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Development of a Supplementary Geometry Book Integrating Realistic Mathematics Education and Reog Ponorogo Ethnomathematics to Improve Elementary Students' Numeracy Literacy

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Abstract

This study presents the development of a supplementary geometry book for elementary students by integrating Reog Ponorogo ethnomathematics into the Realistic Mathematics Education (RME) approach to enhance numeracy literacy. The research employed a Research and Development (R&D) methodology using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Validation instruments involved expert evaluations in content, pedagogy, media, and language, alongside practicality questionnaires and numeracy literacy assessments. The developed book achieved high validity across expert domains: 89.8% (content), 91% (media), 94% (learning), and 90% (language). Student response also indicated high practicality (82.3%). A one-sample t-test and N-gain analysis showed a significant improvement in numeracy literacy, with an N-gain score of 0.6461 (categorized as moderate), reflecting a "quite effective" level. These findings suggest that incorporating ethnomathematical elements from local culture within an RME framework can provide meaningful, contextual learning experiences and foster mathematical understanding in early-grade students.

Keywords: *supplementary books, realistic mathematics education, ethnomathematics, numeracy literacy.*

Abstrak

Penelitian ini menyajikan pengembangan buku suplemen geometri untuk siswa sekolah dasar dengan mengintegrasikan etnomatematika Reog Ponorogo ke dalam pendekatan Pendidikan Matematika Realistik (RME) untuk meningkatkan literasi numerasi. Penelitian ini menggunakan metodologi Penelitian dan Pengembangan (R&D) dengan menggunakan model ADDIE (Analisis, Desain, Pengembangan, Implementasi, Evaluasi). Instrumen validasi melibatkan evaluasi ahli dalam konten, pedagogi, media, dan bahasa, di samping kuesioner praktikalitas dan penilaian literasi numerasi. Buku yang dikembangkan mencapai validitas tinggi di seluruh domain ahli: 89,8% (konten), 91% (media), 94% (pembelajaran), dan 90% (bahasa). Respon siswa juga menunjukkan kepraktisan tinggi (82,3%). Uji-t satu sampel dan analisis N-gain menunjukkan peningkatan yang signifikan dalam literasi numerasi, dengan skor N-gain sebesar 0,6461 (dikategorikan sebagai sedang), yang mencerminkan tingkat "cukup efektif". Temuan ini menunjukkan bahwa menggabungkan unsur-unsur etnomatematika dari budaya lokal dalam kerangka RME dapat memberikan pengalaman belajar yang bermakna dan kontekstual serta menumbuhkan pemahaman matematika pada siswa kelas awal.

Kata kunci: *buku suplemen, realistic mathematics education, etnomatematika, literasi numerasi.*

INTRODUCTION

Numeracy literacy is a fundamental aspect of the National Literacy Movement, encompassing not only the ability to use numbers and symbols but also the skills needed to interpret, analyze, and communicate quantitative information in various formats such as graphs, tables, and charts for everyday decision-making (Atmazaki et al., 2017). Proficiency in numeracy goes beyond routine calculation; it reflects students' capacity to understand and apply mathematical concepts in authentic, real-life contexts (Han et al., 2017).

Despite its importance, the level of numeracy literacy among Indonesian students remains alarmingly low. Damanik and Handayani (2023) report that Indonesian students scored an average of 376 in mathematics on the 2018 Programme for International Student Assessment (PISA), placing the country 73rd out of 79 and well below the international average of 489 (Hewi & Shaleh, 2020). In line with these findings, the OECD (2019) noted that approximately 72% of Indonesian students had not reached minimum proficiency in mathematics. This problem is compounded by several factors, including limited access to contextualized mathematics tasks, a shortage of high-quality instructional materials that support numeracy development, and conventional teaching practices that often fail to engage learners (Indrastuti et al., 2024; Putrawangsa & Hasanah, 2022).

The scarcity of appropriate learning resources further hinders progress. According to the Ministry of Education and Culture, only 10 of the 644 titles in the national digital repository qualify as children's books containing elements of numeracy literacy. Moreover, the 2022 Minimum Competency Assessment (AKM) shows that the national average for numeracy was only 1.57 on a 1–3 scale. Although East Java slightly exceeded this figure with an average of 1.63, and Ponorogo Regency performed marginally better at 1.69, these scores still indicate a widespread need for more effective and contextually relevant numeracy instruction at the primary level.

