research and Development (R&D) study produced culturally embedded materials that were validated by experts, with validity scores of 85.4% for content and 85% for assessment instruments. The materials were also considered highly practical (96.93% by students, 96% by teachers) and effective, as indicated by a moderate average N-Gain of 0.42 in student learning outcomes. In addition to improving conceptual understanding and mathematical literacy, the developed materials serve as a culturally responsive pedagogical model that is in line with the objectives of the Merdeka Curriculum and supports the preservation of local culture.

Keywords: Local Wisdom Literacy, Mathematical Literacy, Teaching Materials, Algebra

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Introduction

Mathematical literacy, defined as the capacity to reason, analyse, and apply mathematical knowledge in diverse real-life contexts, is widely regarded as a crucial competency for students in the 21st century (OECD, 2018). This perspective aligns with the historical and socio-cultural view that mathematics is not a culture-free discipline but is intrinsically shaped by societal practices. Various civilizations have developed their own mathematical systems to address concrete problems in fields such as economics, architecture, and ritual practices (Burton, 2011; Essien & Egbai, 2016; Hollings & Parkinson, 2024). This suggests that learning mathematics is not merely about mastering abstract symbols, but also about understanding its roots in human activity and local knowledge. Therefore, integrating students' cultural environments and intuitive reasoning, often cultivated through local traditions, could serve as a meaningful bridge to developing robust mathematical literacy.

Despite this recognized potential, a significant gap persists between theoretical advocacy for culturally responsive mathematics education and its practical implementation in many classrooms, particularly in algebra instruction. Conventional teaching materials and methods often continue to emphasize decontextualized problem-solving, largely neglecting the systematic use of local cultural contexts as a pedagogical resource. This disconnection may lead students to perceive algebra as irrelevant to their lives, thereby limiting their engagement and conceptual understanding.

The eastern part of Indonesia, particularly Timor Island, possesses a rich heritage of implicit mathematical knowledge embedded in its cultural practices. Indigenous activities, such as traditional trading, the construction of houses (*lopo*), and the creation of woven fabrics (*tenun*), demonstrate sophisticated applications of numerical concepts, geometric reasoning, patterns, and measurement systems (Deda & Disnawati, 2024; Dominikus et al., 2023; Dosinaeng, Lakapu, & Leton, 2020). However, a critical gap persists in the literature. While these practices have been occasionally documented, there is a scarcity of research that systematically analyses and transforms this cultural knowledge into validated, practical, and effective teaching materials for formal mathematics education, particularly for teaching abstract topics like algebra. This gap leaves a valuable resource untapped and contributes to a disconnect between students' cultural identity and their classroom learning experiences. As a result, this local wisdom is not only vulnerable to erosion by modernization but is also absent as a meaningful tool for enhancing mathematical literacy. Therefore, this study aims to fill this gap by developing and evaluating culturally-based algebra teaching materials that integrate Timorese ethnomathematics, thereby bridging cultural heritage with academic learning.

Since the introduction of the concept of ethnomathematics by D'Ambrosio (1985), discourse on the diversity of mathematical expressions in various cultural communities has begun to gain space in the study of mathematics education. Ethnomathematics highlights the importance of viewing mathematics not only as a Western product packaged in formal notation and academic institutions, but also as part of a society's way of life (Appelbaum & Stathopoulou, 2023; Plenary Papers Galindo & Newton, 2017; Sudirman et al., 2024). This approach offers a more inclusive and democratic perspective on knowledge, and challenges the hegemony of a single paradigm in mathematics learning (Rosa & Orey, 2020). In this context, mathematics is no longer interpreted solely as an academic object, but as a social construction born from diverse cultural experiences. Therefore, recognition of the existence and value of local knowledge is important to realize more relevant, equitable, and transformative mathematics education.

Various studies have shown that integrating local cultural elements into mathematics learning not only increases students' relevance and participation, but also strengthens their identity as part of a community that has its own history and way of thinking. For example, research by Risdiyanti & Sulisworo

(2021) and Tampubolon, Sibarani, Zuhri, et al. (2023) show that implementing an ethnomathematics context in the classroom can increase student engagement and deepen their understanding of abstract concepts in the national curriculum. Research by Fouze & Amit (2023) also shows that an ethnomathematics-based approach can strengthen the self-confidence of students from minority cultural groups, because they feel that their cultural values are recognized and appreciated in the learning process. In addition, a study by Dosinaeng et al. (2025) found that students find it easier to develop conceptual understanding when mathematical concepts are presented through cultural contexts that are familiar to their daily lives. Therefore, the integration of local cultural elements is not only pedagogically beneficial, but also serves as an important means of building a more inclusive, equitable, and realized education in the socio-cultural realities of students.

In the context of Indonesia's rich cultural diversity, the Timorese community offers a highly potential field for ethnomathematical exploration. Initial field observations have revealed the presence of mathematical structures and concepts embedded in various cultural expressions of Timorese society, including traditional numeration systems (Maure & Jenahut, 2022), geometry (Dosinaeng, Lakapu, & Leton, 2020; Nurmaya et al., 2021), and mathematical patterns in ikat weaving (Lakapu, Uskono, et al., 2021), which exhibit fractal structures, symmetry, and recursive patterns that implicitly resemble the Fibonacci sequence. However, although these studies have made valuable initial contributions to documenting mathematical elements within Timorese culture, there remains a significant gap in this area of research. Key issues that have not yet been thoroughly explored include how the intergenerational transmission of mathematical knowledge takes place within the community, and the extent to which these traditional concepts are adapted to support mathematical students in improving their mathematical literacy. Moreover, questions remain about how such local knowledge systems can be effectively integrated into formal education without losing their cultural essence. Addressing these gaps is crucial for developing more inclusive and culturally responsive mathematics education in Indonesia.

