



DEVELOPMENT OF AN RME-BASED LEARNING MODULE INTEGRATING NUMERACY LITERACY INDICATORS FOR PRIMARY SCHOOL STUDENTS

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Abstract

Despite the growing use of Realistic Mathematics Education (RME) in mathematics instruction, few studies have developed learning modules that explicitly integrate numeracy literacy indicators throughout the learning process for primary school students. This study aimed to develop an RME-based learning module that is valid, practical, and effective in improving primary school students' numeracy literacy. This Research and Development (R&D) study employed the ADDIE model involving 25 fifth-grade students at SDN Sidodadi. Data was collected through observations, questionnaires, and pretest-posttest tests and analyzed using percentage analysis and the N-gain test. The developed module achieved validity scores of 90% for the module aspect and 95% for the content aspect, both categorized as very valid, while its practicality reached 85% (very practical). Students' numeracy literacy improved from a mean pretest score of 62.84 to 81.88, with an N-gain score of 0.63 (effective). The novelty of this study lies in integrating numeracy literacy indicators into every stage of the RME learning syntax. Therefore, the developed module can support numeracy-oriented mathematics learning in primary schools.

Keywords: *Learning Modules; Numeracy Literacy; Realistic Mathematics Education*

Abstrak

Meskipun penggunaan Pendidikan Matematika Realistik (RME) dalam pembelajaran matematika semakin meluas, hanya sedikit penelitian yang telah mengembangkan modul pembelajaran yang secara eksplisit mengintegrasikan indikator literasi numerasi di sepanjang proses pembelajaran bagi siswa sekolah dasar. Penelitian ini bertujuan untuk mengembangkan modul pembelajaran berbasis RME yang valid, praktis, dan efektif dalam meningkatkan literasi numerasi siswa sekolah dasar. Penelitian dan pengembangan (R&D) ini menggunakan model ADDIE yang melibatkan 25 siswa kelas lima di SDN Sidodadi. Data dikumpulkan melalui observasi, kuesioner, serta tes pretest-posttest, dan dianalisis menggunakan analisis persentase serta uji N-gain. Modul yang dikembangkan mencapai skor validitas sebesar 90% untuk aspek modul dan 95% untuk aspek isi, keduanya dikategorikan sebagai sangat valid, sedangkan tingkat kepraktisannya mencapai 85% (sangat praktis). Literasi numerasi siswa meningkat dari skor rata-rata pra uji sebesar 62,84 menjadi 81,88, dengan skor N-gain sebesar 0,63 (efektif). Keunikan penelitian ini terletak pada integrasi indikator literasi numerasi ke dalam setiap tahap sintaks pembelajaran RME. Oleh karena itu, modul yang dikembangkan dapat mendukung pembelajaran matematika yang berorientasi pada literasi numerasi di sekolah dasar.

Kata kunci: Literasi Numerasi; Modul Pembelajaran; Pembelajaran Matematika Realistik

INTRODUCTION

21st-century education identifies numeracy literacy as one of the essential competencies that students must possess (Harsono, Murti, & Cahya, 2023). Numeracy literacy is defined as an individual's ability to apply mathematical concepts and procedures logically and systematically in a variety of real-world situations (Rezky, Hidayanto, & Parta, 2022). The role of this competency is becoming increasingly

important because it enables individuals to use numeric information as a basis for making sound decisions (Kosasih, Imswatama, & Lukman, 2025). Numeracy literacy skills can be identified through several indicators, including (1) skills to use numbers and mathematical symbols for problem-solving, (2) skills to analyze information in various representations, and (3) skills to interpret the results of that analysis as a basis for decision-making (Kemendikbud, 2017).

At the primary school level, mathematics instruction is not only focused on mastering computational procedures but also on developing a logical and systematic way of thinking that serves as the foundation for the development of numeracy literacy skills (Perdana & Suswandari, 2021). Evidence from the field indicates that students' numeracy literacy skills remain low (Nato, Taga, Suryani, & We'u, 2024). This is reflected in students' difficulties in understanding the context of problems, interpreting data, performing accurate calculations, and constructing relevant mathematical models to solve contextual problems (Triyani & Chumdari, 2025). In line with this, the government, through the National Assessment, emphasizes that numeracy literacy is one of the minimum competencies that must be developed as an indicator of national education quality (Pusat Asesmen dan Pembelajaran, 2020).

