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Development of a Realistic Mathematics Education-Based Teaching Module Integrated with Culture for Students at SMAN 1 Palopo

Fiki Waris [1*], Taufiq [2], Ma'rufi [3], Patmaniar [4]

[1, 2, 3, 4,] Universitas Cokroaminoto Palopo, Indonesia

* fikiwaris11@gmail.com

Abstrak

The limited availability of teaching materials that connect mathematical concepts with students' real-life and cultural contexts has become a critical challenge in improving students' conceptual understanding and cultural awareness in mathematics learning. Therefore, this study aims to develop a culture-integrated teaching module based on the Realistic Mathematics Education approach for students at SMAN 1 Palopo, particularly on the topic of systems of linear equations in three variables. This study employed a research and development (R&D) method using the 4D (Define, Design, Develop, and Disseminate) development model. The research subjects consisted of students of SMAN 1 Palopo and mathematics teachers involved in the implementation stage. Data were collected using module validation sheets, learning implementation observation sheets, teacher response questionnaires, student response questionnaires, and learning outcome tests. The product analysis procedures included validity analysis by experts, practicality analysis based on teacher and student responses, and effectiveness analysis based on learning implementation and student learning outcomes. The results of the development analysis indicate that the Realistic Mathematics Education-based teaching module integrated with local culture is valid, practical, and effective. Expert validation results show that the module meets the language and presentation criteria. Teacher and student responses indicate positive perceptions of the module's usability and relevance. Furthermore, learning outcome test results demonstrate that students were able to solve problems according to the indicators of Realistic Mathematics Education integrated with culture, indicating improved understanding of systems of linear equations in three variables.

Keywords: *Teaching Module, Realistic Mathematics Education, System of Linear Equations in Three Variables*

Introduction

Curriculum change and development are inevitable efforts to improve the quality of education and to respond to social, technological, and cultural transformations. The curriculum functions as a fundamental framework that guides the learning process in schools and determines the direction of students' competency development (Salsabilla et al., 2023). In Indonesia, educational reform is currently manifested through the implementation of the Independent Curriculum (Kurikulum Merdeka), which emphasizes flexibility in learning, student-centered instruction, and the development of character aligned with the Pancasila Student Profile. This curriculum aims not only to strengthen students' academic competencies but also to cultivate values such as independence, creativity, collaboration, critical thinking, and global diversity (Maulida, 2022).

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The successful implementation of the Independent Curriculum is closely related to the availability and quality of teaching materials used by teachers in the classroom. One of the most important learning tools is the teaching module, which serves as a systematically designed learning resource containing learning objectives, materials, learning activities, media, and assessment instruments. A well-developed teaching module does not merely present subject matter but also facilitates meaningful learning experiences and supports the development of students' character in accordance with Pancasila values (Ayu et al., 2021). Therefore, teaching modules play a strategic role in bridging curriculum goals and classroom practice.

However, empirical evidence shows that many teachers still face difficulties in designing and implementing teaching modules that are fully aligned with the principles of the Independent Curriculum. Modules often require a sequence of interconnected and multimodal learning activities that engage students actively through contextual problems and guiding questions (Al Mamun, 2020). Limited understanding of module design principles, especially those that integrate character education and contextual learning, frequently results in teaching materials that are procedural, teacher-centered, and detached from students' real-life experiences (Nurhayati et al., 2022). This condition creates a gap between curriculum expectations and actual learning practices, potentially hindering students from achieving the intended learning outcomes.

One instructional approach considered effective in addressing this issue is Realistic Mathematics Education. Realistic Mathematics Education emphasizes that mathematics learning should begin with real-life situations that are meaningful to students, enabling them to construct mathematical concepts through contextual exploration (Safitri et al., 2022). In this approach, students are guided by teachers to rediscover mathematical ideas by solving problems derived from everyday experiences, thus making mathematics more relevant and applicable (Ananda, 2018). Realistic Mathematics Education also highlights the process of mathematization, where students transform real-world situations into mathematical models, bridging informal knowledge and formal mathematical concepts (Palinussa et al, 2025).