This study introduces several distinct novelties that address the identified gaps in culturally responsive mathematics education. Conceptually, it encourages the notion of “local wisdom literacy” as a specific pedagogical framework for algebra instruction. While ethnomathematics studies often document cultural mathematical practices, this research moves beyond documentation by systematically transforming Timorese local wisdom, such as measurement systems in trade, weaving patterns, and culturally embedded numerical reasoning, into a structured literacy that students can leverage to decode abstract algebraic concepts. This approach reframes local culture not merely as a motivational context but as a fundamental literacy tool, analogous to numerical or textual literacy, which is a novel theoretical contribution to the field.

Therefore, this study aims to address this critical gap by developing and validating a complete suite of algebra teaching materials grounded in the "local wisdom literacy" framework. The development will follow the systematic ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to ensure a high-quality product. The novelty of this research lies in its move beyond superficial cultural inclusion towards deep integration, where algebraic concepts are intrinsically linked to cultural artifacts and reasoning processes; for instance, variables are introduced through dynamic patterns in traditional weaving, and linear equations are derived from Timorese barter systems. The quality of the final product will be rigorously evaluated based on three essential criteria: validity (through expert judgment), practically (based on teacher and student responses), and effectiveness (measured by the improvement in students' mathematical literacy scores). By providing empirical evidence for this approach, this study offers a replicable model for integrating local wisdom into formal education, thereby bridging a persistent gap between policy ambition and classroom practice in culturally responsive mathematics education.

Methods

This study employed a Research and Development (R&D) approach with the primary aim of designing culturally relevant mathematics teaching materials to enhance students' mathematical literacy skills. The research was conducted at SMP Negeri Lorotuan in Atambua, involving seventh-grade students for the 2024/2025 academic year as research participants.

The quality of the developed product was evaluated based on three core aspects: validity, practicality, and effectiveness. The validity aspect was assessed by two subject matter experts prior to classroom implementation. Practicality was determined based on feedback from both teachers and students after using the product during instructional sessions. Effectiveness was measured by analyzing students' learning outcomes through a comparison of pretest and posttest scores. A product was considered effective if at least 80% of students met or exceeded the Minimum Mastery Criteria (KKM) score of 70 and demonstrated improvement across three key indicators of mathematical literacy: the application of mathematical concepts in real-life contexts, the ability to analyze information presented in various forms, and the skill to draw conclusions and make predictions based on data. The 80% criterion used in this study to determine product success is based on general standards in Indonesian education: success in classroom learning is indicated when at least 75% of students exceed the Minimum Completion Criteria (KKM) (Nurlaili et al., 2022).

Before the instructional materials were implemented in the classroom, the test instruments underwent prior validation and reliability testing. To evaluate the effectiveness of the product, improvements in students' abilities were assessed by comparing pre-test and post-test scores. This

evaluation focuses on three key competency areas: 1) The ability to apply mathematical concepts to solve real-life contextual problems; 2) The skill to read, interpret, and analyze mathematical information presented in a variety of data representations; and 3) The capacity to draw conclusions and make predictions based on mathematical analysis. Quantitative data collected from these assessments were then analyzed to determine how significantly the developed learning materials contributed to enhancing students' mathematical literacy.

In addition to written assessments, this research also employed interviews and questionnaires as supporting data collection tools. Semi-structured interviews were conducted with mathematics teachers and seventh-grade students to explore learning challenges and contextual needs in the classroom, such as: students' difficulties in grasping fundamental algebraic concepts; the limited active participation of students during the learning process; and the mismatch between instructional content and students' socio-cultural contexts.

Meanwhile, questionnaires were administered to two experts to evaluate the product's quality in terms of content, language use, and visual presentation. These instruments utilized a Likert scale ranging from 1 to 5, with evaluation indicators covering: alignment of content with the national curriculum standards; integration of local cultural elements into the instructional material; and ease of use of the product by both students and teachers.

This study employed the ADDIE instructional design framework, which consists of five core phases: Needs Analysis, Design, Development, Implementation, and Evaluation (Dosinaeng et al., 2025). The Figure 1 below presents the workflow of the ADDIE framework.

