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Development of Culturally Responsive Mathematics E-Learning: Integrating the *Sikambang* Tradition of The Barus Coastal Community through the WordPress Platform

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ABSTRACT

Purpose - The purpose of this study is to develop culture-responsive mathematics e-learning by integrating the Sikambang Pesisir Barus tradition into the WordPress platform, creating learning that is contextual, meaningful, and relevant to students' cultural backgrounds.

Methodology - This research methodology uses a development research (R&D) design with the Plomp model. The research subjects were students/teachers from MTSN 1 and SMP Muhammadiyah 28 Barus, class VII-A, with 24 and 30 students, respectively. The research procedures include the stages of needs analysis, product design and development, expert validation, limited and field trials, and revisions until a valid, practical, and effective product is obtained. The intervention was carried out through the implementation of learning activities on a WordPress-based e-learning platform containing material on quadrilaterals and triangles. The research instruments included expert validation sheets, implementation observation sheets, student response questionnaires, and mathematical literacy ability tests. Data analysis was carried out descriptively and inferentially through tests of validity, practicality, and effectiveness, including n-gain calculations and analyses of learning completeness and student responses.

Findings - The results show that a WordPress-based mathematics e-learning integrated with the Sikambang culture meets the criteria for validity, practicality, and effectiveness. The developed media was considered feasible by experts, easy to use in learning, and received positive responses from students. In addition, students' mathematical literacy improved. It can be concluded that integrating local culture into e-learning can make learning more meaningful and engaging.

Significance- These implications and contributions position WordPress as a viable alternative for driving innovative, contextually relevant learning experiences.

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INTRODUCTION

Technological developments demand more innovative and engaging learning approaches. Technology in education plays a vital role in nurturing essential 21st-century skills (Kalyani, 2024). However, mathematics learning is still often considered difficult because it is rarely connected to students' daily lives and local culture. In fact, regional cultures, such as the Sikambang tradition of the Barus coastal community, can serve as meaningful learning resources. In addition, the use of digital platforms such as WordPress can help create learning environments that are easily accessible and interactive. The importance of technological media in the digital era is evident, as they can support and enhance learning (Simamora et al., 2023b). Therefore, this study aims to develop culturally responsive mathematics e-learning that integrates the Sikambang tradition of the Barus coastal region through WordPress, and to determine its validity, practicality, and effectiveness in mathematics learning.

The background of the problem explains that, in line with the times, the educational curriculum also demands the integration of culture into school learning (Fajriyah, 2018). So far, cultural concepts have rarely been integrated into school learning, leading many younger generations to forget or even fail to understand the meanings of existing cultures. Previous studies on ethnomathematics-based learning were generally conducted in a conventional, offline manner, such as through textbooks, student worksheets, printed materials, and direct classroom activities. The use of ethnomathematics-based LKS in grade VII students of SMPN I was effective (Ba'ru et al., 2022). Most developed digital media were still general in nature and had not closely connected learning materials to cultural contexts related to students' daily lives. The needs analysis conducted at MAN/MTs showed that the learning process was still dominated by lecture-based methods using printed worksheets (LKS) without digital integration and without the introduction of local culture. As a result, students had difficulty understanding the learning materials and lacked adequate knowledge of the local culture (Meilani et al., 2025). Cultural practices enable the embedding of mathematical concepts. Cultural values reflect the integration of mathematical concepts and acknowledge that every community develops its own specific ways of carrying out mathematical activities. One example is the Barus coastal culture, in which a cultural heritage element is the art used in traditional wedding ceremonies and sunat rasul (circumcision ceremonies), namely Sikambang (Ruwaida, 2014).

Wedding receptions use the art of Sikambang dance, and this tradition consists of several stages (Pasaribu, 2014) : (1) the escorting stage; (2) the basanding stage (handkerchief dance); (3) the group dance stage (umbrella dance); and (4) the scarf dance stage. Sikambang, as a cultural tradition, has a social function (Rizki et al., 2023). The Sikambang cultural art reflects the life of coastal communities, especially those in the Barus coastal area.

So far, the learning process in schools has relied solely on monotonous, less engaging textbooks and has not fully utilized technology (Fikriyah et al., 2022). To support the implementation of such learning models, one way to improve students' ability to master learning concepts is to apply digital-based learning through web-based platforms. Research on ethnomathematics and digital learning has developed rapidly, including studies that integrate local wisdom into digital mathematics learning media. However, no studies have been found that specifically integrate the Sikambang tradition into WordPress-based mathematics e-learning. Studies that systematically integrate both within digital mathematics learning media remain limited (Sholihat et al., 2026). This study uses WordPress. WordPress is a content management system (CMS) launched by Matt Mullenweg and Mike Little in 2004. WordPress can help users create and manage websites without coding, organize layouts, add features, and create website content easily (Yi-Ping, 2011). Initially, WordPress functioned as a platform for displaying written posts on simple websites. However, WordPress has evolved significantly and now supports a wide range of websites. Learning materials, worksheets, and even instructional media, such as videos, will be displayed on WordPress, helping students better understand learning concepts. In addition, it can be accessed through Android devices, which most students already own.

This study addresses the following central research problems:

1. What are the levels of validity, practicality, and effectiveness of the WordPress platform integrated with the Sikambang tradition of the Barus coastal region?
2. Are students' learning outcomes improved after receiving instruction through the development of WordPress media integrated with the Sikambang tradition of the Barus coastal community?

The development of digital technology has encouraged the use of e-learning as a medium for mathematics learning (Cirneanu & Moldoveanu, 2024). Various studies have shown that e-learning can improve learning flexibility, student independence, and the efficiency of the learning process (Lutfiani et al., 2025). Digital learning platforms are also widely used; however, their implementation is often generic and lacks contextual relevance (Pinto & Leite, 2020).

On another aspect, ethnomathematics, or culture-based mathematics, has developed as an approach to connect mathematical concepts with local cultural practices (Batiibwe, 2024). Previous studies indicate that integrating local culture into mathematics learning can enhance conceptual understanding, learning motivation, and appreciation of regional culture. However, most of these studies are still based on face-to-face learning, use conventional media, and have not been systematically integrated into digital e-learning platforms (Hendri et al., 2025).