Several previous studies have reported positive impacts of Realistic Mathematics Education on students' mathematical understanding, problem-solving skills, and learning motivation (Sholeh et al., 2021; Apriyanti et al., 2023). Other studies have further expanded Realistic Mathematics Education by integrating local cultural contexts, showing that cultural elements can enrich learning situations and make mathematics more meaningful for students (Utami et al., 2019; Lestari et al, 2023). For example, traditional games, local architecture, traditional foods, and regional measurement practices have been used as contextual problems to introduce mathematical concepts such as geometry, ratios, and arithmetic operations.

Despite these promising findings, a closer examination of previous studies reveals several research gaps. First, most existing studies focus primarily on the effectiveness of Realistic Mathematics Education-based learning in improving cognitive outcomes, such as students' achievement or problem-solving abilities, while limited attention is given to the systematic development of teaching modules that align with the structure and demands of the Independent Curriculum. Second, although cultural integration has been explored, many studies treat culture merely as a learning context, without explicitly linking it to the Pancasila Student Profile dimensions, such as collaboration, independence, critical reasoning, and noble character.

Third, research on culture-integrated Realistic Mathematics Education modules at the senior high school (SMA) level, especially in Indonesia, remains relatively scarce. Most studies are conducted at the elementary or junior high school level, leaving a gap in research targeting

higher-level mathematical concepts and learners. In addition, previous research often reports the implementation of Realistic Mathematics Education in classroom settings without producing validated and practical teaching modules that teachers can directly adopt and adapt. As a result, teachers still lack concrete, ready-to-use learning resources that integrate Realistic Mathematics Education, local culture, and character education in a structured manner. This gap highlights the need for development research that not only examines learning outcomes but also produces high-quality instructional products that are valid, practical, and effective.

Integrating local culture into mathematics learning is particularly relevant in the Indonesian context, as students already possess cultural knowledge embedded in their daily lives. Cultural elements function as "cultural assets" within students' cognitive schemas, making learning more familiar and meaningful (Tambunan, 2025). In mathematics learning, meaningful contexts are essential for helping students understand abstract concepts more easily (Tambunan, 2025). For example, local cultural practices such as traditional musical instruments can be used to introduce mathematical concepts such as linear equations in three variables.

In the Palopo context, local cultural elements, such as musical instruments, provide a rich and authentic context for mathematics learning. This cultural context not only supports conceptual understanding but also promotes values such as cooperation, responsibility, respect for diversity, and appreciation for local wisdom, values that align strongly with the Pancasila Student Profile (Fitriyani et al., 2024). For example, contextual problems in the module were designed using situations related to traditional Luwu musical instruments, such as comparing quantities, prices, or production of different instruments to represent systems of linear equations.

Based on these considerations, this study focuses on developing a culture-integrated mathematics teaching module using the Realistic Mathematics Education approach, aligned with the Independent Curriculum and the Pancasila Student Profile. This study seeks to address the identified research gaps by producing a structured teaching module that systematically integrates Realistic Mathematics Education principles, local cultural contexts, and character education. The developed module is expected to be valid, practical, and effective in enhancing students' mathematical understanding and character development. Ultimately, this study aims to contribute to improving the quality of mathematics learning at SMA Negeri 1 Palopo, both in academic achievement and in the cultivation of Pancasila-based character.

Method

The development model used in this study is the Four-D (4D) model, which consists of four main stages: define, design, develop, and disseminate. This model was chosen because it has proven effective in developing systematic and structured learning products, from needs identification and product design to widespread dissemination (Firdaus et al., 2024). This model is designed to produce valid, practical, and effective learning products, which, in the context of this research, are in the form of mathematics teaching modules based on Realistic Mathematics Education, with cultural integration and the dimensions of the Pancasila Student Profile.

The define stage involves defining problems and needs through the development of teaching modules, including literature studies, observations, and interviews. The design stage is the initial design process for a mathematics teaching module based on Realistic Mathematics Education that integrates culture thoroughly. The development stage is a crucial phase in the development of teaching modules that includes validation and testing processes. In addition to the teaching modules that have been designed, instruments created at the design stage will be

validated by experts, including mathematicians, mathematics education experts, and Luwu cultural experts. The dissemination stage, where the teaching modules that have been developed and tested will be disseminated for use by teachers and students more widely.