One promising approach to address this need is Realistic Mathematics Education (RME), which encourages students to engage in problem-solving through meaningful, context-based scenarios. By situating mathematics within familiar situations, RME enables students to develop conceptual understanding through active participation (Palinussa et al., 2024; Sri Sutarni et al., 2024). Research has shown that this approach enhances student participation and fosters more positive attitudes toward mathematics (Duong Huu et al., 2021). According to Ahmad Fauzan et al. (2024), RME not only improves academic achievement but also strengthens literacy and numeracy, particularly at the elementary level. Its adaptable nature makes it suitable for teachers with varying levels of experience and across different school settings, as it supports students in constructing mathematical knowledge from everyday life contexts (Palinussa et al., 2024).

In parallel, ethnomathematics has emerged as a culturally responsive approach to mathematics instruction. It situates mathematical learning within meaningful local cultural contexts, thereby enhancing student engagement and conceptual understanding (Prahmana et al., 2021; Hortelano & Lapinid, 2024). Research shows that cultural artifacts such as traditional games, music, and crafts—many of which are rich in mathematical content—can be integrated effectively into mathematics instruction (Kusuma et al., 2024; Lidinillah et al., 2022).

Ethnomathematics has been found to improve understanding in topics such as linear equations and geometry (Manapa, 2021; N. Sari et al., 2023) and to foster both numeracy literacy and student motivation when used in instructional materials such as worksheets (Kamal Arief SA et al., 2024). Thus, this approach not only contextualizes learning but also contributes to cultural preservation and the reinforcement of students' local identities.

Numerous studies have highlighted the benefits of RME-based materials in fostering creativity (Rismaratri & Nuryadi, 2018; Rudyanto et al., 2019; Sitorus, 2016), , improving problem-solving skills (Ventistas et al., 2024; Yuanita et al., 2018), , and promote mathematical literacy (Çakıroğlu et al., 2024; Nurmasari et al., 2023; Sumirattana et al., 2017). RME serves as a bridge between abstract mathematical ideas and the students' real-life experiences (Sevinc & Lesh, 2022; Vos, 2018). Similarly, integrating ethnomathematical perspectives in elementary school curricula has been shown to increase both academic performance and learning motivation (Alim et al., 2021; Putri et al., 2019; W. R. Sari & Mutmainah, 2018a).

Nevertheless, empirical studies that intentionally integrate RME with ethnomathematics—especially in early primary education—remain limited. Most existing implementations of RME are focused on secondary education, and few have evaluated their impact on numeracy literacy using standardized instruments. Furthermore, region-specific cultural elements such as *Reog Ponorogo*, which contain rich mathematical representations, are still largely absent from instructional design despite their educational potential.

To fill this gap, the present study aims to design and evaluate a supplementary geometry book for Phase A students (Grades 1–2), combining RME principles with ethnomathematical content derived from *Reog Ponorogo*. The goal is to create a culturally grounded, pedagogically sound learning resource that can enhance numeracy literacy while also supporting cultural appreciation. The study adopts a research and development approach to assess the material's validity, practicality, and effectiveness in classroom settings.

METHODS

This study adopted a Research and Development (R&D) design to produce a culturally contextualized mathematics supplementary book grounded in the principles of Realistic Mathematics Education (RME). The development process was guided by the ADDIE model—Analysis, Design, Development, Implementation, and Evaluation—which offers a structured and iterative framework that supports continuous refinement based on feedback throughout each phase (Reiser and Mollenda cited in Rangkuti, 2016).

A combination of qualitative and quantitative instruments was used to evaluate the validity, usability, and effectiveness of the learning material. Validation involved structured expert reviews in four key areas: subject matter, pedagogical suitability, media presentation, and language use. Practicality was examined through student questionnaires, designed to assess the ease of use, clarity, and engagement of the material from the learner's perspective. To evaluate the impact of the product on learning outcomes, students completed pretests and posttests tailored to core indicators of numeracy literacy. Each tool was carefully designed to assess essential dimensions of educational quality, such as the relevance and accuracy of content, clarity of visual layout, alignment with student developmental stages, and the appropriateness of language and instructions. The criteria used in the expert validation are presented in Table 1.