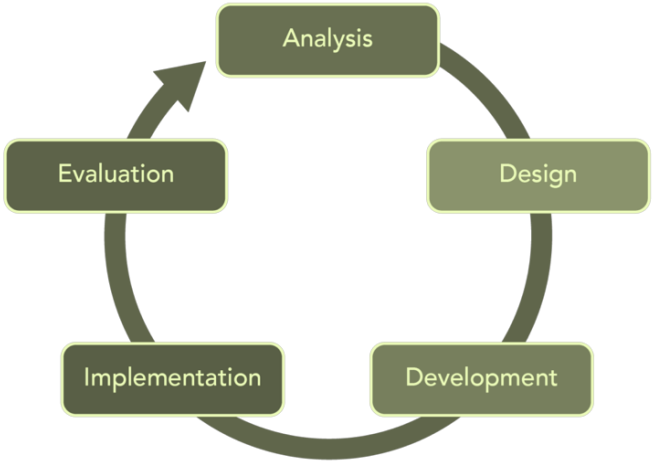

Figure 1. *ADDIE Instructional Design Framework*

Based on Figure 1, the ADDIE instructional design framework represents a widely recognized and systematic approach to developing effective learning solutions, structured into five interconnected and

often iterative phases. It begins with the Analysis phase, where classroom observations and in-depth discussions with educators were conducted to identify instructional challenges and determine the key components that could enhance students' mathematical abilities. This insight then informs the Design stage, which focuses on outlining specific learning objectives, developing assessment instruments, and strategizing instructional methods and content organization. Subsequently, the Development phase involves the creation of the actual learning materials and activities based on these detailed design specifications. The prepared materials are then put into practice during the Implementation phase, where the instruction is delivered to the learners in the intended environment. Finally, the Evaluation phase regularly assesses the effectiveness and efficiency of the entire instructional process and its products, with findings often providing critical feedback that loops back to refine earlier stages, thereby underscoring the model's iterative nature and commitment to continuous improvement.

In the Design stage, a comprehensive set of instructional elements was prepared, including reference materials, content outlines, and assessment tools. These learning materials covered algebraic concepts, culturally relevant contextual examples, practice exercises, and evaluation instruments.

Subsequently, the Development phase involved translating the instructional design into a tangible product. Once developed, the product's validity was assessed by two subject matter experts prior to classroom implementation. The validation was conducted using the formula (Dosinaeng et al., 2025):

$$The\ percentage\ of\ feasibility = \frac{The\ total\ score\ obtained}{The\ maximum\ possible\ score} \times 100\% \qquad (1)$$

A product was considered valid if it achieved an average score of at least 75% from the validators.

Following validation, the product progresses to the Implementation phase, where teachers apply it in real classroom settings. After the learning sessions, students completed a post-test to assess learning gains and filled out a response questionnaire. Teachers also provided feedback via a separate evaluation form. The practicality of the product was calculated using the same percentage formula, with a minimum threshold of 75%.

The final phase, Evaluation, assesses the effectiveness of the learning materials. The product was deemed effective if at least 80% of students met or exceeded the Minimum Competency Criteria (MCC). The improvement in student outcomes was calculated using the *Normalized Gain* (*N-Gain*) formula (Dosinaeng et al., 2025):

$$N - Gain = \frac{Skor\ Pretest - Skor\ Posttest}{Skor\ Maksimal - Skor\ pretest} \qquad (2)$$

The levels of students' learning improvement were categorized based on their *N-Gain* scores. An *N-Gain* value of less than 0,3 indicates a low level of improvement. Scores ranging from 0,3 to less than 0,7 were classified as showing moderate improvement. Meanwhile, an *N-Gain* score equal to or greater

than 0,7 was considered to reflect a high level of learning improvement. Furthermore, a product was considered effective if at least 80% of students met or exceeded the Minimum Mastery Criteria (KKM) score of 70. This 80% criterion is based on general standards in Indonesian education, where success in classroom learning is indicated when at least 75% of students exceed the KKM (Nurlaili et al., 2022). The students' mastery was demonstrated across three key indicators of mathematical literacy: the application of mathematical concepts in real-life contexts, the ability to analyze information presented in various forms, and the skill to draw conclusions and make predictions based on data.

Finally, the Evaluation phase regularly assesses the effectiveness and efficiency of the entire instructional process and its products, with findings often providing critical feedback that loops back to refine earlier stages, thereby underscoring the model's iterative nature and commitment to continuous improvement. Through this systematic approach, the research aims to produce instructional materials that are not only validated and user-friendly but also capable of significantly improving students' mathematical literacy through a culturally grounded learning model.

Results and Discussion

Analysis Stage

In this section, three analyses are conducted, namely: 1) analysis of competencies to be developed; 2) analysis of student characteristics; and 3) analysis of learning material content.

Analysis of Developed Competencies

According to the Ministry of Education and Culture of Indonesia (2017) there are six aspects of numeracy, namely: 1) estimating and calculating whole numbers; 2) using fractions, decimals, percentages, and ratios; 3) recognising and applying patterns and relationships; 4) using spatial reasoning; 5) performing measurements; and 6) interpreting information from statistical data. The alignment of these components with the curriculum can be seen in Table 1 below.

Table 1. *Relationship between Numeracy Components and Curriculum*

Numeracy Literacy Components	Curriculum
Making estimates and performing calculations using whole numbers	Numbers
Applying fractions, decimals, percentages, and ratios	Numbers
Identifying and analysing patterns and relationships	Numbers and Algebra
Engaging in spatial reasoning	Geometry and Measurement
Utilizing various measurement techniques	Geometry and Measurement
Understanding and interpreting data from statistical information	Data Processing

This study focuses on the aspect of algebra, which, according to Table 1, is closely related to the components of recognising and using patterns and relationships. Therefore, the analysis focuses on

students' skills in identifying patterns and establishing relationships between variables in the context of algebra

Analysis of Student Characteristics

To understand the students' initial abilities, a pre-test of algebraic literacy skills was administered to 28 seventh-grade students. The percentage of correct answers is presented in Table 2 below.