Development of a Teaching Module Based on Realistic Mathematics Education on the material of three-variable linear equation systems for class X students of SMA Negeri 1 Palopo, consisting of ten classes totaling 340 people. The selected samples were class X Pluto and class X Neptune. The study began with observations at the UPT of SMA Negeri 1 Palopo by conducting observations with several students and teachers to determine the problems and needs of students in learning mathematics. Next, the researcher determined the solution, namely the Development of a Teaching Module Based on Realistic Mathematics Education. The results of the Development of a Teaching Module Based on Realistic Mathematics Education were tested for product feasibility by two validators.

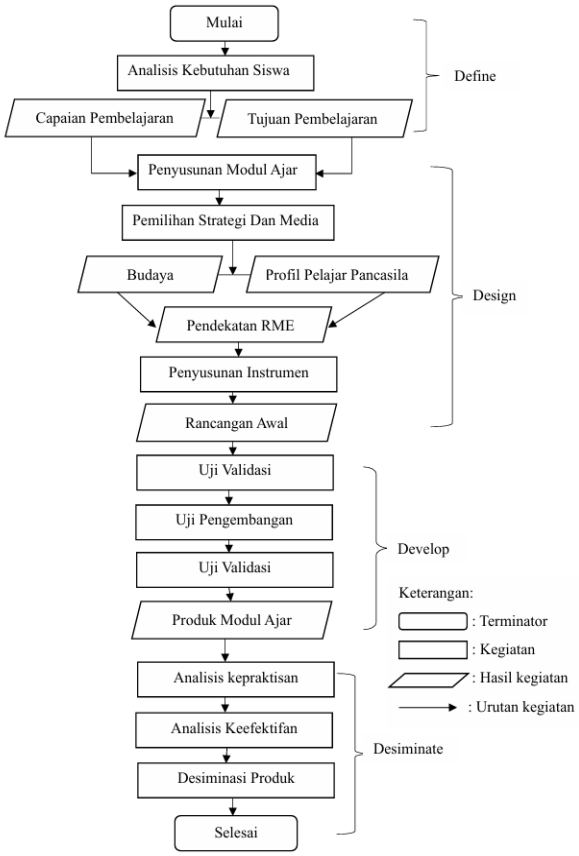

Figure 1. 4D Research Stage

Validation results are declared valid if they fall into the sufficiently valid category. This is based on validation criteria adapted and based on Aiken's V-index formula (Retnawati, 2016).

Table 1. Validation Criteria

Results	Criteria
$0{,}80 < V \leq 1{,}00$	Very Valid
$0{,}60 < V \leq 0{,}80$	Valid
$0{,}40 < V \leq 0{,}60$	Quite Valid
$0{,}20 < V \leq 0{,}40$	Less Valid
$0 < V \leq 0{,}20$	Invalid

Validity testing aims to ensure that the teaching module meets the established criteria, both in terms of content, construction, culture, and its relationship to the Pancasila Student Profile.

The formula used to calculate validity is as follows. The validity data is obtained from the experts, and the total score for each indicator of the teaching module will be calculated and classified according to the criteria set out in Table 2. If the result is more than 60%, then the teaching module is declared valid for use and can be tested further.

Table 2. Product Validity Assessment Criteria

Evaluation %	Category
80 < N ≤ 100	Very Valid
60 < N ≤ 80	Valid
40 < N ≤ 60	Quite Valid
20 < N ≤ 40	Less Valid
0 < N ≤ 20	Invalid

This practicality test was conducted by distributing a questionnaire to teachers. The results were then calculated using the following formula, The results of this calculation are then compared with the criteria in Table 3. If the percentage is more than 60%, the module is declared practical for use in the learning process.

Table 3. Product Practicality Assessment Criteria

Evaluation %	Category
80 < N ≤ 100	Very Practical
60 < N ≤ 80	Practical
40 < N ≤ 60	Quite Practical
20 < N ≤ 40	Less Practical
0 < N ≤ 20	Impractical

This effectiveness test was conducted by distributing a warm student questionnaire and evaluation test questions. The results of this questionnaire were then calculated using the following formula. The results of this calculation are then compared with the criteria in Table 4. If the percentage is more than 80%, the module is declared effective for use in the learning process.