Table 1. Product Rating Indicators by Experts

Member Ratings	**Aspects**
Material	Content eligibility
	Quality of learning
	Presentation/display quality
	Quality of interaction
Design/Media	Readability
	Serving
	Graphic
Learning	Characteristics of *Realistic Mathematics Education*
	Principles of *Realistic Mathematics Education*
Language	Harassment
	Communicative
	Dialogical and Interactive
	Suitability with the level of development of students
	Collapse and integration of the mindset
	Utilization of terminology, symbols, or icons.

The practicality questionnaire is designed to measure the ease of use and acceptance of the supplement book. The practicality of the product utilized is reflected in Table 2.

Table 2. Practicality Response Indicators

No.	**Practicality Response Indicators**
1.	Learning
2.	Language
3.	Serving
4.	Visual Communication

Meanwhile, the numeracy literacy test instrument was compiled based on the numeracy literacy indicators from Han et al. (2017), As presented in Table 3.

Table 3. Numeracy Literacy Indicators

No.	Numeracy Literacy Indicators
1.	Utilized a diverse range of numerical values and mathematical symbols to address everyday problem-solving
2.	Capable of interpreting data presented in multiple formats (such as graphs, tables, charts, diagrams, etc)
3.	Evaluated the findings from the analysis to inform decision-making

The data obtained from the product validation process was analyzed using content analysis to review suggestions and comments from validators, as well as percentage descriptive analysis to determine the level of product validity based on the criteria from Arikunto (2018) . This can be seen in Table 4.

Table 4. Validity Criteria for Supplement Book Products

Percentage (%)	Product Eligibility Criteria
< 21%	Very invalid
21% - 40%	Invalid
41% - 60%	Quite valid
61% - 80%	Valid
81% - 100%	Highly Valid

Data from the student practicality questionnaire were also analyzed in a descriptive percentage manner and classified according to the categories in Table 5.

Table 5. Product Practicality Percentage Category

Score Interval	Category
80,01% - 100%	Very Practical
70,01% - 80%	Quite Practical
50,01% - 70%	Less practical
1% - 50%	Impractical

To evaluate the outcomes of the pretest and post-test in numeracy literacy, a one-sample t-test was conducted to identify any significant differences. Additionally, to assess the effectiveness of the product, the N-Gain value was calculated using Hake's formula (1998), and the results were interpreted based on the criteria outlined in Tables 6 and 7.

Table 6. N-Gain Score Criteria

Score N-Gain	Criteria
$\langle g \rangle < 0.30$	Low
$0.30 \leq \langle g \rangle < 0.70$	Medium
$0.70 \leq \langle g \rangle$	High

Table 7. Percentage N-Gain Criteria

N-Gain Percentage	Criteria
‹g› < 40%	Ineffective
40% ≤ ‹g› < 55%	less effective
55% ≤ ‹g› < 75%	Quite effective
75% ≤ ‹g›	effective

All stages of product development and testing are carried out sequentially and repeatedly to ensure that the resulting supplement books meet the measure of validity, usability, and efficiency of numeracy literacy learning. So that the resulting products can effectively contribute to the improvement of numeracy literacy of grade 2 elementary school students, especially through a mathematics learning approach that is contextual, interesting, and in accordance with the characteristics of children.

RESULTS AND DISCUSSION

The ultimate objective of this study is to create a supplementary book on geometry utilizing *the Realistic Mathematics Education* approach, based on ethnomathematics reyog Ponorogo, which contains elements of numeracy literacy. The results will be explained as follows:

ANALYSIS

The analysis phase in this study involved three key components. First, a curriculum analysis was conducted to identify the targeted learning outcomes for flat geometry materials in Phase A (Grades 1 and 2). These outcomes include recognizing flat shapes, composing flat shapes (composition), and decomposing them (decomposition). Second, a student characteristic analysis was carried out to ensure that the developed materials align with the cognitive development of early-grade learners. Students in Phase A are generally at the concrete operational stage, in which learning is most effective when supported by physical objects or visual representations. Consequently, the instructional design emphasized hands-on and visual learning approaches. Third, an availability analysis of existing learning resources was conducted to examine the accessibility of mathematics-related literacy materials. This involved reviewing content from several official repositories. From the Ministry of Education and Culture's website (https://repositori.kemdikbud.go.id), only 10 children's books were identified as containing numeracy literacy elements. Additional searches through the Bintang Pusnas and I-Pusnas digital platforms—both connected to the National Library of Indonesia—revealed just 11 book titles relevant to numeracy literacy.

