Development of an RME-Based Teaching E-Module in the Peatlands Context for Grade VIII SMP Pythagorean Theorem Material

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Abstract

This study aims to develop a mathematics teaching e-module based on the Realistic Mathematics Education (RME) approach within the peatlands context for Grade VIII students on the Pythagorean Theorem. The research applies nine stages of the Dick and Carey instructional design model: identifying instructional goals, conducting instructional analysis, analyzing learners and contexts, writing performance objectives, developing assessment instruments, designing instructional strategies, developing instructional materials, conducting formative evaluation, and revising instruction. The study involved 31 students and one mathematics teacher. Data were collected through expert validation sheets and response questionnaires for teachers and students. Expert validation results showed that all aspects of the e-module and student worksheet (LKPD) including content, context, evaluation, media, language, format, and layout achieved high validity. Teachers and studens rated the product in the Good to Very Good category, which means the e-module and LKPD are feasible for classroom use. Revisions based on experr and user feedback made the Final Prototype clearer and more engaging. Overall, the study indicates that the RME-based e-module with a peatland context is valid, pratctical, and effective in improving students' understanding of the Pythagorean Theorem throught contextual learning.

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INTRODUCTION

The current curriculum development encourages educators to innovate and develop interactive teaching modules that align with students' needs and actively engage them in the learning process, particularly in mathematics learning (Wahyuni et al., 2024). Mathematics is an essential subject in everyday life because through learning mathematics, students are able to develop logical thinking abilities and cognitive skills, for example in the topic of the Pythagorean Theorem (Ningsih et al., 2021). However, students often experience difficulties in learning the Pythagorean

Theorem, such as not understanding the basic concepts of triangles, the elements of triangles, the types of triangles, and lacking foundational knowledge of the Pythagorean concept itself (Kusumah & Umbara, 2024). Based on these issues, a teaching module that meets students' needs will be developed an RME-based mathematics e-module within the peatlands context as a guide for teachers in teaching the Pythagorean Theorem to help students better understand its concepts.

A teaching module is a learning device or instructional design developed based on the applied curriculum and used in the learning process to achieve the predetermined competency standards (Sanjaya et al., 2022). Teaching modules can be presented in both hard copy and soft copy formats; soft copy modules can be implemented through technological support in the form of electronic teaching modules, or e-modules, which are systematically and interactively designed to be studied independently through electronic devices to facilitate access, management, and use of learning materials (Tarigan et al., 2021). The purpose of an e-module is to support active learning in schools by providing digital materials that are accessible, easy to use, and designed to stimulate student engagement; additionally, e-modules enable learners to study independently, explore content gradually, and interact with activities and materials that make the learning process more active and meaningful (Mikić et al., 2025; Rajabalee & Santally, 2021). Based on these considerations, an e-module is esssentially a curriculum-based digital material that makes learning content easiier to access and organize, while its interactive nature helps students learn actively and independently.

One instructional approach that can be applied in the development of e-modules to enhance the quality of learning and create a more interactive classroom atmosphere is the Realistic Mathematics Education (RME). This approach encourages students to engange with mathematical ideas through situations that are close to their own experiences, allowing concepts to grow not from abstract explanations but from real-life contexts (Inci et al., 2023). Realistic Mathematics Education (RME) was first introduced by Hans Freudenthal, who believed that mathematics develops from human activity, the approach was later expanded by Marja Van den Heuvel-Panhuizen, who emphasized that meaningful learning occurs when students work with contexts related to their everyday lives (Heuvel-panhuizen, 2016). Realistic Mathematics Education (RME) includes four main stages as described by Gravemeijer (1994): (1) Situation: students begin bye exploring a real-life context; (2) Model of: they create a simple model to reprsent the situation; (3) Model for: the model is then used for reasoning and solving problems: (4) Formal knowledge; students draw formal mathematical conclusions from their findings (Gravemeijer, 1994). Based on these characteristics, Realistic Mathematics Education (RME) offers a context-driven learning approach that enables students to construct and reorganize mathematical ideas in meaningful ways, this is what makes Realistic Mathematics Education (RME) higly suitable for developing e-modules tha are interactive, realistic, and systematically strustured according to the four stages proposed by Gravemeijer.