Table 4. Product Effectiveness Assessment Criteria

Evaluation %	Category
90 - 100	Very Effective
80 - 89	Effective
65 - 79	Quite Effective
55 - 64	Less Effective
0 – 54	Ineffective

The results of all these analyses will provide a comprehensive picture of the quality of the Realistic Mathematics Education-based teaching module integrated with the Pancasila Student Profile, whether it meets the valid, practical, and effective criteria for use in learning at SMAN 1 Palopo.

Result

Define

At the define stage, the researchers identified the problems and learning needs at UPT SMA Negeri 1 Palopo as a basis for justifying the development of the teaching module. This stage involved analyzing student needs, learning outcomes, and learning objectives through initial observations, interviews, and questionnaires. The interviews with students indicated that mathematics was perceived as a difficult subject, particularly when dealing with contextual and story-based problems. Meanwhile, interviews with teachers revealed that mathematics plays a

crucial role in everyday life, especially in solving real-life problems. Teachers also emphasized that in teaching the topic of Systems of Linear Equations in Three Variables using the Realistic Mathematics Education approach, it is essential to highlight the sequence of problem-solving steps to minimize errors in obtaining correct results. However, several obstacles were identified, including students' limited understanding of problem statements and their difficulties in solving contextual story problems based on Realistic Mathematics Education. The needs analysis conducted through a questionnaire further showed that most teachers and students require teaching materials that are contextual, engaging, and closely related to their cultural environment.

Culture was identified as a valuable component for integration into mathematics learning because it contains patterns, symbols, shapes, and values that can be meaningfully linked to mathematical concepts. To support this analysis, a 16-item questionnaire was administered to students to identify their specific learning needs, and the results were used as key considerations in developing the learning module. Based on the identified needs, the expected learning outcomes at the end of Phase E are that students are able to solve problems involving systems of linear equations in three variables, as well as problems related to quadratic equations and functions (including imaginary roots) and exponential equations and functions with the same base. Accordingly, the learning objectives are formulated to enable students to correctly model contextual problems into systems of linear equations in three variables after engaging with the learning resources, and to accurately determine the solution sets of such systems through group discussions in contextual problem-solving activities.

Design

The design stage was conducted by formulating a comprehensive product development plan, with the primary product being a literacy-based mathematics teaching module integrated with the Luwu culture. This stage began with the preparation of the teaching module by determining the material title, formulating learning outcomes, and specifying learning objectives in accordance with the Independent Curriculum. The selected material focused on the System of Linear Equations in Three Variables. The module was systematically structured to include an introduction, contextual problems, learning activities, reflection sections, and evaluation tasks. The learning materials were developed using the Realistic Mathematics Education approach and explicitly linked to relevant cultural elements. For example, contextual problems in the module were designed using situations related to traditional Luwu musical instruments, such as comparing quantities, prices, or production of different instruments to represent systems of linear equations. In addition, contextual student worksheets were compiled, containing activities such as analyzing data from cultural events, interpreting information from traditional performances, and solving mathematical problems derived from local cultural practices.

These worksheets were designed to guide students through the process of mathematization, from real-life cultural situations to formal mathematical representations. The selection of learning strategies and media was based on an analysis of students' needs and characteristics, as well as the nature of the mathematics content to be integrated. Cultural elements, particularly traditional musical instruments and local cultural activities, were intentionally used as learning contexts to increase student engagement and facilitate conceptual understanding. The module also included illustrations, short reading texts (literacy components), and discussion prompts related to the Luwu culture to strengthen students' cultural literacy and appreciation of local heritage.

Furthermore, the module was designed to support the development of the Pancasila

Student Profile, especially the dimensions of critical thinking, collaboration, independence, and global diversity rooted in local wisdom. Learning activities encouraged students to work in groups, discuss contextual problems, and reflect on cultural values embedded in the learning process. The application of the Realistic Mathematics Education approach enabled students to connect mathematical concepts to real-world and cultural contexts familiar to them, thereby fostering deeper, more meaningful learning. To evaluate the feasibility and effectiveness of the module, various research instruments were prepared, including expert validation sheets, observation sheets on learning implementation, teacher and student response questionnaires, and learning outcome tests. The result of this stage was an initial draft of a culture-integrated mathematics teaching module, complete with learning scenarios, contextual worksheets, assessment instruments, and reflection activities. This draft served as the foundation for limited trials and subsequent revisions in the development stage.