This scarcity of instructional materials was further substantiated by interviews with teachers at SD Tarbiyatul Islam. The teachers reported that existing mathematics textbooks do not adequately support independent learning or foster numeracy literacy skills. Consequently, they often must design their own instructional materials using suitable pedagogical approaches. These findings indicate an urgent need for the development of a culturally relevant supplementary book to support the enhancement of students' numeracy and literacy competencies.

DESIGN

The design phase involved multiple stages aligned with the objectives of the ADDIE model. First, the structural design of the supplementary book was developed, including its core components and instructional flow. Second, the content development focused on the targeted flat geometry topics: recognizing, composing, and decomposing flat shapes, with contextual integration of Reog Ponorogo ethnomathematics. Third, the layout and visual design of the book were created to ensure accessibility and engagement for early-grade learners.

Additionally, this phase involved the design of evaluation instruments used during product validation. These included expert assessment rubrics covering material, media, instructional strategies, and language; student response questionnaires to evaluate practicality; and pretest–posttest instruments aligned with numeracy literacy indicators. As Arif et al. (2022) assert, following a thorough analysis, the design phase is intended to produce a usable prototype that can be iteratively refined based on empirical feedback.

DEVELOPMENT

At the product development stage, it is performed across two stages, namely the development of supplement books, assessment, and revision of the developed products. While the description at the development stage is explained as follows:

Product Development

Book cover, book identity, Foreword, and Table of Contents

The cover of the supplement book consists of two pages, namely the front and back pages, the identity of the book which is a description of the supplement book, and the preface contains the author's gratitude and gratitude to the party who has helped complete the book and a brief overview of the contents of the book. While the table of contents contains the initial part of the book's identity, it also includes discussions in the supplement book and a bibliography. The design of the display can be presented in the following image:

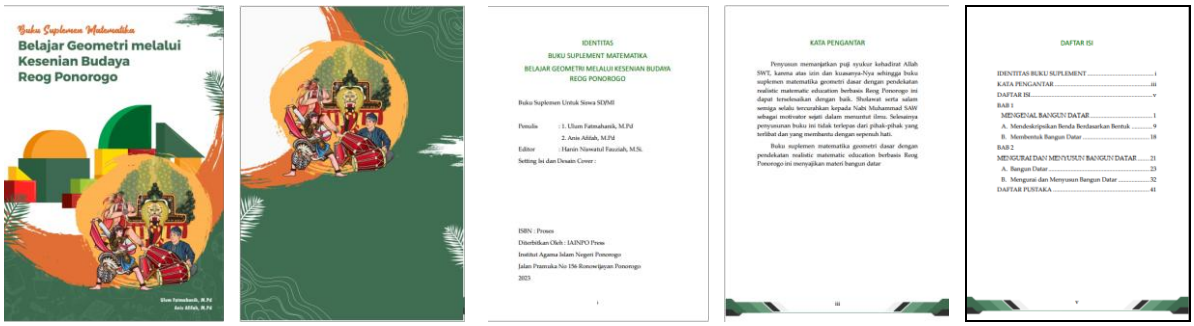

Figure 1 Cover design, book identity, foreword, table of contents

Core sections and bibliography

The core content of the supplementary book is organized into two chapters, each aligned with the learning outcomes for mathematics in Phase A (Grades 1 and 2). The first chapter, titled *Recognizing Flat Shapes*, comprises two sub-sections: *Describing Objects Based on Shape* and *Forming Flat Shapes*. In the first sub-section, students are introduced to four categories of two-dimensional shapes—curved, triangular, rectangular, and polygonal—through culturally relevant visualizations derived from Reog Ponorogo performance elements,

including dancers' attire and traditional musical instruments. This ethnomathematical context serves to ground abstract geometric concepts in familiar, meaningful representations. The second sub-section focuses on the composition of flat shapes, illustrating how larger figures can be constructed from the combination of simpler geometric forms. These instructional materials also draw upon imagery and motifs from Reog Ponorogo to reinforce visual-spatial reasoning. The second chapter, *Decomposing and Reconstructing Flat Shapes*, includes two sub-sections: *Unraveling* and *Arranging Flat Shapes*. This chapter guides students in analyzing composite figures by breaking them into constituent parts and reconstructing them, thereby supporting early development of spatial decomposition and composition skills. The visual and contextual design of these sections is illustrated in Figure 2.