Table 2. *Student Pretest Results*

Indicator	Percentage
Construct mathematical expressions by using symbols or letters to represent unknown values	67,86%
Represent a given situation or condition using algebraic expressions	46,43%
Perform operations or transformations on algebraic forms	10,71%

The data in Table 2 above shows that no indicator achieved a minimum of 80% student mastery. The evaluation results show that students' mastery of the three basic algebraic competencies still does not meet the minimum mastery target of 80%. The indicator of formulating mathematical statements using variables was the highest with an achievement of 67.86%, although it was still 12.14% below the standard. Meanwhile, the ability to express conditions in algebraic form is mastered by only 46.43% of students, indicating difficulties in translating contextual problems into symbolic form. The lowest achievement is in the indicator of manipulating algebraic forms (10.71%), which signifies significant challenges in applying the properties of mathematical operations. This data highlights the urgent need for more contextual learning, structured scaffolding-based exercises, and interventions to bridge the competency gap among students.

Analysis of Learning Material Content

Content analysis of learning materials was conducted to evaluate the extent to which mathematics teaching materials, particularly on the topic of algebra at the junior high school level, are able to support the development of students' mathematical literacy in accordance with the requirements of the Merdeka Curriculum and the contextual needs of students. In this context, there are three main aspects that were analysed, namely: 1) the depth and breadth of algebra content; 2) relevance to real-life contexts; and 3) integration of local wisdom values

1) The depth and breadth of algebra content

   The algebra material in textbooks used in schools generally covers basic concepts, such as algebraic forms, algebraic operations, linear equations with one variable, and their application in simple problems. However, observations indicate that although the spirit of the Merdeka Curriculum is to prioritise conceptual understanding and contextual learning, analysis of textbooks and

implementation in the field shows that the presentation of algebra material is sometimes still dominated by a procedural approach, with insufficient emphasis on deep and relevant conceptual understanding.

2) Relevance to real-life contexts

The analysis shows that the connection between algebra material and students' life contexts is still very limited. The contextual questions used are mostly artificial and irrelevant to students' daily experiences. The contexts raised are mostly generic illustrations, such as buying books or calculating age, which do not reflect the socio-cultural diversity of students in various regions.

3) Integration of local wisdom values.

The analysis results indicate that the teaching materials used, particularly in the topic of algebra, do not explicitly accommodate the integration of local wisdom values. Local cultural practices such as weaving, traditional calculation systems, measurement systems, or calculations in local economic activities have not been used as contexts in mathematics learning. However, previous research has shown that linking mathematical concepts to local wisdom can increase student engagement and strengthen mathematical concept understanding through authentic and meaningful experiences (Purnamasari & Mashuri, 2025; Rakhmawati & Alifia, 2018).

Conclusion of the Analysis

The analysis reveals that while algebra topics in junior secondary mathematics textbooks cover the essential concepts outlined in the national curriculum, their connection to students' real-life contexts remains limited. The exercises and problems provided are mostly generic, offering minimal relevance to students' everyday experiences. Furthermore, there is an almost complete absence of local cultural integration within the algebra learning materials. This is a missed opportunity, considering that culturally embedded contexts have the potential to significantly enhance student engagement and deepen conceptual understanding. These findings underscore the need to develop contextualized and culturally grounded instructional materials that support meaningful and relevant mathematical literacy in alignment with students' socio-cultural backgrounds.

Design Stage

The learning design is guided by several basic principles, namely: 1) the material focuses on the introduction and application of algebraic patterns and relationships; 2) the use of contextual questions related to students' daily lives; 3) problems designed to be relevant to students' local experiences; and 4) the presentation of information using images, diagrams, or graphs to support the visualisation of concepts. Furthermore, in an effort to enrich the teaching materials, a literature study was conducted covering two

aspects, namely: 1) ethnomathematics studies, to identify forms of patterns and relationships from local wisdom; 2) educational studies, to determine the ideal structure of teaching materials in line with a literacy-based approach.

This teaching material is structured with six main components, including: introduction, Pancasila learner profile, learning objectives, open-ended questions, core material, and assessment. The introduction section provides an overview of how algebraic concepts emerge in the cultural traditions of East Nusa Tenggara. The Pancasila learner profile section describes the character and values of Pancasila that are expected to be developed during the learning process. The learning objectives section outlines the goals to be achieved through this learning process. The opening questions section is used to spark curiosity and initiate discussion. The core material section contains learning content accompanied by local illustrations and guiding questions. Finally, the assessment section contains questions that train students' critical and creative thinking and evaluate their understanding of algebra.

Development Stage

At this stage, researchers began developing teaching materials based on the results of the analysis and design that had been prepared previously. The products developed were local wisdom-based mathematics teaching materials integrated into the seventh-grade junior high school algebra curriculum. Activities at this stage included the development of preliminary drafts of teaching materials and product validation

Development of the Initial Draft

The initial draft of the teaching materials was developed by taking into account the results of the student needs analysis and the characteristics of the local context that had been studied previously. The structure of the teaching materials refers to the principles of active and independent learning, which provide space for exploration, discovery, and reinforcement of concepts through the students' real experiences.