Figure 2. Cover of the Culture-Integrated Mathematics Teaching Module

Figure 2 presents the cover design of the mathematics teaching module developed in the design stage. The module focuses on the topic of Systems of Linear Equations in Three Variables for Grade X students and integrates local cultural elements from the Luwu region. The visual layout was intentionally designed to be attractive and student-friendly, aiming to increase learners' motivation and interest in mathematics learning. The cover also reflects the integration of literacy components and contextual learning as part of the Independent Curriculum.


Di Sulawesi Selatan, terdapat tiga jenis alat musik: talindo, gesok-gesok dan kecapi. talindo dimainkan dengan cara memetik senarnya, gesok-gesok dimainkan dengan cara digesek, dan kecapi dimainkan dengan cara dipetik. Dirwan membeli 2 talindo, 1 gesok-gesok, dan 2 kecapi seharga Rp 3.350.000,00. Heru membeli 1 talindo, 2 gesok-gesok, dan 1 kecapi seharga Rp 1.900.000,00. Haryono membeli 2 talindo dan 2 kecapi seharga Rp 3.200.000,00. Jika Wahyu membeli 1 talindo, 3 gesok-gesok, dan 2 kecapi, berapa yang harus dibayar Wahyu?

Talindo Gesok-gesok Kecapi

Pembahasan:

Misalkan: x = harga talindo
y = harga tifa
z = harga kecapi

Diketahui:

Dirwan : $2x + y + 2z = 3.350.000$ ...pers (1)
Heru : $x + 2y + z = 1.900.000$ ...pers (2)
Haryono : $2x + z = 2.550.000$ ...pers (3)

Ditanyakan:

Jika Wahyu membeli 1 talindo, 3 gesok-gesok, dan 2 kecapi, berapa yang harus dibayar Wahyu?

Figure 3. Example of a Contextual Problem on Systems of Linear Equations in Three Variables Based on Luwu Traditional Musical Instruments

Figure 3 illustrates an example of a contextual mathematics problem embedded in the teaching module. The problem utilizes traditional Luwu musical instruments, namely talindo, gesok-gesok, and kecapi, as real-life contexts for representing a system of linear equations in three variables. This design is aligned with the Realistic Mathematics Education (RME) approach, which emphasizes the use of meaningful real-world situations to support students' mathematization processes from contextual understanding to formal mathematical representations.

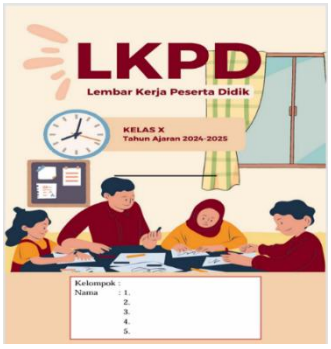

Figure 4. Cover of the Student Worksheet (LKPD) Developed in the Design Stage

Figure 4 shows the cover of the Student Worksheet (Lembar Kerja Peserta Didik/LKPD) developed to support the implementation of the teaching module. The LKPD was designed to facilitate collaborative learning and active student engagement through group-based activities. Visual elements and layout were adapted to suit students' characteristics and to create a comfortable learning atmosphere, while maintaining consistency with the cultural theme integrated into the module.


Tujuan Pembelajaran

Setelah melihat sumber belajar, siswa dapat memodelkan masalah kontekstual kedalam sistem persamaan linear tiga variabel dengan tepat Setelah berdiskusi secara kelompok, siswa dapat menentukan himpunan penyelesaian sistem persamaan linear tiga variabel kedalam masalah kontekstual dengan benar.

Penugas

Tuliskan identitas pada sampul Lembar Kerja ini Bacalah LKPD dengan cermat Diskusikan dengan teman kelompok kalian Tulis hasil diskusi sesuai tempat yang disediakan Periksa kembali LKPD setelah diskusi selesai.