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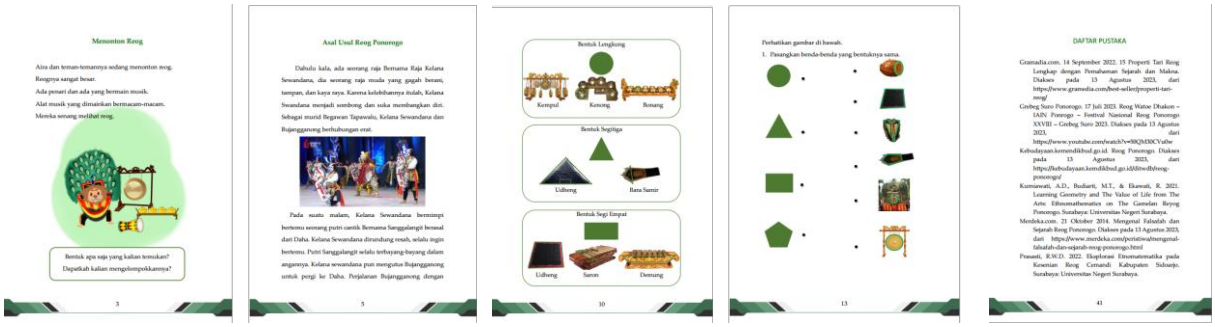
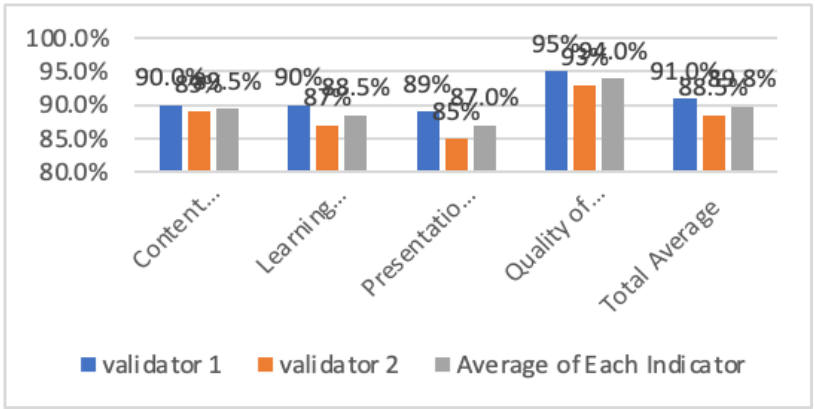


Figure 2. Example of content design and supplementary book library list

Member Ratings

Feasibility is assessed by conducting product evaluations with experts, including material experts, media, learning, and linguists. The total number of evaluators comprises eight validators, categorized by each type of validation. There are two validators specifically designated for subject matter expert validation, which aims to determine feasibility regarding the material of the product being developed. The results of the validation from the subject matter experts are presented as follows:

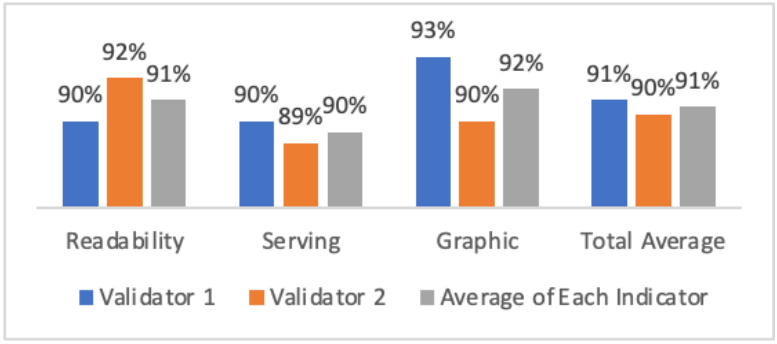


Graph 1. Material Expert Validation Results

Based on Graph 1, the average validation score provided by content experts for the developed supplementary book was 89.8%, which falls within the "highly valid" category. Specifically, the content feasibility aspect scored an average of 89.5%, learning quality 88.5%, presentation quality 87%, and interaction quality 94%. These results indicate that the material is well-aligned with intended learning objectives and appropriately addresses

students' cognitive and developmental needs. According to Nerita et al (2018), instructional materials are considered valid when they align with the curriculum, support learning outcomes, and present accurate subject matter content. Similarly, Yulia (2021a) emphasized that valid teaching materials not only match the content being taught but also foster student engagement, curiosity, and motivation to learn. Despite the strong overall validation, expert reviewers noted that the supplementary book would benefit from clearer instructional guidance in each section and more realistic formulations of competency test items, which should be aligned with, but not attempt to cover, all indicators of numeracy literacy.