Realistic Mathematics Education (RME) requires mathematics learning to be grounded in real-life contexts that students encounter in their daily environment. The realistic context used in this e-module development is peatlands, as Central Kalimantan ranks as the second-largest peatland area in Indonesia, following Papua (Noor & Sulaeman, 2022). Peatlands are wetland ecosytems where the buildup of organic matter happens faster than its decay, causing layers of peat to form, these ecosystems are found in various climates and on almost every continent, covering an estimated 4 million km^2 worldwide, this area represents around 70% of the planet's natural freshwater wetlands and about 3% of the Earth's total land surface (International Peatlands Society, 2024). Using peatland context in an RME-based e-module is therefore highly relevant, particulary for students in Central Kalimantan on of Indonesia's regions with extensive peatland landscape, through this context, mathematical learning becomes more meaningful because it relates directly to student's surroundings while also helping them understand peatlands as an important global ecosystem.

An RME-based e-module designed within the peatlands context is essentially a digital learning resource that uses real situations related to peatland ecosystem as an entry point for students to make sense of mathematical ideas, by connecting mathematics to axamples that reflect their everyday environment, the e-module invites students to reason, solve problems, and build awareness of the ecological system in which the live (Karim et al., 2024). The use of this approach is supported by several studies showing that realistic and context-based learning materials improve students' engament, strengthen their problem-solving skills, and gradually enhance numeracy and mathematical thinking (Palinussa et al., 2025). Based on this, integrating the Realistic Mathematics Education (RME) approach into an e-module on the peatlands context is considered appropriate because it offers digital learning that is both meaningful and relevant to students' daily lives.

The e-module will later be embedded into the Math on Peatlands Context (MPC) application. MPC is an AI-supported platform that provides various teaching components, including modules, instructional materials, student worksheets, learning videos, and AR-based assessments. The system also features face recognition technology to help teachers identify students' emotional responses and potential learning difficulties during the lesson (Demitra et al., 2024). With these features, the developed e-module becomes easier for teachers to access and apply in their classrooms.

Current learning practices in Indonesia still face several challenges, such as limited student engagement, inconsistent use of technology, and a lack of learning activities that connect school content with real-life contexts (Mali et al., 2023). These issues align with the 2023 P3D Guidelines, which emphasize the importance of digital learning innovation as a way to improve learning dynamics, creativity, and overall education quality (Kemdiktisaintek, 2023). Meanwhile, Ministerial Regulation No. 12 of 2024 highlights that the New Learning Paradigm encourages character development, learning flexibility, and the use of authentic contexts to ensure that learning becomes deeper and more meaningful (Permendikbud, 2024). Based on these principles, teachers are expected to utilize electronic learning modules that are student-centered and relevant to the real environments students come from (Widiantari et al., 2022). However, field observations show that schools rarely use real-life contexts in developing teaching modules, relying instead on conventional modules that require students only to listen, even though connecting content to daily life can help students better understand mathematical concepts. This is supported by Sasalia et al. (2025), who found that instruction applying real-life problems can strengthen students' critical and participatory thinking. Therefore, the researcher will develop an RME-based e-module in the peatlands context for the Pythagorean Theorem for Grade VIII students.

RESEARCH METHODS

The RME-based e-module in the peatlands context for the Grade VIII Pythagorean Theorem was developed using the Research and Development (R&D) method with the Dick and Carey model. The Dick and Carey model is an instructional design framework that views learning as a system composed of ten stages, namely: (1) Identify Instructional Goal(s); (2) Conduct Instructional Analysis; (3) Analyze Learners and Contexts; (4) Write Performance Objectives; (5) Develop Assessment Instruments; (6) Develop Instructional Strategy; (7) Develop and Select Instructional Materials; (8) Design and Conduct Formative Evaluation of Instruction; (9) Revise Instruction; and (10) Design and Conduct Summative Evaluation (Dick & Carey, 1990). Based on these ten stages, an RME-based e-module within the peatlands context for the Grade VIII Pythagorean Theorem was developed. Figure 1 presents the diagram of the Dick and Carey model.