The novelty of this study lies in the development of culturally responsive mathematics e-learning on the WordPress platform that systematically integrates the Sikambang Tradition of the Barus coastal community into the content, learning activities, and assessment of mathematics learning, using the Plomp development model.

The main innovation of this research lies in three aspects. First, the use of WordPress as a culturally responsive mathematics learning platform, that not only serves as a digital learning medium but also facilitates contextual, interactive mathematics learning integrated with local cultural values. Second, the integration of the Sikambang tradition into three essential learning components, namely: (1) learning content through contextual mathematical materials based on Barus coastal culture, (2) learning activities that connect students' mathematical exploration with local cultural practices, and (3) assessment designed to measure students' mathematical literacy skills within cultural contexts. Third, this study offers a replicable, adaptable development model for other local cultural contexts, thereby advancing technology-based mathematics learning innovations grounded in local wisdom.

METHODOLOGY

Research Design

This study employed the Research and Development (R&D) method by adapting the Plomp model (Plomp & Nieveen, 2007), which consists of the following stages : (1) Initial investigation (analysis of mathematics learning needs, student characteristics, local cultural conditions, analysis of the use of digital learning media, curriculum review, materials, and the WordPress platform); (2) Design (preparation of material structure, WordPress display design, integration of Sikambang cultural elements into mathematics learning, preparation of learning activities, WordPress-based media, as well as assessment and evaluation instruments); (3) Realization/Development (development process including creating WordPress pages/features, uploading materials such as teacher’s books, student’s books, model books, worksheets/LKPD, and learning videos); (4) Testing/Evaluation/Revision (expert validation, limited trials, and user evaluation in the form of suggestions to improve the material content and appearance); (5) Implementation (application of the WordPress media in the learning process; at this stage, observations are made regarding the implementation of the product, student and teacher responses, and the impact on student learning outcomes). This method was chosen because the study's objective was to develop a culturally responsive mathematics e-learning product on WordPress that is valid, practical, and effective. The research procedure was carried out through the following stages:

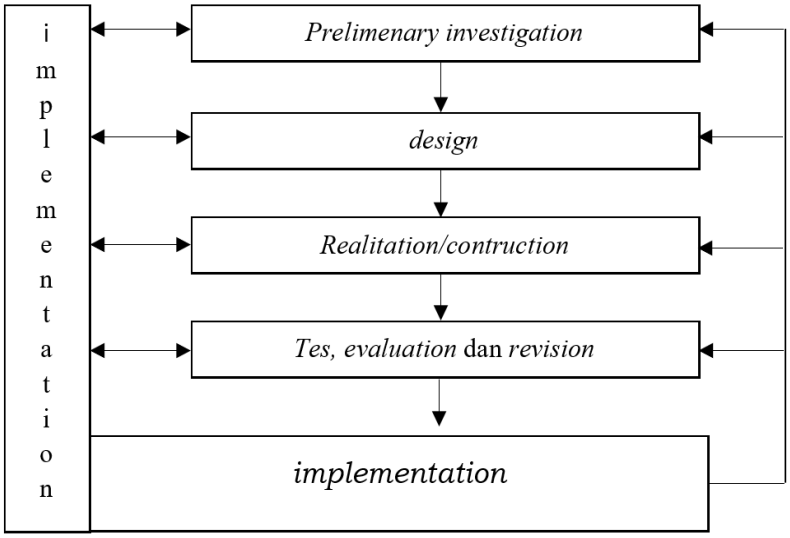

Figure 1. Plomp Model Development Diagram

Participant

The subjects of this study were seventh-grade students and mathematics teachers from MTsN 1 Tapanuli Tengah and SMP Muhammadiyah 28 Barus, both located in Tapanuli Tengah Regency. The number of student participants at MTsN 1 Tapanuli Tengah was 24, while SMP Muhammadiyah 28 Barus had 30, with each school involving one mathematics teacher. The student participants were approximately 12–14 years old, which falls within the early adolescence stage at the junior high school/Madrasah Tsanawiyah level. The research subjects included both male and female students with diverse academic abilities. The characteristics of the participants also reflected the social and cultural environment of the Barus coastal community, which is closely associated with the Sikambang tradition, thereby supporting the development of culturally responsive mathematics learning media based on WordPress.

The subjects were selected using a simple random sampling technique (Hossan et al., 2023), namely selecting respondents at random without distinguishing their abilities or backgrounds, so that every student and teacher had an equal opportunity to become a research subject. Meanwhile, the object of this study was WordPress-based learning media integrated with the Sikambang tradition of the Barus coastal culture.

Data Collection

This study utilized observation, questionnaires, tests, and documentation to gather empirical data. Observation was used to examine the implementation of learning using WordPress-based e-learning in the classroom. Questionnaires were distributed to experts and students to obtain data on product validity and user responses to the developed media. Tests were used to measure students' mathematical literacy skills through pretests and posttests. Meanwhile, documentation was used to collect supporting data throughout the research process, including activity photographs, students' work results, and learning documents.

Instrument

To address the established research problems, the developed instruments directly target and resolve each research question. These instrument sheets will be distributed to experts (lecturers), practitioners, teachers, and students. The instruments used in this study were as follows:

Expert validation sheets for the research instruments, consisting of 10 category items covering indicators of presentation feasibility, content feasibility, construction, and language. The assessment criteria were: score 5 = very valid, score 4 = valid, score 3 = fairly valid, score 2 = less valid, and score 1 = invalid; (ii) Expert and practitioner assessment sheets regarding the practicality of the WordPress media integrated with the Sikambang cultural context, consisting of material content components (7 items), construction components (7 items), and language components (5 items); (iii) Student response questionnaires toward the

learning process consisting of 12 response items with assessment criteria of strongly agree, agree, less agree, and disagree; (iv) Students' Mathematical Literacy Ability Test consisting of 4 questions, where each item included indicators such as: the ability to use various numbers or symbols related to basic mathematics in solving everyday problems, the ability to analyze information presented in various forms (graphs, tables, charts, diagrams, etc.), and the ability to interpret the results of problem analysis in order to make predictions and decisions. The validity and reliability of the test instruments were assessed using SPSS 26. Furthermore, to determine the improvement in students' mathematical literacy skills, the N-gain formula was used:

$$N - Gain \frac{= Posttest\ Score - Pretest\ Score}{/Maximum\ Score - Pretest\ Score}$$ (Nurmilawati, 2023)

Next, a paired-samples t-test was conducted to examine improvements in students' mathematical literacy. Prior to hypothesis testing, a normality test was conducted using SPSS 26. Since this study only involved one experimental class without a comparison or control class, a homogeneity test was not conducted.