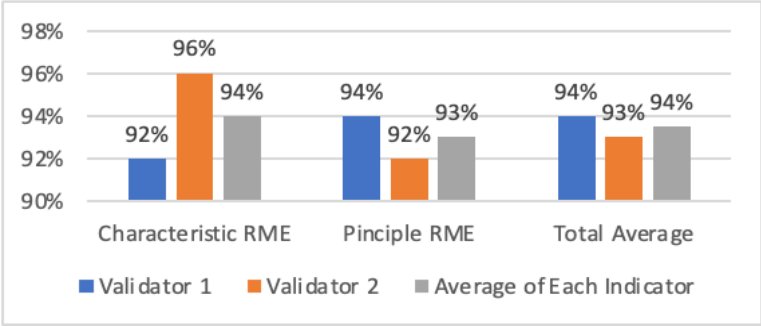
Furthermore, the validation of media experts is conducted to determine the feasibility of the media within the developed supplement book. The results of the validation of media experts are illustrated in the following graph.



Graph 2. Media Expert Validation Results

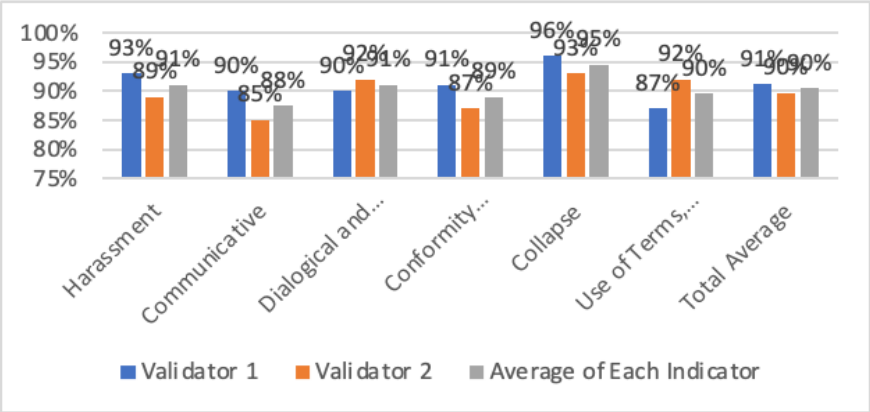
Based on Graph 2, the average percentage of validation of media experts in the development of supplement books is 91%, with very valid criteria. Media expert validation consists of three aspects, with a percentage of each aspect, namely the readability aspect of 91%, the presentation aspect of 90%, and the graphic aspect of 92%. This result is by Prastowo's statement, (Fatianti et al., 2024) which states that in teaching material, the use of images and graphics can motivate students in learning. In addition to the notes, suggestions, and criticisms given are that it is necessary to complete the image presented with the help of lines to emphasize the shape of the flat building in question and include the source of the image if it is not your creation.

Validation of learning experts aims to obtain feasibility in the use of learning approaches from the developed supplement books. The aspects that will be measured in this validation are the characteristics and principles of the Realistic Mathematics Education learning approach. The results of the validation of learning experts are presented in the following Graph 3.



Graph 3. Learning Expert Validation Results

Based on Graph 3, the average percentage of validation of learning experts overall in the development of supplement books is 94%, with very valid criteria. The average percentage of validation of learning experts in the characteristic aspects of *Realistic Mathematics Education* is 94%, and the average in the aspect of *Realistic Mathematics Education* principles is 93%. While suggestions for improvement in product development include the use of *Real Context* at the beginning of each learning session in the supplement book, each problem does not accommodate all aspects of Realistic Mathematics Education. As for linguistic validation, the aim is to obtain the feasibility of using language structure in the developed supplement book. The aspects that will be measured in this validation are straightforwardness, communicative, dialogical, suitability with the level of development of students, collapse, and use of thought flows, use of terms or icons. The results of linguistic validation are presented in Graph 4.