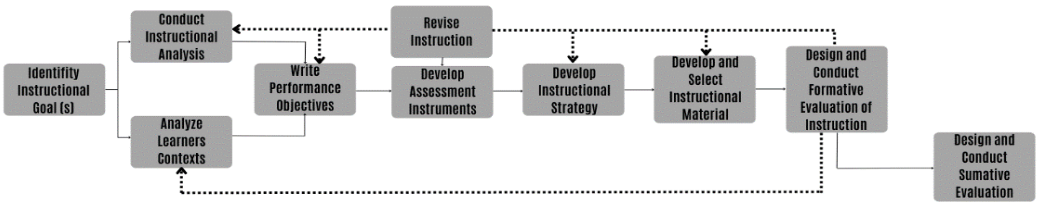


Figure 1. Diagram of the Dick and Carey model

Based on the Dick and Carey diagram, this study employed all ten stages of the Dick and Carey (1990) instructional design model in developing the RME-based e-module within the peatlands context for the Grade VIII Pythagorean Theorem material. The stages used in this study are described in Table 1. The table presents an explanation of each development stage, including its objectives, main activities, and outcomes.

Table 1. Description of the Dick and Carey model stages

No	Dick & Carey Stage	Description of the Dick & Carey Stage
1.	Identify Instructional Goal(s)	The first step in an instructional design model is to establish the learning objectives, which describe the new information and skills that students are expected to master after completing the instruction.
2.	Conduct Instructional Analysis	After identifying the instructional goals, the next step is to understand the procedures required to achieve those goals and to identify the subordinate skills needed.
3.	Analyze Learners and Contexts	In addition to analyzing learning objectives, it is also important to analyze the learners, the learning context, and the context in which the skills will be applied.

Table 1. (*continued*)

4.	Write Performance Objectives	Based on the instructional analysis and the description of entry skills, specific statements are developed to determine what learners should be able to do after completing the instruction.
5.	Develop Assessement Instruments	Based on the established learning objectives, appropriate assessments are developed to measure learners' ability to achieve those objectives.
6.	Develop Intructional Strategy	Using the results of the previous five steps, an instructional designer identifies theory-based strategies to achieve the intended learning outcomes.
7.	Develop and Select Instructional Materials	In the seventh step, the instructional strategies are used to create learning materials, including learner guides, instructional content, and assessments.
8.	Design and Conduct Formative Evalution of Instruction	A series of evaluations is then planned to gather data that will be used to identify problems or opportunities for improvement in the instruction.
9.	Revise Instruction	The final step in the design and development process becomes the first step in the revision cycle. Revisions are made continuously throughout the design and development process, using information obtained from the subsequent steps to reassess earlier assumptions and decisions.
10.	Design and Conduct Summative	This evaluation assesses the absolute or relative value of the instruction after it has undergone formative evaluation and been revised according to the designer's standards. The nine fundamental steps described in this paragraph represent the procedures used in the systems approach to instructional design, aiming to improve the quality of the final product.

Based on the ten stages of the Dick and Carey model, the researcher employed only nine stages, with stages one through seven producing a valid RME-based e-module within the peatlands context. The validity of the e-module was evaluated using a validation instrument that included five assessment aspects with a total of sixteen statements, the review was carried out by two expert validators both of whom specialize in RME and peatland-related content.. The validation sheet was adapted from the study by Aulia & Prahmana (2022) and adjusted to suit the developed e-module, using a five-point Likert scale with the following categories: Very Poor (VP) = 1, Poor (P) = 2, Fair (F) = 3, Good (G) = 4, and Very Good (VG) = 5. The expert validation results were then analyzed using the following formula:

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

The validity interpretation index follows the classification shown in Table 2.

Table 2. Validity measurement categories

Categories	Meaning
V < 0.4	Weak
0.4 ≤ V ≤ 0.8	Moderate
V > 0.8	High

The eighth to ninth stages of the Dick and Carey model, which include formative evaluation and revision, were carried out to examine the practicality of the developed e-module and the accompanying learning media, namely the student worksheet (LKPD). This was conducted through the distribution of response questionnaires to both teachers and students, consisting of one mathematics teacher and 31 junior high school students. The teacher response questionnaire for the e-module consisted of five aspects and twenty statements; the teacher response questionnaire for the LKPD also consisted of five aspects and twenty statements; and the student response questionnaire for the LKPD consisted of five aspects and twenty statements, all adapted from Ulandari et al. (2019). The statement indicators were assessed using a five-point Likert scale with the following categories: Strongly Disagree (SD) = 1, Disagree (D) = 2, Fairly Agree (FA) = 3, Agree (A) = 4, and Strongly Agree (SA) = 5. The responses from both the teacher and the students were later categorized using the classification formula shown in Table 3.