Figure 2. *One of the illustrations in the teaching materials developed*

Figure 2 above is one of the contextual illustrations based on local wisdom developed in this teaching material product. In the introduction, there is a story about Mariani, a child who has m lontar leaves to make *oko mama*, a traditional craft from South Central Timor, NTT. In the narrative, Mariani gives 4 lontar leaves to her sister, Yuni, and Yuni then asks her mother for an additional 10 lontar leaves. Her mother is said to have twice as many lontar leaves as Mariani. This illustration is then developed into a visual stimulus to support students' understanding of algebra through mathematical expression representation activities by asking questions about the total number of lontar leaves now owned by Yuni and her mother.

From the story, students are guided to identify and arrange algebraic forms such as $m - 4$, $2m$, and $2m - 10$. Simplifying these expressions into $3m - 14$ is part of the learning objective, which is for students to be able to arrange and simplify algebraic forms from contextual situations. To support the achievement of competencies, the Pancasila Student Profile is integrated into the design objectives, such as strengthening character in faith and devotion to God the Almighty, fostering global diversity through the introduction of local culture, and promoting critical and independent thinking through story-based problem-solving activities. Questions such as ‘How many total lontar leaves do Yuni and her mother have?’ are used as discussion prompts and critical thinking activities for students. Meanwhile, the assessment strategies designed are formative and contextual, such as evaluating students' thinking processes, their ability to formulate expressions, and their participation in group discussions.

Product Validation

At this stage, the developed product is validated, particularly in two main areas: 1) learning materials; 2) assessment instruments. The final scores for these two areas will determine the final outcome of the product validation.

Validation of learning materials

The learning materials were validated to ensure their suitability with the Merdeka Curriculum and mathematics literacy indicators. The validation scores are shown in Table 3 below.

Table 3. *Results of Learning Material Validation*

No.	Indicator	Maximum Score	Validator 1	Validator 2
1	Consistency with the curriculum	10	9	8
2	Integration of relevant content or materials	10	8	9
3	Clarity and comprehensibility	10	9	8
4	Assessment and evaluation processes	10	8	9
5	Ease of access and availability	10	9	9
6	Correspondence with mathematical literacy benchmarks	15	13	12
	Total	65	56	55
	Average		55,5	
	Final Score		85,4%	
	Criteria		Valid	

Based on Table 3, the final validation score for the learning material section was 85.4%, which falls into the valid category with minor revisions without having to return to the validator. The revisions made were related to the images used so that they would be more contextual. The revisions made can be seen in Figure 3 below.

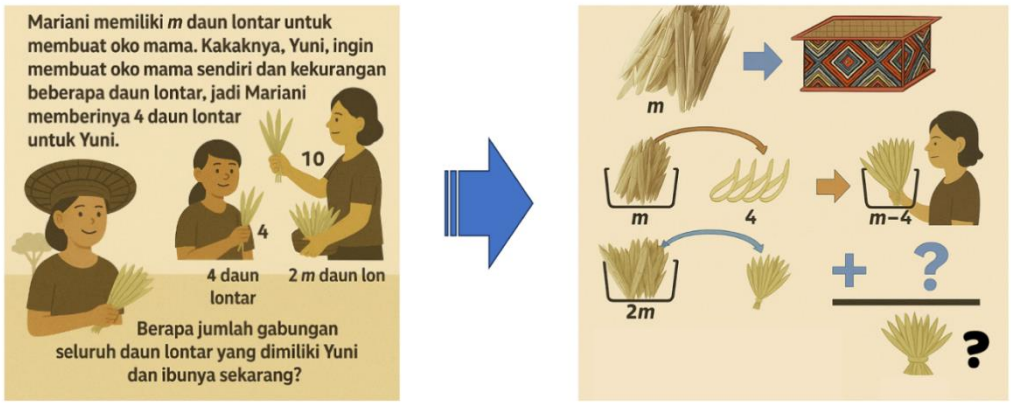

Figure 3. *Revision of Images in Teaching Materials Based on Validator Results*

In Figure 3 above, it can be seen that there is an additional image of oko mama on the right-hand side of the picture. This reinforces the contextual aspect of the illustration provided, as oko mama is a cultural object that is part of the daily life of the Timorese people

Validation of assessment instruments

The validation of the assessment instrument can be seen in Table 4 below.

Table *4.* *Assessment Instrument Validation Results*

No.	Indicator	Maximum Score	Validator 1	Validator 2
A.	**Consistency with Literacy Proficiency Standards**			
1.	Applying mathematical concepts to solve real-life problems	5	4	5
2.	Examining and interpreting information presented in different formats (such as images, graphs, tables, and diagrams)	5	4	4
3.	Drawing conclusions from analyzes to support decision-making	5	4	4
B.	**Suitability for Students' Knowledge Level**			
1.	Appropriateness of data comprehension and analysis for seventh-grade students	5	5	4
2.	Relevance of mathematical applications to real-world situations for Grade VII learners	5	4	4
3.	Compatibility with the logical reasoning and critical thinking abilities of seventh-grade students	5	4	5
	Total	30	25	26
	Average			25,5
	Final Score			85%
	Criteria			Valid

Based on the validation results in Table 4 above, the mathematical literacy assessment instrument obtained an average score of 25.5 out of a maximum score of 30, with a final score of 85%, thus falling into the valid category. Overall, this instrument is considered suitable for use because it is in line with mathematical literacy indicators and takes into account the ability level of seventh-grade students. Although there were slight differences in assessment among validators, no indicators received low scores, ensuring the quality of the instrument remains intact.