Graph 4. Linguistic Validation Results

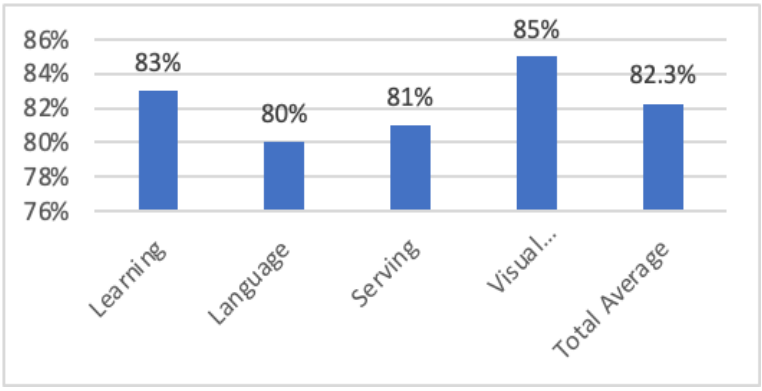
Based on Graph 4, the average percentage of overall linguistic validation in the development of supplement books is 90%, with very valid criteria. The average percentage in the aspect of straightness is 91%, communication aspect 88%, dialogical and interactive aspect is 91%, the average percentage in the aspect of conformity with the level of development of students is 89%, while in the aspect of collapse and the use of the flow of thought is 95% and the percentage in the aspect of the use of terms or icons is 90%. These results show the validity of the teaching materials because they contain a clear, easy-to-read, and understandable language structure. This is following Yulia's (2021) statement that valid teaching materials are those that contain clarity in conveying and using language with the correct rules. Suggestions for improvement in linguist validation include the need to change the origin story of the Ponorogo reog into a narrative story with simple language, and there is an inconsistency in the use of standard language.

IMPLEMENTATION

After going through the stages of product development, validation, and revision, the students' response to the developed product and its effectiveness in improving numeracy literacy skills will be measured. Hafiz (Fatianti et al., 2024) stated that in research, product development must be able to be used in learning and be considered good by observers. Therefore, the product is worth testing if the validator has stated that the product is valid.

Practical Response

The researcher tested the students' response to the supplement book developed by providing a questionnaire of practical responses to 2nd-grade students of SD Tarbiyatul Islam Kertosari Babadan Ponorogo, totaling 22 students. The results of the response to the supplement book are as follows**:**



Graph 5. Results of Students' Practical Response to Supplement Books

Based on graph 5 above shows that the average percentage of students' practical responses to the learning aspect is 83%, the language aspect is 80%, the presentation aspect is 81%, and the visual communication aspect is 85%. Meanwhile, the overall average percentage in the development of supplementary books with the Realistic Mathematics Education approach based on Reog Ponorogo ethnomathematics is 82.3%, with very practical criteria. This outcome is in line with the results of a study (Mustofa & Cintamulya, 2017) which states that the teaching materials developed with very practical means that it very easy to use in learning.

Effectiveness of Supplement Books

Data on students' numeracy literacy ability in flat building materials was obtained through the pretest and posttest given to students. The pretest and posttest questions were prepared as many as 3 questions that have been adjusted to the numeracy literacy indicators. The difference between pretest and posttest results will be analyzed using a one-sample t-test. Pretest and posttest scores are presented in Table 8.

Table 8. Numeracy Literacy Test Results

Before (pretest)					**After (Postest)**				
N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
22	50	70	62.0	6.12567	22	75	95	86,36	5.82520

Table 8 shows students' numeracy literacy skills before and after using supplementary books. The average numeracy literacy ability before using supplement books is 62, while the average numeracy literacy ability after using supplement books is 86.36. Furthermore, to test whether there is an average difference between before and after using the supplement book, the normality test of the difference between pretests and posttests is first carried out. The results are as follows.

Table 9. Normality Test Result Gain Score

		Df	Sig	Taraf Sig	Keputusan Uji
Gain score Numeracy	Literacy	22	0.216	0.05	Normal

Based on the results of the normality test, the data were found to be normally distributed, as indicated by the significance value of 0.216, which exceeds the threshold of 0.05. Therefore, a homogeneity test for the difference between posttest and pretest scores was deemed unnecessary, given that both datasets were obtained from the same group of participants. Following the confirmation of normal distribution, a one-sample t-test was applied to assess if the mean scores differed significantly before and after the implementation of the supplementary book. The outcomes of this analysis are presented below.