Data Analysis

This study employed descriptive analysis to evaluate the Missouri Mathematics Project model within the Barus coastal culture. Three primary metrics—validity, practicality, and effectiveness—structured the data analysis phase. Deep analysis of expert and practitioner data rigorously assessed the validity of the developed media. In contrast, field trial data assessed the practicality and effectiveness of the developed learning media.

The analysis process involved a systematic examination of various data sources to provide a comprehensive overview of the quality and feasibility of the WordPress media developed for the Barus coastal culture. Through this descriptive approach, the study produced an in-depth evaluation, enabling the identification of strengths and areas for further development of the proposed innovative learning media. The detailed analysis procedures used are as follows:

Analysis of Data from the Validation Results of the Learning Media

The validity level of the WordPress media based on the Barus coastal culture is presented in Table 1 below (Zafrullah et al., 2024).

Table 1. Validity Criteria of Learning Media

Criteria	Description
$1 \leq Va < 2$	Invalid
$2 \leq Va < 3$	Less valid
$3 \leq Va < 4$	Valid
$Va = 4$	Highly valid

The criteria for stating that the Barus coastal culture-based WordPress media has a good level of validity are achieved if the minimum validity level attained is within the valid category, namely $3 \leq Va < 4$. If the validity achievement level is below the valid category, revisions must be made based on suggestions or corrections from the validators. Furthermore, the validation process is repeated. This process continues until we obtain an ideal learning medium in terms of both content and construct validity.

Analysis of the Practicality Data of the Learning Media

The following are the product practicality criteria according to Akker (1999):

Table 2. Practicality Criteria Based on Expert and Practitioner Assessments

Interval	Criteria
1 ≤ PA < 2	Vey Low
2 ≤ PA < 3	Low
3 ≤ PA < 4	Moderate
4 ≤ PA < 5	High
PA = 5	Very High

Based on this interval, the WordPress media is considered to have a good level of practicality (PA) if the obtained score falls within the range of $\mathbf{4 \leq Pa < 5}$, which is categorized as high. If the score obtained is below this range, revisions to the learning media are required based on the review results and recommendations from experts and practitioners.

Analysis of the Effectiveness Data of the Learning Media

According to Akker (Rochmad, 2012), effectiveness refers to the extent to which the experiences and outcomes of an intervention are consistent with the intended objectives. In development research in the field of learning, indicators used to determine whether the implementation of a model is effective can be seen from the following components: (1) the results of students' mathematical numeracy ability tests using the N-Gain calculation method; (2) student response questionnaires; and (3) teacher response questionnaires.

Table 3. Criteria for Student and Teacher Responses

Percentage	Category
85% ≤ Response	Very Positive
70% ≤ Response < 85%	Positive
50% ≤ Response < 70%	Less Positive
Response < 50%	Not Positive

The target of this study is that the Likert-scale results of student and teacher responses must be at least in the "positive response" category, as a requirement for the effectiveness of WordPress media in the Barus coastal culture.

FINDINGS

Preliminary Investigation Stage

Based on the preliminary observation, the students' mathematical competence at MTs Barus has not met expectations. The six key points in the 2013 Curriculum have not been fully implemented, resulting in the mathematics learning outcomes of Grade VII students at MTs Barus, particularly in students' mathematical literacy skills not yet reaching the expected level of mastery. In addition, based on interviews conducted with teachers and students:

Table 4. Results of the Teacher and Student Response Survey on Mathematics Learning

Question Components	Teacher Response	Student Responses
Learning tools used	Printed books and whiteboard	School textbooks
Has the learning media used been digital?	Never	Never
Has a learning model based on the Barus coastal culture ever been applied in mathematics learning?	Never	Never
Do you know about the Sikambang culture of Barus?	Yes	Yes
What do you think about applying the "Sikambang" culture in learning mathematics?	Interesting, something new that develops the Barus culture, especially when connected with mathematics	Happy and curious to experience learning mathematics through the Sikambang culture of Barus, something new

Based on Table 4, the data demonstrate that teachers have yet to optimize the deployment of the learning media. In addition, student responses showed that 81% of 55 respondents stated they did not like mathematics because it was considered difficult. This condition indicates that teachers have not made maximum efforts to design and implement innovative learning media to increase students' interest and engagement in mathematics learning.

Furthermore, the use of learning media integrating the Barus coastal culture has never been implemented, according to both teachers and students. The learning tools used in the instructional process are still limited to school-provided textbooks, without student worksheets (LKPD) or learning media, especially those based on the Barus coastal culture and aligned with relevant learning models.

Design Stage

At this stage, the learning tools were designed, including tests of students' mathematical literacy skills and WordPress-based learning media. In addition, research instruments were also designed to collect data during the development and validation process of the resulting learning media.

The learning achievement test used in this study consisted of a series of questions designed to measure students' mathematical literacy skills, both before (pretest) and after (posttest) the implementation of the learning media. The questions were relevant to the topics of triangles and quadrilaterals, were clearly designed, systematically and measurably, and focused on assessing students' abilities to understand, interpret, communicate, and represent mathematical ideas logically and systematically.

This learning media directly contextualizes triangles and quadrilaterals within the daily life and cultural values of the Sikambang-Barus coastal community.