One approach that can be taken is through the development of instructional materials in the form of modules (Munawarah, Fajriana, Listiana, Maryana, & Aklimawati, 2023). Modules are systematically designed to help students achieve learning objectives and to make it easier for teachers to present material in accordance with students' characteristics and needs (Sektivulan, Ningrum, Rohman, & Pujiastuti, 2024). Modules consist of key components, including general information, learning outcomes, learning objectives, learning activities, assessments, learning media, and references (Nengsih et al., 2024). In addition, effective modules are self-instructional, self-contained, stand-alone, adaptive, and user-friendly (Sabila, Putri, & Arrsyi, 2022). To optimize the role of modules in improving numeracy literacy skills, it is necessary to integrate a learning approach that connects mathematical concepts to students' real-life contexts.

Realistic Mathematics Education (RME) is an approach that emphasizes the use of real-world contexts as a starting point for learning so that students can develop a more meaningful understanding of mathematical concepts in line with their experiences (Cardak & Kiray, 2023). Through RME, students are encouraged to actively engage in discovering concepts based on experiences closely related to their daily lives (Nana, Simarmata, & Hijriani, 2024). In its implementation, this approach involves several stages: (1) understanding contextual problems, (2) solving problems, (3) discussing results, and (4) concluding (Pangestu & Ruqoyyah, 2023). Gravemeijer (1994) explains that the principles of RME include didactic phenomenology, guided reinvention or progressive mathematizing, and self-developed models (Oktavia & Palupi, 2025). These principles enable students to construct mathematical concepts through real-world contexts, thereby aligning with the development of numeracy literacy skills.

Several previous studies have examined the development of Realistic Mathematics Education (RME)-based modules for various learning materials in primary school (Bahar, Majid, Yuliany, Munirah, & Sriyanti, 2024; Erni, Rohana, & Fakhrudin, 2022; Anisah, Susanta, & Djuwita, 2023; Adna, Chasanah, & Muyasaroh, 2024; Anggraeni, Khaq, & Pangestika, 2024). The results of these studies indicate that RME-based modules can support the creation of learning experiences that are more contextual, meaningful, and student-centered. In addition, a number of studies also indicate that the implementation of the RME approach can improve various mathematical skills among students, such as problem-solving, critical thinking, and mathematical reasoning (Sabrina & Subekti, 2025; Hidayanthi, 2022; Mutafarida & Amir, 2026). These findings suggest that the RME approach has the potential to be integrated into the development of learning modules that support the improvement of numeracy literacy among primary school students.

Despite these positive findings, previous studies have primarily focused on improving general

mathematical competencies, such as learning outcomes, conceptual understanding, problem-solving skills, and critical thinking, rather than explicitly integrating numeracy literacy indicators into RME-based learning modules. Since numeracy literacy emphasizes the ability to interpret, analyse, and apply mathematical information in authentic contexts (Rosdiana, Rosita, & Yuliawati, 2025), this limitation highlights an important research gap. Therefore, this study developed an RME-based learning module that systematically integrates numeracy literacy indicators into each stage of the RME learning syntax. The novelty of this study lies in the systematic integration of numeracy literacy indicators into the RME learning syntax, providing a structured learning module specifically designed to strengthen primary school students' numeracy literacy. Based on the above description, this study aims to develop a Realistic Mathematics Education (RME)-based module that is valid, practical, and effective for improving the numeracy literacy of primary school students.

METHOD

This study employed the Research and Development (R&D) method using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Sugiyono, 2023). During the Analysis phase, learning needs were identified through a curriculum review, an analysis of student characteristics, and preliminary observations regarding numeracy literacy skills. The results of the analysis were used as the basis for determining the direction of the module's development. The Design phase involved drafting an initial module design, which included defining learning objectives, selecting contexts relevant to students' daily lives, and designing learning activities based on the Realistic Mathematics Education (RME) syntax integrated with numeracy literacy indicators. At this stage, a research instrument outline is also developed to collect data on the validity, practicality, and effectiveness of the modules being developed.