Table 3. Category formula for measuring teacher and student response questionnaires

Formula	Results	Categories
$\bar{X} > \bar{X}_i + 1.8\ x\ sb_i$	X > 4.2	Very Good
$\bar{X}_i + 0.6\ x\ sb_i < X \leq \bar{X}_i + 1.8\ x\ sb_i$	3.4 < X ≤ 4.2	Good
$\bar{X}_i - 0.6\ x\ sb_i < X \leq \bar{X}_i + 0.6\ x\ sb_i$	2.6 < X ≤ 3.4	Fair
$\bar{X}_i - 1.8\ x\ sb_i < X \leq \bar{X}_i - 0.6\ x\ sb_i$	1.8 < X ≤ 2.6	Poor
$\bar{X} \leq \bar{X}_i - 1.8\ x\ sb_i$	X ≤ 1.8	Very Poor

After the e-module was implemented and student responses were collected, their learning outcomes were assessed through the Student Worksheet (LKPD) to evaluate how effective the developed module was in supporting their understanding.

RESULTS AND DISCUSSION

The findings of this study were derived from the nine stages of the Dick & Carey (1990) model, which guided the development of the mathematics e-module within the peatlands context. This model was selected because it offers a clear and systematic sequence from identifying learning needs to evaluating the final product. Following these stages, the e-module was designed to meaningfully connect the peatland ecosystem with mathematics learning. The results are presented in table form based on the research methods and variables used. Data analysis and evaluation were carried out using formulas grounded in the theoretical framework. Each section of the results includes at least two sentences to ensure clarity. The outcomes obtained from each stage of the Dick & Carey model are described below.

Identify Instructional Goals

In this stage, the learning oucomes to be achieved by students are determine. The learning outcomes are developed with referenced to the topic of the Pythagorean Theorem for Grade VIII students. The leaning outcomes are derived from the Merdeka Currculum accessed through guru.kemendikdasmen.go.id and are used as a reference for instruction. The gegeral learning outcomes used for Grade VIII are as follows: “At the end of Phase D, students are able to create nets of three-dimensional shape (prisms, cylinders, pyramids, and cones) and construct these solids from their nets. Students are able to use the relationships among angles formed by two intersecting lines and by two parallel lines cut by a transversal to solve problems (including determining the sum of interior angles of a triangle and finding unknown angles in a triangle). They are able to explain the properties of congruence and similarity in triangles and quadrilaterals and use them to solve problems. They ar able to demonstrate the validity of the Pythagorean Theorem and apply it to solve problems (including determining the distance between two points on the Cartesian coordinate plane). Students are able to perform single transformations (reflection, translation, toation, and dilation) of points, lines, and plane figures on the Cartesian coordinate plane and use them to solve problems.” These learning outcomes are then narrowed down based on the topic of the Pythagorean Theorem, resulting in the following specific learning outcome: “Students are able to demonstrate the validity of the Pythagorean Theorem and apply it to solve problems (including determining the distance between two points on the Cartesian coordinate plane).” The pupose of these learning outcomes is ti explain the reason why the learning activities are conducted and to describe the expected competencies that students should possess after completing the learning process.

Conduct Instructional Analysis

In the second stage, the process focuses on indentifying the initial competencies that students must possess before entering the material to be taught. These initial competencies are obtained by deriving and elaborating the learning outcomess into systematic steps that students are required to master, enabling the researcher to formulate the students’ prior abilities. The initial competencies used in this study are: (1) Understanding squares and square roots of numbers; and (2) Understanding right triangles. The purpose of determining initial competencies in learning is to identify students’ prior knowledge before they receive new material, so that teachers can adjust instructional strategies, methods, and the depth of content to be delivered. By understanding students’ initial competencies, learning can be designed more effevtively, prevent misconceptions, and ensure that the established learning objectives are realistic and aligned with the needs and characteristics of the students.