The learning materials were presented in a visual format, featuring conceptual explanations, geometric illustrations, and examples of problems involving triangles and quadrilaterals drawn from real-life situations in the cultural life of the Barus coastal community, such as traditional building shapes, weaving patterns, and local cultural ornaments. The presentation of the material was designed to make learning more contextual, meaningful, and closely related to students' experiences. The media display was attractively designed through the selection of colors, images, and layouts that reflected the characteristics of local culture, while maintaining readability, conceptual clarity, and systematic organization of the material.

This media was uploaded and made accessible online via a WordPress website, allowing students to use it flexibly on smartphones, tablets, or computers connected to the internet. The learning materials were organized sequentially and systematically into a unified, standalone learning flow, starting with a concept introduction, exploring plane figure properties, providing examples of applications, and ending with practice exercises. This structure enables students to understand the concepts of triangles and quadrilaterals comprehensively without depending on further materials.

Using WordPress as a learning platform allows the integration of text, images, and interactive elements (such as quizzes, links, or supporting videos) in a more systematic way. This supports the implementation of web-based learning to improve the mathematical literacy skills of Grade VII junior high school students, especially in understanding, interpreting, and communicating the concepts of triangles and quadrilaterals across various contexts. Link: https://www.matematikabudaya.my.id/

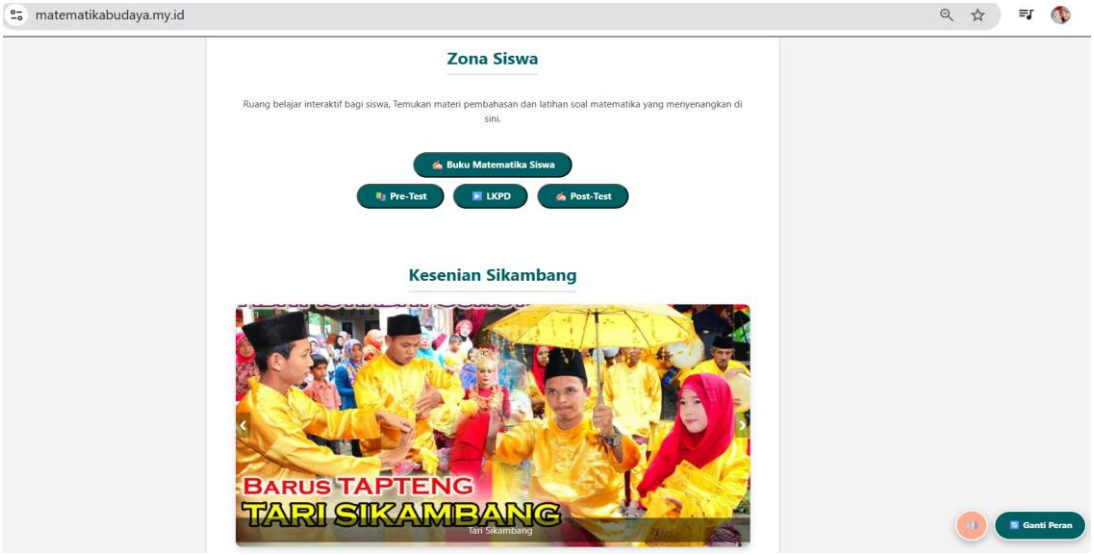

Figure 2. WordPress Display as a Learning Medium

Realization Stage

WordPress-based learning media were developed as part of prototype-1 and arranged according to the components of the learning model. This media presents the topics of triangles and quadrilaterals through an attractive, interactive, and contextual visual display. The content includes conceptual explanations, geometric illustrations, and examples of applications in the daily life of the Barus coastal community. The media design emphasizes harmonious colors, communicative layout, and ease of navigation, thereby supporting an effective learning experience. This media can be accessed online on various devices and is designed as a single, cohesive learning flow to help students understand concepts comprehensively.

The instruments realized were designed to assess the quality of supporting tools, practicality, implementation, student responses, and students' mathematical literacy achievement. The details of the realized instruments are as follows:

a. Realization of learning tool instruments, including validation sheets for WordPress-based learning media and mathematical literacy ability tests.
b. Realization of media practicality instruments in the form of expert assessment sheets evaluating the practicality of the learning media, based on ease of use, clarity of syntax, and suitability to classroom learning conditions.
c. Realization of media implementation instruments, in the form of expert assessment sheets evaluating the feasibility of the learning media for implementation, is used to assess the conformity of learning implementation with the developed media design.
d. Realization of student response instruments, in the form of student response questionnaires regarding the implementation of the learning media, aimed at identifying students' perceptions, interests, and engagement during learning activities.
e. Student learning achievement instruments, in the form of mathematical literacy ability tests, are used to measure students' mastery levels before and after the implementation of the learning media.

Testing / Evaluation / Revision Stage

The instruments used in developing the M2PBPB learning media were tested for validity by experts through the research instrument format validation sheets, as shown in the table below:

Table 5. Feasibility Test Results of Research Instruments for M2PBPB Learning Media

No	Instrument	Assessment Aspects				Remark
		Presentation Feasibility	Content Feasibility	Construction	Language	
1.	WordPress Validation Sheet	√	√	√	√	Feasible with Minor Revisions
2.	Validation Sheet for Students' Mathematical Literacy Ability Test	√	√	√	√	Feasible with Minor Revisions
3.	Student Response Questionnaire	√	√	√	√	Feasible with Minor Revisions

Based on Table 5. Regarding the feasibility test results for the research instruments, it can be concluded that all instrument categories were feasible to use with revisions. Therefore, revisions were made to each instrument in accordance with the validators' (experts and practitioners) directions and suggestions. Furthermore, the instruments deemed feasible were implemented to measure, assess, and validate the

validity, practicality, and effectiveness of the WordPress learning media and the supporting tools.