The Development phase involved creating the module based on the previously formulated design. The resulting module was equipped with contextual materials and systematic learning activities. In addition, the research instruments were developed based on a previously formulated rubric. The developed module was validated by an expert in Mathematics Education and Management to assess its feasibility before implementation. Revisions were made based on the validator's suggestions and recommendations. Next, during the Implementation phase, the developed module was implemented in the classroom over four learning sessions. Finally, the Evaluation phase was conducted to assess the quality of the developed module in terms of its validity, practicality, and effectiveness.

To test the effectiveness of the developed module, this study employed a pre-experimental design in the form of a one-group pretest-posttest design. This design was used to determine changes in students' skills before and after the intervention, without involving a control group. The study was conducted at SDN Sidodadi during the even semester of the 2025/2026 academic year with 25 fifth-grade students selected using purposive sampling based on their suitability for the research objectives. The participants were selected using purposive sampling because the class had previously experienced difficulties in numeracy literacy based on the teacher's initial assessment and represented the target users of the developed module. The research instruments used included validation sheets from subject matter experts and module experts to assess the module's feasibility; a student response questionnaire to measure the module's practicality; a test to measure students' numeracy literacy skills; and an observation sheet. The validation forms and student response questionnaires used a 1–4 Likert scale. Data collection was conducted through observation, questionnaires, and tests. Observation was used to obtain information regarding the initial learning conditions and the implementation of learning using the module. Questionnaires were used to collect data on student responses to the developed module, while tests were

used to obtain data on students' numeracy literacy skills before and after instruction.

Data were analysed using quantitative descriptive methods. Validation results were analysed as percentages to determine the module's validity, while questionnaire data were analysed as percentages to determine the module's practicality. The effectiveness of the module in improving students' numeracy literacy skills was analyzed using the N-gain calculation based on pretest and posttest results to determine the level of improvement in students' skills after using the developed module. N-gain analysis was employed to determine the magnitude of students' improvement after the intervention because it provides a normalized measure of learning gain. The formula for calculating N-gain is

$$N\text{-Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Ideal Score} - \text{Pretest Score}}$$

The analysis results were then interpreted based on the criteria established in Table 1, Table 2 and Table 3.

Table 1. Validity Level Criteria

Achievement (%)	Qualification	Criteria
81 - 100	Very Good	Highly Valid
61 - 80	Good	Valid
41 - 60	Fairly Good	Fairly Valid
21 - 40	Not Very Good	Not Very Valid
0 - 20	Very Poor	Invalid

Source: (Asyhari & Silvia, 2016)

Table 2. Practicality Level Criteria

Achievement (%)	Qualification	Criteria
81 - 100	Very Good	Highly Practical
61 - 80	Good	Practical
41 - 60	Fairly Good	Fairly Practical
21 - 40	Not Very Good	Less Practical
0 - 20	Very Poor	Not Practical

Source: (Asyhari & Silvia, 2016)

Table 3. Effectiveness Level Criteria

N-gain Score	Qualification	Criteria
$g \geq 0,7$	High	Highly Effective
$0.3 \leq g < 0,7$	Moderate	Effective
$0 < g < 0.3$	Low	Fairly Effective
$g = 0$	Stable	Less Effective
$g < 0$	Very Low	Not Effective

Source: (Adna et al., 2024)

RESULTS AND DISCUSSION

This section presents the research findings and discussion derived from the process of developing and testing a Realistic Mathematics Education (RME)-based learning module designed to improve the numeracy literacy of primary school students. The research findings include the validity of the module, the validity of the content, the practicality of the module, and the effectiveness of the module, which was analyzed using N-gain scores. The development phase resulted in an RME-based learning module designed to improve the numeracy literacy of primary school students. The module was structured by

integrating RME syntax and numeracy literacy indicators into each learning activity. The layout of the developed module is shown in Figure 1.