Implementation Stage

At this stage, teaching materials that have been validated are implemented in the classroom to evaluate their practicality and effectiveness in achieving the predetermined learning objectives. The materials developed focus on basic algebraic concepts, such as understanding algebraic forms, algebraic operations, and their application in everyday contexts integrated with local wisdom values. In this implementation, teachers use teaching materials to guide seventh-grade students in gradually building their understanding of algebra, while developing their mathematical literacy skills. The contextual approach used makes it easier for students to relate algebraic concepts to real-life situations they encounter in their environment. Feedback from teachers and students after using these materials is then collected and analysed to ensure quality and impact.

The results of the analysis of student responses to the developed teaching materials can be seen in Table 5 below.

Table 5. *Results of Student Response Analysis After Using the Developed Product*

No.	Indicator	Maximum Score	Score Obtained
1.	Students' engagement with the developed teaching materials	280	280
2.	Enhancement of students' understanding of mathematical concepts	420	420
3.	Connection between the teaching materials and local cultural knowledge	280	280
4.	Suitability of the difficulty level of the materials for students	280	244
5.	Adequacy of examples and practice exercises provided	280	256
6.	Impact of the materials on students' mathematical literacy development	420	420
	Total	1960	1900
	Final Score		96,93%
	Criteria	Very Practical	

Based on Table 5 above, the final score of student responses after using the developed product was 96.93%, categorised as very practical. This teaching material was rated very good in increasing students' interest and conceptual understanding, relevant to local wisdom, and effective in improving mathematical literacy skills. Although there are minor shortcomings related to the difficulty level and the quantity of example questions and exercises, the teaching material remains highly appropriate for classroom use.

Notes from students indicate that they feel helped in understanding algebra material because it is presented in a context that is close to their lives. One student wrote, 'The pictures in this material are interesting and help me understand algebraic problems more easily.' In addition, another student said, 'This material helps me understand algebraic operations, especially when related to buying and selling activities in the local market.' This shows that visual representations help in understanding abstract concepts. However, some students also admitted to experiencing difficulties when first solving real-world problems because they were not yet accustomed to them. This is reflected in lower scores on the "Appropriateness of teaching material difficulty level" indicator.

In addition to students, researchers also collected and analysed teacher responses after the implementation process. The results of the teacher response analysis can be seen in Table 6 below.

Table 6*. Results of Teacher Response Analysis After Using the Developed Product*

No.	Indicator	Maximum Score	Score Obtained
1.	Planning and organization of the learning process	10	10
2.	Presentation and explanation of the subject matter	10	10
3.	Level and quality of student engagement and participation	10	10

4.	Opportunities for practice and real-life applications	10	9
5.	Assessment and review of learning outcomes	10	9
	Total	50	48
	Final Score		96%
	Criteria		Very Practical

Based on Table 6 above, the final response rate of teachers after using the developed teaching materials was 96% categorized as very practical. Teachers stated, “The advantage of these teaching materials is their ability to connect algebra with students’ real lives and serve as a means to introduce local cultural values in the context of mathematics learning.”

The results of the analysis at the implementation stage above indicate that the developed teaching materials are not only valid in terms of content but also highly practical and effective for use in the learning process in Grade VII. Positive responses from students and teachers indicate that the contextual approach integrated with local wisdom can enhance learning interest and understanding of algebraic concepts, leading to improved mathematical literacy skills among students. Although there are still challenges in terms of the difficulty level of contextual problems, this product is overall considered capable of bridging meaningful and relevant mathematics learning with students' real lives. This strengthens the potential of teaching materials as an innovative alternative in humanistic and contextual algebra learning.

Findings from this study indicate that, from a practical perspective, student responses (96.93%) and teacher responses (96%) show that this product is not only easy to use but also enhances student engagement in the learning process. This reinforces Saragih's findings, which emphasise that a locally-based cultural approach can enhance learning motivation by creating more authentic learning experiences. Previous research findings also emphasise the importance of a contextual approach in mathematics learning, particularly at the junior high school level (Afni & Hartono, 2020; Rohimatunisa, 2022; Syamsuddin & Istiyono, 2018). The findings of this study demonstrate that when local cultural elements familiar to students, such as patterns in traditional weaving, local measurement systems, or buying and selling practices in traditional markets, are used as the context for learning, a measurable increase occurs in students’ attention, curiosity, and active involvement in the learning process. Stimulating interest must begin with students' knowledge derived from experiences they have built through their own means (Rosa & Orey, 2016). Knowledge is easier to understand and accept when presented in a context familiar to learners. Previous research findings also indicate that integrating local wisdom can enhance interest in learning mathematics (da Silva et al., 2023; Leton et al., 2025; OECD, 2023; Pugu et al., 2024; Sukma et al., 2022). The integration of local cultural contexts was found to bridge the gap between

formal mathematical language and students' real-life experiences**,** addressing a previously identified barrier to understanding algebraic concepts, as evidenced by the improvement in students' ability to represent contextual problems algebraically (as shown in Table 2 and post-test results). In other words, students no longer learn in a foreign and rigid space, but in a context that is culturally and emotionally relevant, and it is hoped that this will increase students' interest in learning mathematics.