Table 10. One Sample t Test Results

	t	df	Sig (two-sided)	Sig	Decision test
Gain score Literacy Numeracy	20.854	21	0.001	0.05	Ho Rejected

Based on Table 10, because 0.001 < 0.05, Ho was rejected, indicating a significant difference in numeracy literacy skills before and after the use of supplementary books. Furthermore, an N-gain test was conducted to assess the effectiveness of the supplement books on numeracy literacy skills. The outcome N-gain score test is as follows.

Table 11. N-Gain Test Results

	N	Mean	Category
N-Gain Score	22	0.6461	Medium
N-Gain Persen	22	64.61	Quite Effective

Table 11 shows that the average n-gain score of numeracy literacy is 0.6461, which states that the increase in numeracy literacy ability is in the medium category. Furthermore, the average n-gain score percentage results showed 64.61%, which means that the supplement books developed for improving numeracy literacy are in the category of quite effective. These results show that supplementary books with the Realistic Mathematics Education approach based on Reog Ponorogo ethnomathematics can improve students' numeracy literacy. This means that the Realistic Mathematics Education approach is effective for the development of teaching materials because, in its development, it integrates the real-world context so that understanding in mathematics will be more meaningful if students can connect to daily life (Ariyani, 2019).

EVALUATION

The findings revealed a substantial improvement in students' numeracy literacy following the implementation of the developed supplementary book. The average score increased from 62 (pretest) to 86.36 (posttest), with a one-sample t-test yielding a statistically significant result (t = 20.854, p = 0.001). The mean N-gain score was 0.6461 (64.61%), placing the intervention in the "moderately effective" category. These results demonstrate the

effectiveness of integrating Realistic Mathematics Education (RME) with Reog Ponorogo ethnomathematics in enhancing mathematical understanding at the elementary level.

This study reinforces prior research that highlights RME's capacity to improve mathematical reasoning through real-world contextualization (van den Heuvel-Panhuizen & Drijvers, 2020; Fauzan, Slettenhaar, & Plomp, 2021) and responds to challenges identified by Ekawati et al. (2020) regarding Indonesian students' difficulties in spatial and geometric literacy. The cultural contextualization using ethnomathematics further amplifies learning impact, as shown in studies by Prahmana & D'Ambrosio (2020) and Son et al. (2020), who found that blending RME with local cultural contexts increases cognitive engagement and accessibility across diverse student groups.

In addition, the development of a supplementary book grounded in Realistic Mathematics Education (RME) and the ethnomathematical elements of Reog Ponorogo has proven to be highly valid and practical for classroom implementation at the elementary school level. The intervention has also demonstrated a notable effectiveness in enhancing students' numeracy literacy. These findings align with those reported by Fendrik et al. (2024), who emphasized that instructional models incorporating ethnomathematical contexts can significantly strengthen mathematical competencies. Similarly, studies conducted by Indrastuti et al. (2024) and Khatimah (N. Sari et al., 2023) affirmed the positive impact of RME-based student worksheets (LKPD) in advancing numeracy literacy through the integration of authentic, real-life contexts that resonate with students' everyday experiences. The current study also reinforces the conclusions drawn by Sari and Muthmainah (2018b), who asserted that embedding ethnomathematics into instructional settings not only cultivates student motivation but also deepens conceptual understanding in mathematics. Similarly, ethnomathematics-based learning fosters connections between students lived experiences and formal mathematical concepts (Rowlands and Carson, 2002).

Moreover, this work extends the findings of Nurmasari et al. (2023) on the adaptation of RME through Realistic Mathematics Engineering and affirms the conclusions Anwas et al. (2022), that underscore the pivotal role of material quality in literacy outcomes. By integrating Reog Ponorogo—a rich local cultural asset—into early-grade mathematics instruction, this study offers a scalable model for contextualizing national curriculum content, supporting both numeracy literacy goals and cultural preservation.

CONCLUSION

This study demonstrates that combining Realistic Mathematics Education with ethnomathematical elements from Reog Ponorogo offers an effective strategy for enhancing numeracy literacy in elementary education. The developed supplementary book met high standards of validity and practicality and significantly improved students' numeracy skills. These findings reinforce the value of contextual, culture-based learning in mathematics and support further integration of ethnomathematical perspectives into instructional design to foster meaningful, relevant, and engaging learning experiences.

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