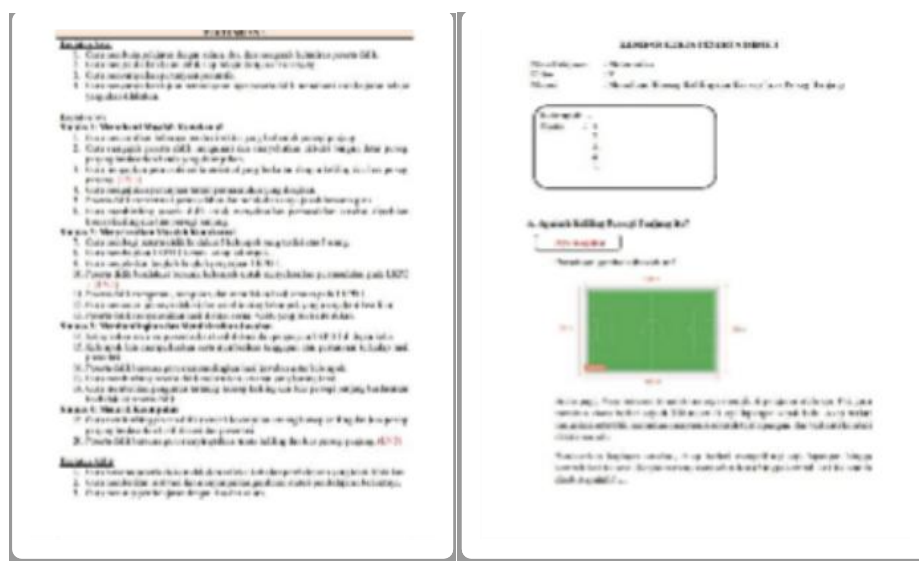


Figure 1. RME Module Display

Figure 1 shows an example of a learning activity in the module that uses real-life contexts as a starting point for learning mathematics. The activity begins with the presentation of a contextual problem closely related to students' experiences, such as measuring the perimeter and area of a field, followed by activities involving identifying information, analyzing data, solving problems, and drawing conclusions in accordance with the RME stages (Pangestu & Ruqoyyah, 2023). Through this series of activities, students not only learn mathematical concepts but are also trained to use numbers, symbols, and numerical information to understand, analyze, and solve problems in real-world contexts.

After the module was developed, it was validated by module experts and subject matter experts to assess the suitability of the resulting product. The results of the module validation assessment are presented in Table 4.

Table 4. Module Validation Results

Aspect	Percentage	Criteria
Self Instructional	92%	Highly Valid
Self Contained	85%	Highly Valid
Stand Alone	81%	Highly Valid
Adaptive	95%	Highly Valid
User Friendly	95%	Highly Valid
Average	90%	Highly Valid

As shown in Table 4, the developed module achieved an average validity score of 90%, indicating that it was highly valid. The self-instructional and self-contained aspects indicate that the material has been comprehensively organized, making it easier for students to learn step by step. The stand-alone and adaptive aspects indicate that the modules can be used flexibly and can adapt to learning needs. On the other hand, the user-friendly aspect shows that the modules are easy for students to use, both in terms of appearance and presentation of the material.

The results indicate that the module meets the characteristics of good instructional material and is

therefore capable of effectively facilitating the learning process. The module was assessed as being aligned with learning needs and easy for students to use, making it suitable for implementation in learning activities (Badan Standar Nasional Pendidikan (BSNP), 2017). This is consistent with the findings (Romla & Wardana, 2024), which indicate that modules receiving high validation scores have met the necessary components and characteristics of a module, thereby making them suitable for use in the learning process.

In addition to module validation, content validation was also conducted to assess the quality of the module's content and its alignment with the learning approach used. The results of the content validation are presented in Table 5.

Table 5. Content Validation Results

Aspect	Percentage	Criteria
Content Appropriateness	88%	Highly Valid
Language Appropriateness	100%	Highly Valid
Presentation Appropriateness	94%	Highly Valid
RME Context	96%	Highly Valid
Average	95%	Highly Valid

As presented in Table 5, the content validation results indicate that the module achieved an average validity score of 95%, which falls into the highly valid category. In terms of language, the material demonstrated the use of communicative and easily understandable language. Meanwhile, in terms of presentation, the module was systematically organized to support a gradual understanding of concepts. As for the RME context aspect, the results indicate that the module's content is integrated with real-world contexts relevant to students' daily lives, thereby helping them understand concepts in a more meaningful way.