Interest in learning mathematics is a crucial component of educational success, as it serves as the primary driver of students' intrinsic motivation (Boadu & Boateng, 2024; Lina & Aryani, 2024; Yeh et al., 2019; Yeribatuah & Arthur, 2023). he positive responses from students and teachers indicate that a contextual approach integrated with local wisdom can enhance learning interest and understanding of algebraic concepts, leading to improved mathematical literacy among students. Although there are still challenges in terms of the difficulty level of solving contextual problems, this product is overall deemed capable of bridging meaningful and relevant mathematics learning with students' real-life experiences. This strengthens the potential of teaching materials as an innovative alternative in humanistic and contextual algebra learning. Additionally, our observations also show that students are more active in asking questions and discussing when problems or materials are related to their own culture; exhibit higher self-confidence, as they feel they have prior competence in understanding the problem context; experience learning satisfaction, as they can find the ‘meaning’ behind the mathematical concepts being studied; and are more motivated to complete tasks and problems, even challenging ones, because they do not feel alienated from the context. Within the framework of the Merdeka Curriculum, which emphasises differentiated and context-based learning, these findings are highly relevant and urgent for broader implementation. The application of local wisdom literacy is not only a strategy to increase learning interest but also an effort to decolonise mathematics education, freeing it from the dominance of symbols and narratives that are detached from the local lives of students.

Evaluation Stage

At this stage, the effectiveness of teaching materials in improving students' mathematical literacy skills, especially in understanding and applying algebraic concepts, was evaluated. The evaluation was conducted by comparing the pre-test and post-test results before and after using the developed teaching materials. The evaluation results can be seen in Figure 4 below.

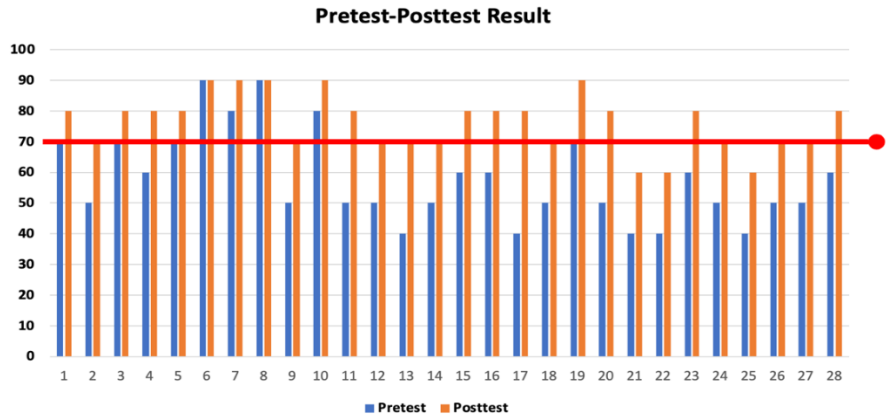

***Figure 4**. Comparison of Pretest and Posttest Results*

Based on Figure 4 above, it can be seen that the students' post-test results showed a significant improvement compared to the pre-test results. Before the learning process, most of the students' pre-test scores were below the established minimum passing grade (70). Many students obtained low scores between 40 and 60, indicating that their initial mathematical literacy skills in algebra concepts were still low. However, after the implementation of the teaching materials, the post-test results showed a significant improvement. Almost all students achieved or exceeded the minimum passing grade. The orange bars (post-test) in Figure 4 are generally higher than the blue bars (pre-test), and even approach the maximum score (100) for some students. This indicates that the developed teaching materials are effective in improving students' mathematical literacy skills in algebra concepts in Grade VII junior high school.

Additionally, the effectiveness of the product was analysed through the calculation of N-Gain scores, the results of which are presented in Figure 5 below.

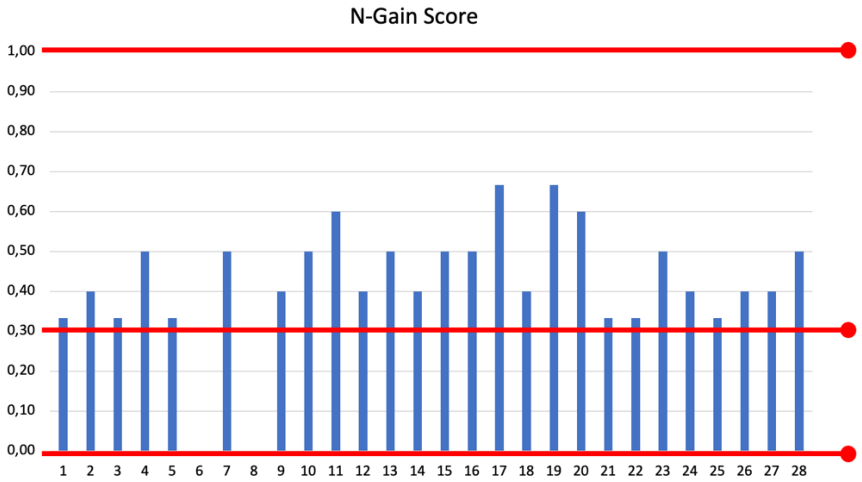

***Figure 5**. N-Gain Score After Product Implementation*

Based on the calculations, the average N-Gain score was 0.42, which is categorized as moderate. This means that, in general, there was a significant improvement in students' abilities after using the product. From the graph in Figure 5 above, it can be interpreted that: 1) most students experienced a moderate improvement in understanding after using the developed teaching materials; and 2) there were 2 students who obtained the same scores for the pre-test and post-test, thus categorized as not experiencing improvement.