Analyze Learners and Contexts

This stage produces an overview of the students and their learning environment, which includes the diversity of students' prior abilities, learning styles, learning needs, and the learning contexts used. This overview allows the learning objectives, materials, strategies, and media to be adjusted to suit the students' characteristics. The analysis reveals that students' do not yet understand how to prove the Pythagorean Theorem formula, are unfamiliar with the sides of a right triangle, and experience difficulties when applying contextual problems related to the Pythagorean Theorem. From the perspective of the learning context, instruction in conducted in a classroom equipped with Wi-fi facilities; however, learning activities have not previosly incorporated real-life contexts, particulary those related to peatland environments. This analysis is used to adjust the instructional strategy to be applied, namely the Realistica Mathematics Education (RME) approach, to support students in understanding mathematical problems based on real-world contexts. The purpose of analyzing instruction and learning context is to obtain a clear picture of student charasteristics, the learning environment, facilities and infrastucture, as well as the social and academic conditions that influence the learning process. This enables teachers to design learning that is relevant, effective, and aligned with students' needs and the real conditions in which learning takes place.

Write Performance Objectives

The fourth stage produces measurable and structured learning objectives that specifically state what stufents are expected to be able to do after the learning process. The learning objectives are derivered from the Grade VIII mathematics teacher's guide published by the Ministry of Education and Culture and are adjusted to the selected learning context. The learning objectives used for the Pythagorean Theorem material are as follows: (1) Constructing a proof in the form of a procedure for the Pythagorean Theorem formula; (2) Calculatingthe hypotenusa and the other sides of a right triangle using the Pythagorean Theorem; (3) Identifying Pythagorean triples and determining the lengths of triangle sides using the Pythagorean Theorem; and (4) Solving real-life problems related to the application of the Pythagorean Theorem. Through these learning objectives, it can be assesed whether students are able to understand the material that has been taught in the classroom.

Develop Assessment Instruments

This stage results in the development of assesment instruments used to measure the achevement of the formulated learning objectives. These istruments include the preparation of test items, observation sheets, questionnaires, and assessment rubrics that are aligned with the established indicators and succes criteria. Through these assesment tools, researchers or teacher are able to objectively evaluate students' abilities, skills, and attitudes after the learning process. The assessment instruments are developed based on the guildelines provided in the Merdeka Curriculum teaching module. The instruments designed consist of essay-type tests to assess students' problem-solving abilities in the topic of translation, observation sheets to evaluate students' activeness and collaboration during learning activities based on the Realistic Mathematics Education (RME) approach, and student response questionnaires to identify students’ perceptions of the developed module. These instruments are constructed in accordance with the learning objectives and predetermined indicators to ensure that the assessment results accurately reflect students’ learning achevements.

Develop Instructional Strategy

This stage results in a systematic instructional strategy design, which includes the selection of learning approaches, models, methods instructional steps, and the management of opening, core, and closing activities. This stuctured design ensures that the learning process is conducted in a direcred and effective manner to achieve the established learning objectives. The researcher designs the instruvtional strategy by employing a Problem-Based Learning (PBL) model combined with the Realistic Mathematics Education (RME) approach. The laearning process begins with the presentation of contextual problems related to proving the Pythagorean Theorem formula, followed by group discussion activities to analyze the problems. The use of the local peatland context aims to assist students in understanding the proof of the Pythagorean Theorem and in recognizing the relatioship between mathematical concepts and their living environment. The learning activities then continue with group prsentations of the discussion results and conclude and apply them in problem-solving situations.

Develop and Select Instructional Materials

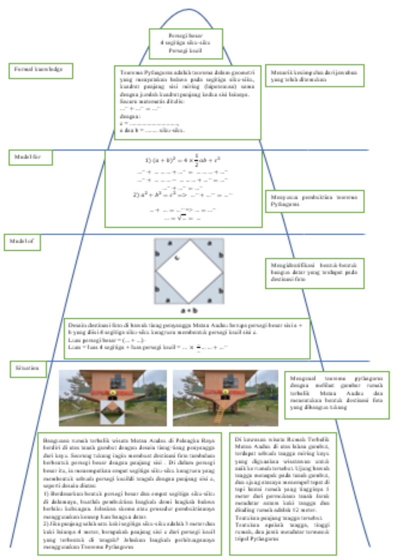
This stage results in the development of teaching materials or learning media designed in accordance witj the learning objectives, students characteristics, and the predetermined instructional strategies. These materials may include teaching e-modules, interactive media, or digital resources, all of which aim to facilitate students’ understanding of the material and support an effective learning process. The following is the design of the teaching module used in this study. The teaching module design can be seen in Figure 2.