These results indicate that the content aligns with the learning objectives, is presented systematically, uses communicative language, and effectively integrates RME contexts. These conditions enable students to understand mathematical concepts more meaningfully and relate them to everyday situations (Anisah et al., 2023). According to Barus, Iksan, Dewi, & Mujib (2023), RME-based instructional materials can connect mathematical concepts to real-world contexts, thereby making learning more meaningful for students.

After the module was deemed valid, the next step was to implement it with students to test its practicality through a student response questionnaire, which assessed ease of use and the feasibility of the learning process. The results of the practicality test are presented in Table 6.

Table 6. Practicality Results from the Response Questionnaire

Aspect	Percentage	Criteria
Module Quality	83%	Highly Practical
Ease of Use	87%	Highly Practical
Teaching Implementation	85%	Highly Practical
Average	85%	Highly Practical

As shown in Table 6, students rated the module as highly practical, with an average practicality score of 85%. The module quality aspect indicates that students rated the module's content and presentation as good, while the ease-of-use aspect received high scores, indicating that the module is easy to understand. Additionally, the learning process implementation aspect shows that the module effectively supports the learning process. This demonstrates that the module is not only theoretically sound but also practical for use in learning activities.

The results indicate that the module is easy for students to use, in terms of module quality, ease of use, and the implementation of the learning process. This practicality is supported by the systematic presentation of material, clear instructions, and learning activities that are easy for students to follow. These findings indicate that the module can be used effectively to support the learning process in the classroom (Romla & Wardana, 2024). These findings are consistent with previous research stating that practical teaching materials can facilitate student learning and support optimal learning implementation (Amanda & Hothimah, 2022). To determine the extent of improvement in students' numeracy literacy skills following the implementation of the learning module, an N-gain analysis was conducted. The results of the N-gain calculations are presented in Table 7.

Table 7. N-Gain Calculation Results

Variable	Pre-test Mean	Post-test Mean	N-gain	Criteria
Numeracy Literacy	62.84	81.88	0.63	effective

As shown in Table 7, the mean pretest score increased from 62.84 to 81.88 after the implementation of the module, resulting in an N-gain score of 0.63, which falls within the effective category. This improvement can be attributed to the characteristics of the developed module, which consistently begins learning with contextual problems familiar to students. Such contextual learning encourages students to identify relevant numerical information, formulate mathematical representations, evaluate alternative solutions, and interpret results before concluding. These learning experiences are consistent with Gravemeijer's theory of Realistic Mathematics Education (RME), which emphasises guided reinvention through meaningful real-life contexts. Consequently, students not only constructed mathematical understanding but also strengthened their numeracy literacy through authentic problem-solving experiences.

These findings are consistent with previous studies reporting that RME-based learning supports contextual mathematics learning and improves students' numeracy literacy and problem-solving abilities (Barus et al., 2023; Landong et al., 2025). However, unlike previous studies, the developed module systematically integrates numeracy literacy indicators into every stage of the RME learning syntax. This integration enables students to progressively identify, analyse, interpret, and apply mathematical information in authentic situations, representing the main contribution of this study. Therefore, the developed module not only serves as a mathematics teaching resource but also functions as an instructional tool for strengthening primary school students' numeracy literacy. In addition, the module has the potential to support the implementation of the Indonesian National Assessment, which identifies numeracy literacy as one of the essential competencies that students are expected to master.

CONCLUSION

This study successfully developed a valid, practical, and effective RME-based learning module for improving primary school students' numeracy literacy. The novelty of this study lies in systematically integrating numeracy literacy indicators into every stage of the RME learning process, allowing students to construct mathematical concepts while applying them to authentic situations. The findings contribute to mathematics education by providing an instructional model that supports both conceptual understanding and numeracy literacy development. Practically, the module can be used by primary school teachers as an alternative learning resource to support numeracy-oriented instruction. Nevertheless, this study was limited to one school and a relatively small sample using a pre-experimental design. Future studies are recommended to involve larger samples, different mathematical topics, and experimental designs to examine the effectiveness of the module more comprehensively.

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