Permasalahan

Di Sulawesi Selatan, terdapat tiga jenis alat musik: pui-pui, kecapi, dan gandrang bulo. Pui-pui dimainkan dengan cara ditiup, kecapi dimainkan dengan cara dipetik, dan gandrang bulo dimainkan dengan cara dipukul. Pak Irfan membeli 2 pui-pui, 1 kecapi, dan 2 gandrang bulo seharga Rp 15.250.000,00. Pak Ilham membeli 1 pui-pui, 1 kecapi, dan 1 gandrang bulo seharga Rp 10.000.000,00. Pak Budi membeli 2 kecapi dan 2 gandrang bulo seharga Rp 14.500.000,00.

Pui-pui Kecapi Gandrang Bulo

Jawablah pertanyaan dibawah ini dengan baik dan benar!

1. Berapakah total pembelian yang harus dibayar oleh ketiganya?
2. Berapakah harga masing-masing dari ketiga alat musik?
3. Jika Pak Budi membeli 1 kecapi, 2 gandrang bulo, dan 2 pui-pui. Berapakah yang harus dibayar?

Figure 5. Learning Objectives and Contextual Problems Presented in the Student Worksheet

Figure 5 presents a section of the LKPD containing the learning objectives, learning instructions, and contextual problems. The contextual tasks are derived from local cultural practices and traditional musical instruments, encouraging students to analyze real-life situations and model them into systems of linear equations in three variables. This design aims to develop students' critical thinking, collaboration skills, and cultural awareness, in line with the Pancasila Student Profile and the principles of the Realistic Mathematics Education approach.

Develop

The development phase was conducted to produce an appropriate and high-quality teaching module through a systematic validation process. Validation testing involved subject matter experts, media experts, and learning experts who evaluated the appropriateness of the module in terms of content accuracy, presentation quality, and instructional approach. This validation process was intended to ensure that the developed module met both substantive and technical quality standards. The validity analysis aimed to determine whether the teaching module fulfilled the established criteria, with the validity score calculated using the formula. Based on the validation of the teaching module, the content aspect was categorized as very valid, as shown in Table 5.

Table 5. Validation of Teaching Modules in Content Aspects

Rated aspect	Appraiser	s1	s2	Amount s	n(c-1)	V	Information

	V.1	V.2						
Completeness of learning outcomes according to the applicable curriculum	5	5	4	4	8	8	1	Very valid
Completeness of format (learning objectives, learning media, learning resources, teaching materials, learning scenarios, learning approaches, learning methods, and learning assessments)	5	4	4	3	7	8	0,88	Very valid

Berdasarkan hasil validasi pada aspek isi, modul ajar dinyatakan memenuhi kriteria kelayakan dengan tingkat validitas yang sangat tinggi. Penilaian dari para validator menunjukkan bahwa substansi materi telah selaras dengan tuntutan kurikulum yang berlaku serta disusun secara sistematis sesuai komponen perangkat pembelajaran yang dipersyaratkan. Struktur modul dinilai komprehensif karena memuat elemen-elemen penting pembelajaran, mulai dari perumusan tujuan hingga perencanaan asesmen. Secara keseluruhan, temuan ini mengindikasikan bahwa modul ajar yang dikembangkan layak digunakan dalam proses pembelajaran tanpa memerlukan revisi yang signifikan pada aspek isi. Based on the results of the validation of the teaching module assessed by the validator, this can be seen in table 6.

Table 6. Teaching Module Validation Results

Appraiser	Assessment Results	Persentase	Criteria
Validator 1	109	87,2%	Very valid
Validator 2	119	95,2%	Very valid
Average score		91,2%	Very valid

Based on the validity interpretation criteria, the average score of 91.2% is categorized as very valid. This indicates that the developed teaching module fulfills the requirements of content, language, and presentation appropriateness, making it suitable for use in the learning process.

Table 7. Practical Results of the Teaching Module

Appraiser	Assessment Results	Persentase	Criteria
Math teacher 1	27	90%	Very practical
Math teacher 2	28	93,3%	Very practical
Average score		91,65%	Very practical

Based on the practicality interpretation criteria, the average score of 91.65% is classified as very practical. This shows that the developed teaching module meets the standards of content, language, and presentation appropriateness and is therefore feasible for use in the learning process. After revisions were made based on expert validation, a limited pilot test was conducted with a small group of students to evaluate their understanding of the teaching module, the clarity of the instructions, and their level of engagement in the culture-integrated learning process.