KEGIATAN INTI

Tahap 1 Orientasi Peserta Didik terhadap masalah

1. Memberikan masalah kepada peserta didik (Situation):
   Bangunan rumah terbalik wisata Matan Andau di Palangka Raya berdiri di atas tanah gambut dengan desain tiang-tiang penyangga dari kayu. Seorang tukang ingin membuat destinasi foto tambahan berbentuk persegi besar dengan panjang sisi $a + b$. Di dalam persegi besar itu, ia menempatkan empat segitiga siku-siku kongruen yang membentuk sebuah persegi kecil di tengah dengan panjang sisi c, seperti desain berikut:
   1) Berdasarkan bentuk persegi besar dan empat segitiga siku-siku di dalamnya, buatlah pembuktian langkah demi langkah bahwa berlaku hubungan $a^2 + b^2 = c^2$. Jelaskan skema atau prosedur pembuktiannya menggunakan konsep luas bangun datar!
   2) Jika panjang salah satu kaki segitiga siku-siku adalah 3 meter dan kaki lainnya 4 meter, berapakah panjang sisi c dari persegi kecil yang terbentuk di tengah? Jelaskan langkah perhitungannya menggunakan

(i) Core activities



(ii) Ice Berg

Figure 2. Prototype of the e-module: (i) core activities and (ii) iceberg model illustration for the first session

After Prototype I was completed, the learning materials were validated by expert validators to assess the quality of the content, context, evaluation components, media, and language. The validation process involved two experts: one specializing in learning strategies and the other in the content of the Pythagorean Theorem. The outcomes of their evaluation are summarized in Table 4.

Table 4. Expert validation results for the e-module

Aspect	Validator		S1	S2	$\sum s$	n(c-1)	V	Validity Interpretation
	1	2						
Content	18	16	17	15	32	8	4	High
Context	13	12	12	11	23	8	2,9	High
Assessment	15	13	14	12	26	8	3,3	High
Media	12	12	11	11	22	8	2,75	High
Language	14	12	13	11	24	8	3	High

Based on the validation results from the experts, all aspects of the e-module showed a high level of validity. The Content aspect received the highest score with V=4, followed by Assessment (V=3.3), Language (V=3), Context (V=2.9), and Media (V=2.75). All of these scores fall within the "High" category, indicating that the e-module is suitable and appropriate for classroom trials. These results show that the content, context, assessment components, media, and language used in the module meet the criteria for good validity, as confirmed by the expert evaluations.

Table 5. Expert validation results for the LKPD

Aspect	Validator		S1	S2	$\sum s$	n(c-1)	V	Validity Interpretation
	1	2						
Format	19	13	18	12	30	8	3,8	High
Language	15	11	14	10	24	8	3	High
Content	38	30	37	29	66	8	3.8	High

Based on the expert validation results for the Student Worksheet (LKPD), all evaluated aspects showed a high level of validity. The Format aspect received a score of V = 3.8, indicating that the layout and presentation of the LKPD are clear and appropriate for use. The Language aspect scored V = 3, showing that the language used in the LKPD is valid and understandable for students, although slight simplification could further enhance clarity. The Content aspect received the highest score, V = 3,8, confirming that the material and content of the LKPD are highly valid and aligned with the learning objectives. Overall, the validation results indicate that the developed LKPD is suitable for use in the learning process, with all aspects format, language, and content meeting the criteria for high validity according to expert evaluation.

Design and Conduct Formative Evaluation of Instruction

This stage involved analyzing responses collected through questionnaires completed by one mathematics teacher and 31 students. The questionnaire evaluated five main aspects: Content Feasibility, Presentation, Language, Practicality, and Display, consisting of a total of 20 statements. The questionnaire was adapted from Ulandari et al. (2019) and has a reported reliability of 85%, indicating that it is of good quality and suitable for use in this study.