Validation of the "WordPress" Learning Media

The validation of the "WordPress" learning media consisted of the material component (7 sub-aspect items), the construction component (7 sub-aspect items), and the language component (5 sub-aspect items). The validation results by experts and practitioners can be seen in the table below:

Table 6. Validation Results of the "WordPress" Learning Media

No	Assessment Aspect	Validator					Average
		I	II	III	IV	V	
1.	Content Material Component	3,85	4,42	4	4	4,71	4,20
2.	Construction Component	4,14	4,57	4,28	4,14	4,28	4,28
3.	Language Component	3,8	4,8	4,4	4	4,2	4,24
	Overall Average Score						4,24

Based on the validation results in Table 6 above, the validation of the "WordPress" learning media by experts and practitioners obtained an average score of 4,24. The results are as follows: the content component scored 4.20, the construction component scored 4.28, and the language component scored 4.24. Based on the validity level criteria, this average score falls within the range $4 \leq 4{,}24 < 5$; therefore, the "WordPress" media is classified as valid. Some suggestions provided by the validators regarding the development of the "WordPress" media include:

Table 7. Suggestions Provided by The Validators

No	Validator Name	Suggestions/Feedback
1.	Dr. Cut Latifah Z, M.Pd	▪ Use images that reflect coastal culture. ▪ Use the Indonesian language on WordPress. ▪ Motivation should be visible on the main page, and use coastal language terms on the homepage.
2.	Dr. Rahmi Ramadhani, M.Pd	▪ Add learning videos to support the teaching materials used.
3.	Dr. Neneng Aminah, M.Pd	▪ All instruments, including lesson plans (RPP), student worksheets (LKPD), teacher books, student books, and model books, should be uploaded to WordPress.
4.	Dr. Abdusima Nasution, MA	
5.	Adriantho Benny Pasaribu, M.Pd	▪ Add a brief description of the media. ▪ State the objectives of using the "WordPress" media. ▪ Use a more structured format

The subsequent revision phase fully addressed these recommendations prior to field testing. With these improvements, the developed "WordPress" media was found to meet the validation standards. This indicates that the "WordPress" media aligns with the characteristics of the Web-Assisted Missouri Mathematics Project Model Innovation Based on Culture and is feasible to use as learning media to support the improvement of Grade VII junior high school students' mathematical literacy skills.

Validition of the Mathematical Literacy Ability Test

The results of the validity testing of each item in the students' mathematical literacy ability test can be seen in the following table:

Table 8. Results of the Students' Mathematical Literacy Ability Test

		Soal_1	Soal_2	Soal_3	Soal_4	Total_Score
Soal_1	Pearson Correlation	1	0.213	0.620**	0.796**	0.847**
	Sig. (2-tailed)		0.297	0.001	0.000	0.000
	N	26	26	26	26	26
Soal_2	Pearson Correlation	0.213	1	0.186	0.279	0.585**
	Sig. (2-tailed)	0.297		0.364	0.168	0.002
	N	26	26	26	26	26

		Soal_1	Soal_2	Soal_3	Soal_4	Total_Score
Soal_3	Pearson Correlation	0.620**	0.186	1	0.530**	0.765**
	Sig. (2-tailed)	0.001	0.364		0.005	0.000
	N	26	26	26	26	26
Soal_4	Pearson Correlation	0.796**	0.279	0.530**	1	0.840**
	Sig. (2-tailed)	0.000	0.168	0.005		0.000
	N	26	26	26	26	26
Total	Pearson Correlation	0.847**	0.585**	0.765**	0.840**	1
	Sig. (2-tailed)	0.000	0.002	0.000	0.000	
	N	26	26	26	26	26

**Correlation is significant at the 0.01 level (2-tailed)

Based on the Pearson Product-Moment correlation analysis, all items in the mathematical literacy ability test were deemed valid because they showed significant correlations with the total score. The correlation values for each test item were as follows: item 1 = 0.847, item 2 = 0.585, item 3 = 0.765, and item 4 = 0.840, all of which were significant at the 0.01 level. Therefore, all four items were considered feasible as research instruments for measuring the mathematical literacy skills of Grade VII junior high school students.

Table 9. Validity Test Results of Students' Mathematical Numeracy Ability Test

No	r_{table} value	$r_{calculated}$ Value	Condition	Validity
1	0,505	0,847	$r_{calculated}$ Value > r_{table} value	Valid
2	0,505	0,585	$r_{calculated}$ Value > r_{table} value	Valid
3	0,505	0,765	$r_{calculated}$ Value > r_{table} value	Valid
4	0,505	0,840	$r_{calculated}$ Value > r_{table} value	Valid

It is known that r-table = 0.505 with a significance level of α = 0.01. Based on the table above, all values of r-calculated > r-table. Therefore, all test items were declared valid and feasible for use.
The reliability of the research instrument can be assessed by examining the reliability index obtained from Cronbach's Alpha calculations in SPSS 26 for Windows. Based on the calculations, the Cronbach's Alpha for the four test items was 0.741.

Table 10. Reliability Test Results of the Mathematical Literacy Ability Test

Cronbach's Alpha	N of Items
0.741	4

Referring to the interpretation criteria of the alpha coefficient, a value above 0.70 is included in the category of acceptable reliability. Therefore, the value of 0.741 indicates that the instrument has an adequate level of consistency.

Practicality

Based on the research findings, the Development of Culturally Responsive Mathematics E-Learning: Integrating the Sikambang Tradition of the Barus Coastal Community through the WordPress Platform was declared to have a good level of practicality. This was indicated by the practicality questionnaire completed by teachers as observers, with an average score of 4.37 across all aspects, placing it in the high category. These findings show that WordPress media is easy to use in learning activities, has an attractive appearance, and helps students understand the material both independently and with teacher guidance. The high practicality indicates that WordPress media can be effectively implemented in the classroom without requiring many adjustments or additional training for teachers, thereby supporting the achievement of learning objectives.