Overall, these results indicate that the use of the developed product has a positive impact on improving students' understanding. Although most students experienced a fairly good improvement, there are some students who require additional attention to support their learning development. This finding serves as a basis that the implemented product is effective; however, further development and additional support are still needed to optimise the learning outcomes of all students.

The results of the pretest-posttest data analysis showed a significant improvement, with an average N-Gain value of 0.42, categorized as moderate improvement. This improvement indicates that the use of locally-based instructional materials can strengthen students' mathematical literacy skills, particularly in understanding concepts and solving contextual problems. These findings align with Tampubolon's research, which shows that an ethnomathematics-based approach can enhance mathematical concept understanding and problem-solving skills. (Tampubolon, Sibarani, Zakiah, et al., 2023). The analysis of the questionnaire results indicates that students responded positively to contextual problems based on their daily experiences, which helped enhance their understanding of mathematical concepts. This is reflected in the highest possible score (420 out of 420) awarded by the students for the indicator related to the improvement of their conceptual understanding.

The interview results also indicate that students find it easier to understand algebraic concepts through contextual illustrations, supporting the theory of connectivism, which emphasizes the importance of the connection between concrete experiences and the learning of abstract concepts (Hendricks, 2019). However, there were two students who did not experience an increase in pretest-posttest results, indicating that the integration of real-life contexts into questions requires additional mentoring strategies, especially for students who are accustomed to procedural learning patterns. This phenomenon is in line with research findings that suggest that the shift from conventional learning to a contextual problem-based approach requires a longer adaptation period for some students (AlBuali & Khan, 2018).

Interviews with teachers showed that the use of these teaching materials was not only academically effective, but also contributed to the preservation of local culture. This supports the findings of Annisha's (2024) research, which states that culture-based education can shape students' cultural identity and

strengthen nationalism in the era of globalization. The integration of local wisdom into teaching materials has had a significant impact. Additionally, the analysis of students' final response scores after using this product showed a 96.93% rating, categorized as highly practical. This teaching material is considered very good and relevant to local wisdom, and it improves mathematical literacy skills. Students' responses also suggest that using contextual problems rooted in their everyday experiences supports a deeper grasp of mathematical concepts. This is demonstrated by the perfect score (420 out of 420) students awarded for the indicator related to enhanced conceptual understanding. Earlier studies by by Dosinaeng, Lakapu, & Leton (2020) emphasize the value of incorporating cultural elements into mathematics instruction to increase relevance and student engagement. This approach aligns with the ethnomathematics perspective, which becomes asserts that mathematics is more accessible when linked to cultural contexts and lived experiences (D'Ambrosio, 1985; Dosinaeng, Lakapu, Jagom, et al., 2020; Lakapu, Beda, et al., 2021; Rewatus et al., 2020). Traditional games like sikidoka, used as examples in teaching materials, not only provide meaningful starting points but also function as connections between cultural heritage and mathematics education (Deda & Disnawati, 2024; Wulansari & Dwiyanti, 2021).

Local wisdom literacy in mathematics education not only enriches students' learning experiences but is also a strategic step in preserving local culture. By highlighting mathematical traces (local knowledge) in the traditions and daily lives of local communities, teachers have acted as cultural agents who not only transmit knowledge but also preserve the collective identity heritage. This supports the national education objectives, which are not only focused on academic achievement but also on character development and the preservation of Indonesia's rich and diverse culture, in line with the concept of ethnomathematics as developed by Ubiratan D'Ambrosio, who argues that ethnomathematics provides a strong theoretical foundation for understanding how mathematics is present in local cultural practices.

Conclusion

This study successfully achieved its aim of developing and validating algebra teaching materials deeply integrated with Timorese local wisdom. The development process, guided by the ADDIE model, resulted in a product that demonstrates high quality across three critical dimensions. First, the materials proved to be highly valid, as evidenced by expert validation scores of 85.4% for content and 85% for assessment instruments, confirming their strong alignment with curriculum standards and mathematical literacy objectives. Second, the materials were found to be highly practical based on implementation data, receiving overwhelmingly positive responses from both students (96.93%) and teachers (96%), who noted their ease of use, cultural relevance, and effectiveness in bridging abstract algebra with students' lived experiences. Third, the materials demonstrated significant effectiveness in improving mathematical literacy, with a moderate N-Gain score of 0.42 indicating meaningful learning gains.

The study's novel approach, deeply embedding algebraic concepts within cultural practices such as traditional weaving patterns and local measurement systems, proved particularly successful in making abstract concepts more accessible and meaningful. This "local wisdom literacy" framework effectively addressed the identified gap between formal mathematics instruction and students' cultural realities. While the research noted that some students required additional support to fully adapt to contextual problem-solving, the overall findings strongly support the value of culturally grounded mathematics education. This research provides educators with a validated, practical, and effective model for creating culturally responsive learning materials that not only enhance mathematical understanding but also preserve and celebrate local knowledge. Future research should explore the adaptation of this approach across different cultural contexts and educational levels, with particular attention to strategies that support diverse learners in contextual mathematics learning.

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