Table 6. Teacher response questionnaire for the e-module

Aspect	Item	Score	Average Score per Aspect	Category
Content Feasilibity	1	4	4,25	Good
	2	4		
	3	5		
	4	4		
Presentation	5	4	3,75	Good
	6	4		
	7	3		
	8	4		
Language	9	4	3,67	Good
	10	3		
	11	4		
Practicality	12	4	4,25	Good
	13	5		
	14	4		
	15	4		
Display	16	4	4,00	Good
	17	4		
	18	3		
	19	4		
	20	5		

Based on the questionnaire responses from the mathematics teacher, all five main aspects of the developed teaching module were rated in the “Good” category. The Content Feasibility aspect received an average score of 4.25, indicating that the material is aligned with the learning objectives and sufficiently comprehensive for use. The Presentation aspect scored 3.75 on average, showing that the module’s presentation methods are appropriate and support the learning process. The Language aspect obtained an average score of 3.67, suggesting that the language is fairly clear and understandable, although minor simplifications could further match students’ proficiency levels. The Practicality aspect scored 4.25, confirming that the module is easy for teachers to use and practical to implement in the classroom. The Display aspect received a score of 4.00, indicating that the visuals and design are appealing and help support student understanding. Overall, these results show that the developed teaching module is suitable for classroom use, with all key aspects meeting the standards for good validity and quality according to the teacher’s evaluation.

Based on the mathematics teacher’s responses to the questionnaire (see Table 7), all five main aspects of the developed Student Worksheet (LKPD) were rated between “Good” and “Very Good.” The Content Feasibility aspect received an average score of 4.50, indicating that the material in the LKPD is complete, relevant, and aligned with the learning objectives.

Table 7. Teacher response questionnaire for the LKPD

Aspect	Item	Score	Average Score per Aspect	Category
Contents Feasilibity	1	5	4,50	Very Good
	2	4		
	3	5		
	4	4		
Presentation	5	4	4,25	Very Good
	6	5		
	7	4		
	8	4		
Language	9	4	3,67	Good
	10	4		
	11	3		
Practicality	12	5	4,50	Very Good
	13	4		
	14	4		
	15	5		
Display	16	4	4,40	Good
	17	5		
	18	4		
	19	5		
	20	4		

The Presentation aspect scored 4.25 on average, showing that the presentation techniques and supporting features in the LKPD are very good and effectively facilitate the teaching and learning process. The Language aspect received a score of 3.67, suggesting that the language used is fairly clear and understandable, though minor simplifications could further match students' proficiency levels. The Practicality aspect obtained an average score of 4.50, confirming that the LKPD is easy for teachers to use and practical for classroom implementation. Meanwhile, the Display aspect received a score of 4.40, indicating that the visuals and design of the LKPD are attractive, clear, and support student comprehension. Overall, these results demonstrate that the developed LKPD is suitable for instructional use, with all main aspects meeting the criteria for good to very good quality according to the teacher's evaluation.

Based on the responses from the 31 students regarding the developed Student Worksheet (LKPD) (see Table 8), all five main aspects received average scores within the "Good" category. The Content Feasibility aspect scored an average of 4.05, indicating that the material in the LKPD is complete, relevant, and aligned with the learning objectives. The Presentation aspect obtained an average score of 3.98, showing that the presentation methods and supporting features in the LKPD are adequate and help facilitate the learning process. The Language aspect received a score of 3.80, suggesting that the language used is fairly clear and understandable, although minor simplifications could make it better suited to students' proficiency levels. The Practicality aspect scored an average of 4.08, confirming that the LKPD is easy for students to use and practical for classroom application. Meanwhile, the Display aspect received a score of 4.04, indicating that the visuals and design are appealing, clear, and supportive of student understanding. Overall, these results demonstrate that the developed LKPD is suitable for classroom use, with all main aspects meeting the criteria for good quality according to student evaluations.

Table 8. Student response questionnaire for the LKPD

Aspect	Item	Average Score per Item	Average Score per Aspect	Category
Content Feasibility	1	4,2	4,05	Good
	2	4,0		
	3	4,1		
	4	3,9		
Presentation	5	4,0	3,98	Good
	6	3,8		
	7	4,1		
	8	4,0		
Language	9	3,9	3,80	Good
	10	3,8		
	11	3,7		
Practicality	12	4,1	4,08	Good
	13	4,0		
	14	4,2		
	15	4,0		
Display	16	4,0	4,04	Good
	17	3,9		
	18	4,1		
	19	4,0		
	20	4,2		

Revise Instruction

During the revision stage, the researcher improved the e-module based on feedback from experts who evaluated its content, context, media, language, and assessment components. Changes were made to ensure clearer presentation, accurate peatland-related examples, and consistent visual formatting throughout the e-module. In addition, the teaching module was revised by considering data from teacher and student questionnaires as well as classroom observations. These data were analyzed to identify weaknesses and areas that needed improvement in the module. The results of this analysis guided the enhancements, culminating in the creation of the Final Prototype. Moreover, the feedback collected during this revision process can serve as a reference for teachers and future researchers to further improve similar instructional modules.