Feedback obtained from both the validation and pilot testing stages was then used to carry out further revisions, with improvements focusing on content accuracy, presentation quality, language clarity, and the strength of cultural contextualization. These refinements resulted in a more polished and improved version of the teaching module, which was subsequently tested on a larger scale. The final product is a literacy-oriented mathematics teaching module integrated with local culture and developed using the Realistic Mathematics Education approach. This module has successfully passed expert validation and development testing, demonstrating that it meets the criteria of validity, practicality, and effectiveness for use in classroom learning.

Desiminate

The dissemination stage focused on sharing the developed teaching module and analyzing its applicability within the learning process. This stage aimed to ensure that the module was not only theoretically valid and practical, but also beneficial when applied in broader educational contexts. The practicality of the module was examined through feedback collected from both teachers and students during the learning process, with particular emphasis on ease of use, clarity of instructions, and the relevance of the content to the learning context. These findings indicate the extent to which the module can be effectively implemented in classroom settings.

In addition, the effectiveness of the module was evaluated based on students' learning outcomes and responses. Key indicators included improvements in students' understanding of mathematical concepts, their ability to solve contextual problems, and their engagement in culture-based learning activities. This analysis highlights the contribution of the module to both cognitive achievement and character development. The developed teaching module was subsequently disseminated through various channels, including scientific forums, teacher training workshops, and academic publications. This dissemination process was intended to facilitate wider adoption of the module by mathematics teachers in diverse educational settings, particularly in schools with similar cultural backgrounds, thereby maximizing its impact on improving mathematics learning and strengthening students' cultural literacy

Discussion

The development of a culture-integrated mathematics teaching module based on the Realistic Mathematics Education approach was motivated by persistent challenges faced by teachers in designing learning materials aligned with the Independent Curriculum. Previous studies have consistently reported that many teachers experience difficulties in translating curriculum demands into structured teaching modules that are student-centered, contextual, and character-oriented (Sutrisno et al, 2024). The findings of this study indicate that the developed module effectively addresses these challenges and provides empirical support for the integration of Realistic Mathematics Education and local culture within the Independent Curriculum framework.

The validation results demonstrate that the developed teaching module achieved a very high level of validity, with an average score of 91.2%, covering aspects of content accuracy, presentation, learning approach, and language use. This finding is consistent with previous development research that reported high validity levels for Realistic Mathematics Education-based teaching materials, typically ranging from 85% to 90% (Jenaman et al, 2022; Safitri et al., 2022). The slightly higher validity score obtained in this study suggests that the integration of local cultural contexts and explicit alignment with the Pancasila Student Profile enhances the relevance and coherence of the module content. From a theoretical perspective, Realistic Mathematics Education emphasizes the use of meaningful, real-life contexts as a starting point for learning, enabling students to construct mathematical understanding through guided mathematization (Herzamzam et al., 2020).

Expert validators highlighted that contextual problems drawn from students' local cultural environments-such as traditional market transactions and local measurement practices-strengthen conceptual clarity and alignment with learning objectives. Culturally familiar contexts reduce cognitive load and enhance the logical structure of the learning material (Sholeh et al., 2021). Therefore, high validity scores indicate that the module is conceptually sound and pedagogically aligned with Realistic Mathematics Education principles and curriculum requirements. In terms of practicality, this module received an average teacher response score

of 91.65%, categorized as highly practical. Teachers reported that the module was easy to use, systematically structured, and compatible with the Independent Curriculum. The contextual learning module significantly improved the ease of implementation and classroom management for teachers (Rusdi et al. 2020). The Realistic Mathematics Education-based module reduced teacher preparation time because learning activities were clearly sequenced and supported by contextual problems (Putri et al, 2026).