Student Response Questionnaire

The analysis of response data from Grade VII-2 students of MTs NU Barus toward the M2PBPB learning model implemented in the classroom can be seen in the following table:

Table 11. Student Response Data Toward Learning Activities

No	Statement Code	Strongly Agree (4)	Agree (3)	Less Agree (2)	Disagree (1)	Total*Weight
1	TPPa	21 students 80,77%	3 students 11,54%	2 students 7,69%	0	97
2	TPPb	17 students 65,38%	8 students 30,77%	1 student 3,85%	0	94
3	TPPc	20 students 76,92%	5 students 19,23%	1 student 3,85%	0	97
4	TPPd	23 students 88,46%	1 student 3,85%	2 students 7,69%	0	99
5	TPPe	17 students 65,38%	7 students 26,92%	2 students 7,69%	0	93
6	MPPa	24 students 92,31%	2 students 7,69%	0 0	0	100
7	MPPb	20 students 76,92%	5 students 19,23%	1 student 3,85%	0	97
8	MPPc	17 students 65,38%	9 students 34,62%	0 0	0	95
9	MPPd	18 students 69,23%	8 students 30,77%	0 0	0	96
10	MPPe	20 students 76,92%	4 students 15,38%	2 students 7,69%	0	56
11	KMPa	19 students 73,08%	5 students 19,23%	2 students 7,69%	0	95
12	KMPb	19 students 73,08%	6 students 23%	1 student 3,85%	0	96
	Total	235 74,84%	63 20,06%	16 5,10%	0	1115
	Positive Response (SA+A)	94,90%				

Based on Table 11. Regarding the recapitulation of student responses to the implementation of WordPress learning media, in general, 95.60% of students responded positively to the learning process. In detail, 92.31% of students showed interest in the learning materials, while 96.15% stated interest in the WordPress-based learning media. In addition, 92.31% of students expressed interest in participating in the lesson due to the different classroom atmosphere, and 96.15% were attracted to the teacher's teaching method. From the aspect of interest, all students (100%) stated that they were interested in the learning process because the atmosphere created was a new experience. Most students also showed interest in the way the teacher managed the learning activities (96.15%). Furthermore, all students (100%) expressed interest in participating in future lessons using the same model, and 92.31% were interested in the web-based learning media used. In terms of usefulness, 92.31% of students stated that the learning tools and media used were easy to understand in terms of language, appearance, and illustrations, thus helping to improve their understanding of the contextual material. In addition, 96.15% of students stated that the learning process helped them understand the cultural values embedded in mathematics instruction.

Based on the average component score of 95.60% and the student response criteria requiring at least 80% of students to give positive responses, it can be concluded that student responses to the WordPress learning media were in the positive category. Thus, one component of the learning media's effectiveness

has been fulfilled: the student response aspect.

Implementation Stage

Implementation was carried out on the learning media that had been declared valid, practical, and effective. The learning media implementation was conducted in two classes using a pretest-posttest design. The analysis of pretest and posttest data was conducted to examine changes in students' mathematical literacy skills individually, both before and after participating in the learning process using the developed learning media. The results of the analysis are presented as follows:

Table 12. Pretest Result Data

Interval	Frequency	%
47 – 53	5	9,26%
54 – 60	9	16,67%
61 – 67	7	12,96%
68 – 74	18	33,33%
75 – 81	10	18,52%
82 – 89	5	9,26%
Total	54	100%

Based on the frequency distribution table with six class intervals, most students were in the 68–74 score interval, accounting for 33.33%. This indicates that students' mathematical literacy skills were generally moderate. Nevertheless, several students reached the high category, indicating an improvement in learning outcomes. However, students remained in the low category, suggesting that further efforts are needed to improve instruction and achieve more equitable learning outcomes. Graphically, the number of students who achieved the Minimum Mastery Criteria (KKM) is shown in the following figure:

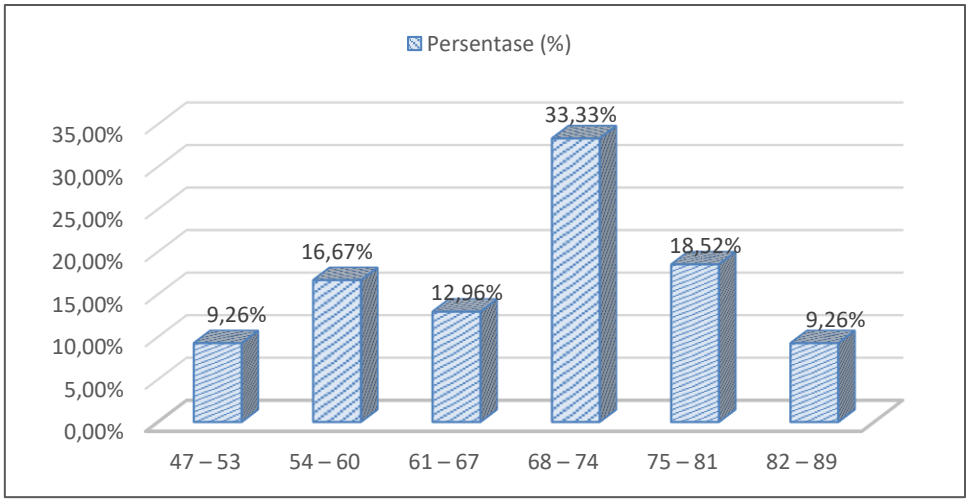

Figure 3. Student Pretest Graph

Furthermore, the following are the posttest results of students' mathematical literacy skills:

Table 13. Posttest Result Data

Interval	Frequency	%
75 – 78	15	27,78%
79 – 82	12	22,22%
83 – 86	15	27,78%
87 – 90	8	14,81%
91 – 94	4	7,41%
Total	54	100%

Based on the frequency distribution table, most students were in the score intervals 75–78 and 83–86,

each with a percentage of 27.78%. This indicates that students' mathematical literacy skills after the implementation of the Web-Assisted Culture-Based Missouri Mathematics Project (MMP) Innovation Model were in the high category. In addition, there were no students in the low category, indicating a significant improvement in learning outcomes compared to before the learning model was implemented. Graphically, the students' posttest results are shown in the following figure:

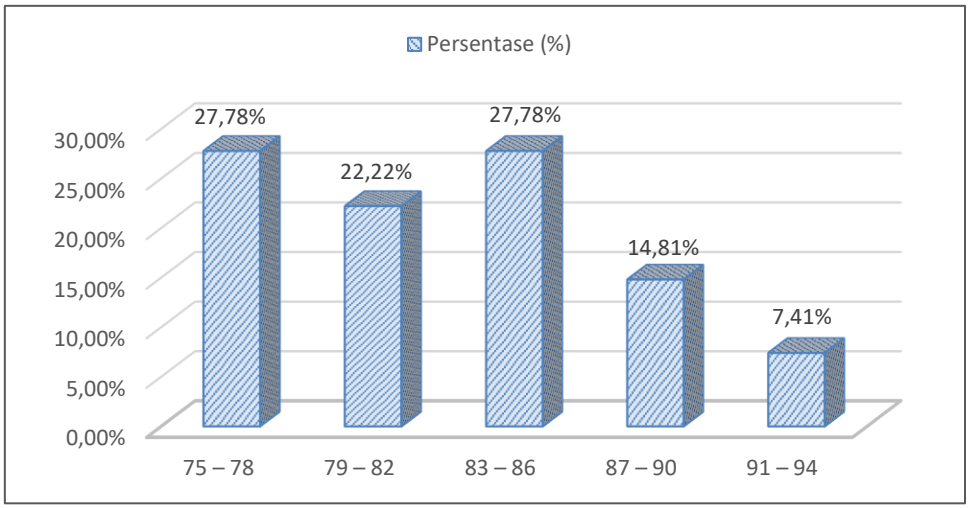

Figure 4. Student Postest Graph

Based on Figure 4, there is a visible improvement in students' mathematical literacy skills before and after the implementation of the Culture-Based WordPress Media. The implementation of the learning media showed that all students made positive progress and were able to solve mathematical literacy test items more effectively. This is supported by comparative data from the pretest and posttest, which indicate that the average scores of all students increased (positive gain). Thus, the positive increase in scores indicates that, at the implementation stage of the Plomp development model, all students optimally improved their mathematical literacy skills after receiving intervention through the developed learning media.

Based on the pretest and posttest data, the improvement in students' abilities was analyzed using the N-Gain formula. The maximum score used in the calculation was 48, obtained from 12 test items, each with a maximum score of 4. The results showed that the students' average pretest score was 32.89, while the average posttest score increased to 39.85. Based on the analysis results, the average N-Gain score obtained was 0.43, which falls into the medium category. These findings indicate that the use of WordPress-based learning media integrated with the Sikambang culture significantly improved students' mathematical literacy. Furthermore, a paired-samples t-test was conducted to examine improvement in students' mathematical literacy skills, preceded by prerequisite data analysis.

Normality Test

The normality test in this study was conducted in SPSS 26 using the Kolmogorov-Smirnov test. The data were considered to be normally distributed if the significance value (Sig.) was greater than 0.05.

Table 14. Normality Test (One-Sample Kolmogorov-Smirnov)

		RES_Pretest	RES_Posttest
N		54	54
Normal Parameters[a,b]	Mean	0.0000000	0.0000000
	Std. Deviation	0.02570817	0.06404106
Most Extreme Differences	Absolute	0.110	0.119
	Positive	0.076	0.119
	Negative	-0.110	-0.054
Test Statistic		0.110	0.119
Asymp. Sig. (2-tailed)		0.099[c]	0.055[c]

Based on the results of the normality test using the Kolmogorov-Smirnov test, the significance values for the pretest and posttest data were 0.099 and 0.055, respectively. Since both p-values were greater than 0.05, the data were normally distributed.

Statistical Test

Since the pretest and posttest data met the normality assumption, the analysis continued using a parametric test, namely the paired-samples t-test.

Table 15. Statistical Test (Paired Samples Test)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-13.333	10.837	1.475	-16.29	-10.37	-9.04	53	0.000

Based on the results of the paired sample t-test, a significance value of 0.000 < 0.05 was obtained; therefore, H_0 was rejected, and H_1 was accepted. This indicates a significant difference between the students' pretest and posttest scores. Thus, it can be concluded that the Development of Culturally Responsive Mathematics E-Learning: Integrating the Sikambang Tradition of the Barus Coastal Community through the WordPress Platform effectively improved students' mathematical literacy skills. To achieve the objective of the mathematics lesson, one of the skills students must master is mathematical numerical literacy (Simamora et al., 2023a).

DISCUSSION

Preliminary Investigation Stage

The results of the initial investigation showed that mathematics learning at MTsN 1 Tapanuli Tengah and SMP Muhammadiyah 28 Barus did not fully support the achievement of the 2013 Curriculum objectives, particularly in developing students' mathematical literacy. Printed textbooks and whiteboards still dominated the learning process, while the use of digital learning media had not been optimized. This condition affected students' low interest in mathematics learning, as indicated by 81% of students stating that mathematics was a difficult and less interesting subject.

The findings also revealed that mathematics learning grounded in the coastal culture of Barus, particularly the Sikambang culture, had never been incorporated into the learning process. In fact, integrating local culture into learning can help students understand mathematical concepts in a more contextual and meaningful way. This aligns with the ethnomathematics approach, which emphasizes the relationship between mathematical concepts and students' cultural and social environments. Ethnomathematical and culturally relevant pedagogies that can assume, in mathematical curricula, the various linguistic and cultural forms of knowledge (Rosa & Orey, 2023).

Nevertheless, both teachers and students responded positively to the integration of Sikambang culture into mathematics learning. Teachers considered this learning approach an interesting innovation that supports the preservation of local culture, while students showed enthusiasm and curiosity toward the new learning experience. Therefore, the development of WordPress-based learning media integrated with the Barus coastal culture was considered relevant to support more interactive, contextual mathematics learning that can improve students' mathematical literacy.

Design stage

The findings suggest that WordPress CMS can serve as an innovative tool in digital mathematics learning, providing a more interactive and effective learning experience (Alfat et al., 2025). The design stage focused on

developing learning instruments and WordPress-based learning media to improve students' mathematical literacy. The learning achievement tests were systematically designed as pretests and posttests on triangle and quadrilateral materials, emphasizing students' abilities to understand, interpret, communicate, and represent mathematical ideas logically and systematically.