The findings indicate that integrating the RME approach with the peatlands context provides students with a more meaningful learning experience (Johar et al., 2025). By engaging in mathematizing processes within real-world contexts, students are able to understand the Pythagorean Theorem not just as a formula, but as a practical tool to solve problems in their surroundings (Fauzan et al., 2025). This is reflected in the high ratings for content feasibility and presentation aspects from both teachers and students, suggesting that the context is easy to visualize and relevant to the local environment (AlShaikh et al., 2024). Expert validation results for the e-module and LKPD show that all aspects fall within the “High” category, confirming that the products meet quality standards for content, media, language, and presentation (Elistiana et al., 2024). The strong validity of the content and material aspects demonstrates that the conceptual structure aligns with RME principles and the requirements of the Merdeka Curriculum (Johar et al., 2025). Furthermore, high scores in media and display aspects indicate that the visual design effectively supports conceptual understanding through illustrations and easily comprehensible contextual representations (Vu et al., 2022). Overall, these validity results confirm that the RME-based e-module and LKPD within the peatlands context are suitable for classroom implementation.

Responses from both teachers and students indicate that the e-module and LKPD are practical, as they are easy to use and do not hinder the learning process (Nurissamawati et al., 2024). High scores in the practicality and display aspects suggest that the instructional structure, material flow, and visual design support intuitive use (Clark & Mayer, 2023). Furthermore, consistently high ratings in the “Good” to “Very Good” categories demonstrate that the media can adapt to students’ digital abilities and meet teachers’ needs in managing learning activities (Koh & Kan, 2021). Based on the LKPD evaluation, students showed strong abilities in connecting peatland-context problems to the steps required for solving Pythagorean problems, they were able to identify relevant contextual information, process data, and systematically apply mathematical concepts. The investigative activities facilitated through the PBL model and the stages of RME encourage more independent and deeper thinking (Santiani et al., 2023). Therefore, the use of an RME-based e-module has been shown to positively contribute to students’ conceptual understanding of mathematics.

The findings also indicate that the RME-based e-module is well-aligned with the principles of the Merdeka Curriculum, which emphasizes contextual, flexible, and student-centered learning (Yuhasriati et al., 2022). Using peatland-context problems supports meaningful learning, as highlighted in the New Learning Paradigm (Irhasyuarna, 2021). In addition, the integration of digital media enhances students’ technological literacy and facilitates independent learning. This makes the e-module relevant for modern instruction in line with the Merdeka Curriculum’s requirements (Sukma & Mam, 2025). The results provide evidence that developing modules grounded in local contexts can strengthen student engagement and understanding without compromising the accuracy of mathematical concepts. The success of the RME-based module in the peatlands context also opens opportunities to apply similar approaches to other mathematical topics or regions with different local contexts. Furthermore, the use of digital technologies, such as e-modules and the MPC application, improves both accessibility and the quality of learning.

Therefore, this study has strong potential to serve as a reference for the broader development of contextual learning modules.

CONCLUSION

This study demonstrates that mathematics learning can become more relevant and meaningful when abstract concepts are connected to real-life situations closely related to students' daily experiences. The development of an RME-based e-module within the peatland context not only produced instructional media that are valid and practical, but also helped students understand the Pythagorean Theorem through deeper contextual reasoning. These findings confirm that combining digital technology, local context, and systematic instructional design can strengthen conceptual understanding and increase student engagement in the learning process.

Therefore, developing digital learning materials grounded in local realities can serve as a sustainable strategy to enrich mathematics learning and encourage educators to apply similar approaches to other mathematical topics. Future researchers are encouraged to extend the implementation of RME-based e-modules to different mathematical content areas and educational levels to examine the effectiveness of local contexts more comprehensively. In addition, future developers could employ experimental designs to compare the impact of using the module with conventional instruction, producing stronger empirical evidence. With these opportunities, further studies are expected to generate learning innovations that are more adaptive, responsive, and aligned with the needs of future education.

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