The high practicality score also indicated that the integration of local culture positively contributed to the ease of use of the learning. Teachers noted that students were more engaged and required less explanation when problems were presented using a familiar cultural context. Culturally integrated learning materials increased classroom interaction and reduced student resistance to abstract mathematical content (Utami et al. 2019). Therefore, practical findings indicate that the developed module not only supports teachers technically but also facilitates smoother learning interactions between teachers and students. The effectiveness of the learning module was demonstrated by positive student responses (84%), which were categorized as effective, and by the results of the learning outcome test, in which 100% of students achieved the maximum score. These results indicate that the module successfully supported students' understanding of Systems of Linear Equations in Three Variables through contextual and realistic learning activities.

These findings are consistent with previous research reporting improved learning outcomes following the implementation of Realistic Mathematics Education-based instruction. Students taught using Realistic Mathematics Education demonstrated stronger conceptual understanding and problem-solving skills compared to students taught using conventional methods (Shahidayanti et al, 2024). Culturally contextualized mathematics learning improves student motivation and achievement. However, the excellent achievement rate observed in this study exceeds the results reported in many previous studies, suggesting that the combination of Realistic Mathematics Education, local culture, and structured module design can produce a synergistic effect on student learning.

Furthermore, the positive student responses indicate that students perceive the learning process as enjoyable, meaningful, and relevant to their daily lives. This aligns with the core principle of Realistic Mathematics Education that mathematics should be viewed as a human activity connected to reality (Sholeh et al., 2021). When students can connect mathematical problems to familiar cultural experiences, they tend to be more actively engaged and develop a deeper understanding.

One of the unique contributions of this research lies in the explicit integration of local culture with the dimensions of the Pancasila Student Profile. While previous studies have incorporated cultural context into mathematics learning, few have systematically linked this context to character development goals (Laurens et al, 2017). The developed module instills values such as cooperation, independence, critical thinking, and respect for cultural diversity in learning activities, discussions, and group work. A culturally based learning environment naturally fosters character education by engaging students with shared values and social practices. Through collaborative problem-solving and contextual exploration, students not only develop mathematical competency but also practice social interaction, responsibility, and respect-key dimensions of the Pancasila Student Profile. Therefore, the effectiveness of this module extends beyond cognitive outcomes to encompass affective and character-related dimensions.

Overall, the findings of this study reinforce the relevance of Realistic Mathematics Education as an instructional approach for the Independent Curriculum and highlight the importance of

integrating local culture into teaching modules. The high validity (91.2%), practicality (91.65%), and effectiveness (84% student response and 100% learning mastery) demonstrate that the developed module is a viable instructional resource for mathematics teachers. These results confirm and extend previous research by showing that culture-integrated Realistic Mathematics Education modules can simultaneously enhance academic achievement and character development. Nevertheless, it is important to acknowledge that this study was conducted in a limited context, involving one school and one mathematical topic. While the findings are promising, further research is needed to test the scalability and adaptability of similar modules across different regions, cultural settings, and mathematical content.

Conclusion

This study developed a culture-integrated mathematics teaching module based on the Realistic Mathematics Education approach for students of SMA Negeri 1 Palopo and demonstrated that the module is highly feasible and beneficial for mathematics learning. The results indicate that the developed module meets the criteria of validity, practicality, and effectiveness. Expert validation results showed a very high level of validity (91.2%), covering content accuracy, presentation, learning approach, and language quality. The practicality assessment by teachers also reached a very high category (91.65%), indicating that the module is easy to use, relevant to students' learning needs, and supportive of contextual and student-centered learning. Furthermore, the effectiveness of the module was confirmed by positive student responses (84%) and learning outcome test results, where all students achieved optimal scores. These findings suggest that integrating local culture into Realistic Mathematics Education-based modules can significantly enhance students' understanding of mathematical concepts, particularly the System of Linear Equations in Three Variables, while simultaneously supporting the development of Pancasila Student Profile values.

The findings of this study have important implications for mathematics education, especially in supporting the implementation of the Independent Curriculum. The developed module can serve as an alternative instructional resource that helps teachers design meaningful, contextual, and character-oriented learning experiences. However, this study has limitations, as it was conducted in a single school with a limited number of participants and focused on one mathematical topic. Therefore, the generalizability of the findings remains limited. Future research is recommended to implement similar culture-integrated Realistic Mathematics Education modules in different schools, regions, and grade levels, as well as to explore other mathematical topics. Further studies may also examine the long-term impact of such modules on students' character development and higher-order thinking skills.

Acknowledgment

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