The developed WordPress media integrated mathematical concepts with the local wisdom of the Sikambang coastal culture of Barus, making learning more contextual and meaningful for students. Learning materials were presented through visual illustrations, geometric representations, and contextual problems derived from cultural elements such as traditional buildings, weaving patterns, and local ornaments. This cultural integration supports the ethnomathematics approach, which connects mathematics learning with students' social and cultural environments.

Furthermore, the use of WordPress enabled flexible online access and the integration of interactive features such as quizzes, videos, images, and supporting links. The structured presentation of materials, aligned with the Missouri Mathematics Project (MMP) model, facilitated interactive, systematic, and student-centered web-based learning. Therefore, the developed media was considered capable of supporting the improvement of seventh-grade students' mathematical literacy, particularly in their understanding and communication of the concepts of triangles and quadrilaterals across various real-life contexts.

Realization Stage

PBL-based interactive learning media supported by WordPress is practical and effective (Suastika et al., 2025). The realization stage resulted in the development of WordPress-based learning media as prototype-1, which was designed to be interactive, contextual, and aligned with the components of the learning model. The media presented Triangle and Quadrilateral materials through attractive visualizations, geometric illustrations, and application examples relevant to the daily life of the Barus coastal community, thereby supporting more meaningful, contextually relevant learning experiences for students. The communicative design, ease of access, and well-structured learning flow also enhanced the effectiveness of web-based learning.

In addition to media development, this stage also developed various research instruments to assess validity, practicality, implementation, student responses, and students' mathematical literacy achievement. These instruments were systematically designed to ensure that the developed media was not only feasible to use but also effective in supporting the mathematics learning process. Therefore, the realization stage became an important step in ensuring the quality of WordPress-based learning media that integrate local culture and are oriented toward improving students' mathematical literacy.

Testing / Evaluation / Revision Stage

Expert assessments show that the assessment tools for instructional media and design are applicable for application (Laksana, 2024)**.** The validation results indicated that the WordPress-based learning media and all supporting research instruments were feasible for use after minor revisions suggested by experts and practitioners. The average validation score of 4.24 placed the media in the valid category, demonstrating that the developed media met the standards of content, construction, and language feasibility. The revisions made based on validator feedback also strengthened the media's quality in terms of cultural representation, instructional completeness, and systematic presentation.

Furthermore, the mathematical literacy ability test showed good validity and reliability. All test items had correlation coefficients above the r-table cutoff, indicating that the instrument was valid for measuring students' mathematical literacy. In addition, the Cronbach's Alpha value of 0.741 indicated acceptable reliability and consistency.

The practicality aspect also showed positive results, as reflected in the teacher assessment score, which was categorized as high. This indicates that the WordPress media was easy to use, attractive, and supportive of the learning process. Student responses to the implementation of media were also highly positive, with most students showing interest, enthusiasm, and greater understanding during learning activities. These findings suggest that integrating WordPress-based learning media into the Sikambang cultural context can support

interactive, contextual, and meaningful mathematics learning while improving students' mathematical literacy.

Implementation Stage

Integration of local wisdom through digital media can serve as an innovative alternative to enhance students' mathematical literacy (Prabawat et al., 2025). The implementation stage demonstrated that integrating WordPress-based learning media with the Sikambang culture improved students' mathematical literacy. The pretest and posttest results indicated an increase in students' learning achievement after the implementation of the learning media, as reflected in a shift from the moderate to the high ability level. In addition, no students remained in the low category after the media intervention, indicating a more equitable improvement in learning outcomes.

The improvement in students' abilities was also supported by an N-Gain score of 0.43, which falls within the medium range. This result indicates that the developed learning media significantly improved students' mathematical literacy. The integration of local culture through the Sikambang cultural context, along with the use of the interactive WordPress platform, provided students with a more contextual, engaging, and meaningful learning experience.

Furthermore, the results of the normality test indicated that the pretest and posttest data were normally distributed, allowing the analysis to proceed using the parametric paired-samples t-test. The statistical test results showed a p-value of $0.000 < 0.05$, indicating a significant difference between the students' pretest and posttest scores. Therefore, the developed WordPress-based learning media was found to be effective in significantly improving the mathematical literacy skills of seventh-grade students.

CONCLUSION

The development of culturally responsive mathematics e-learning through the integration of the Sikambang tradition of the Barus coastal community using the WordPress platform has met the criteria of validity, practicality, and effectiveness. The developed learning media received a validity score in the valid category, while the mathematical literacy test instrument demonstrated validity and reliability in measuring students' mathematical literacy skills. In terms of practicality, the media received a high practicality score from teachers, indicating that the platform was easy to use and suitable for classroom learning activities. In addition, most students responded positively to the implementation of the learning media, indicating that the learning process was more engaging, contextual, and meaningful. The findings also showed that implementing WordPress-based learning media improved students' mathematical literacy, as indicated by the medium category N-Gain score. This suggests that integrating local culture into digital mathematics learning can help students better understand mathematical concepts through contexts closely related to their daily lives.

The main contribution and novelty of this study lie in using WordPress as a culturally responsive mathematics learning platform that systematically integrates the Sikambang tradition into learning content, activities, and assessment. Furthermore, this study offers a replicable development model that can be adapted to other local cultural contexts, thereby advancing technology-based mathematics learning innovations grounded in local wisdom. The implications of this study indicate that culturally integrated digital learning media can serve as an alternative approach for improving mathematical literacy skills while simultaneously supporting the preservation of local culture in educational practices. However, this study has several limitations. The research was conducted with only a limited number of seventh-grade students from two schools in the Barus coastal area. It employed a one-group experimental design without a control group. Therefore, future studies are recommended to involve larger, more diverse samples and comparative experimental designs to obtain broader generalizations regarding the effectiveness of culturally responsive mathematics e-learning.

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