

RME-BASED DOODLE ART COMICS TO STRENGTHEN ELEMENTARY STUDENTS' NUMERACY LITERACY

Rahmi Hayati^{1*}, Edi Syahputra², Edy Surya³, M. Rezeki Muamar⁴, Fazrina Saumi⁵

^{1*,4} Universitas Almuslim, Bireuen, Indonesia

^{2,3} Universitas Negeri Medan, Medan, Indonesia

⁵ Universitas Samudra, Aceh, Indonesia

*Corresponding author: hayatirahmi027@gmail.com

Received 06 February 2026; Received 14 May 2026; Accepted 23 June 2026

Abstract

Numeracy literacy is an essential competency that should be developed from the elementary school level to help students understand and apply mathematical concepts in daily life. However, elementary school students' numeracy literacy remains low, especially in understanding problems, connecting numerical information, and solving contextual mathematical tasks. This condition is caused by mathematics learning that is still abstract, procedural, and less connected to students' real-life experiences. Therefore, contextual and engaging learning media are needed to support numeracy learning. This study aims to develop a Doodle Art comic based on Realistic Mathematics Education (RME) to enhance elementary school students' numeracy literacy. The study employed a Research and Development (R&D) method using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The research instruments included validation sheets, teacher and student questionnaires, numeracy literacy tests, observations, and interviews. The results showed that the RME-based Doodle Art comic was categorized as highly feasible, with an average validation score of 4.41. Teacher responses obtained an average score of 4.54, categorized as very practical, while student responses obtained an average score of 4.50, categorized as very good. In addition, students' numeracy literacy scores increased from 61.10 in the pretest to 76.18 in the posttest. The study concludes that the RME-based Doodle Art comic has the potential to become an innovative and contextual learning medium for improving elementary school students' numeracy literacy.

Keywords: Doodle Art Comic; Elementary School; Literacy; Numeracy; RME

Abstrak

Literasi numerasi merupakan kompetensi esensial yang perlu dikembangkan sejak sekolah dasar agar siswa mampu memahami dan menggunakan konsep matematika dalam kehidupan sehari-hari. Namun, kemampuan literasi numerasi siswa sekolah dasar masih tergolong rendah, terutama dalam memahami masalah, menghubungkan informasi numerik, dan menyelesaikan persoalan matematika kontekstual. Kondisi tersebut disebabkan oleh pembelajaran matematika yang masih bersifat abstrak, prosedural, dan kurang mengaitkan konsep dengan pengalaman nyata siswa. Oleh karena itu, diperlukan media pembelajaran yang kontekstual, menarik, dan sesuai dengan karakteristik siswa sekolah dasar. Penelitian ini bertujuan untuk mengembangkan komik Doodle Art berbasis Realistic Mathematics Education (RME) sebagai media pembelajaran untuk mengembangkan literasi numerasi siswa sekolah dasar. Penelitian ini menggunakan metode Research and Development (R&D) dengan model ADDIE yang meliputi tahap analysis, design, development, implementation, dan evaluation. Subjek penelitian terdiri atas 28 siswa kelas IV sekolah dasar, satu guru kelas, serta dua validator ahli, yaitu ahli pendidikan matematika dan ahli media pembelajaran. Instrumen penelitian meliputi lembar validasi ahli, angket respon guru dan siswa, tes literasi numerasi, observasi, dan wawancara. Hasil penelitian menunjukkan bahwa komik Doodle Art berbasis RME memenuhi kriteria sangat layak dengan rata-rata skor validasi sebesar 4,41. Respon guru memperoleh skor rata-rata 4,54 dengan kategori sangat praktis, sedangkan respon siswa memperoleh skor rata-rata 4,50 dengan kategori sangat baik. Selain itu, hasil tes menunjukkan peningkatan rata-rata kemampuan literasi numerasi siswa dari 61,10 menjadi 76,18. Penelitian ini menyimpulkan bahwa komik Doodle Art berbasis RME berpotensi menjadi media pembelajaran inovatif dan kontekstual untuk mengembangkan literasi numerasi siswa sekolah dasar.

Kata kunci: Komik Doodle Art; Literasi; Numerasi; RME ; Sekolah Dasar



This is an open access article under the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

INTRODUCTION

Numeracy literacy is a fundamental competency that enables students to interpret, use, and communicate mathematical information in various real-life situations (Sastrawati et al., 2025; Asyari et al., 2024). In elementary education, numeracy literacy extends beyond the ability to perform calculations and encompasses skills such as interpreting quantitative information, solving contextual problems, making decisions based on numerical data, and communicating mathematical reasoning logically (Ndiung et al., 2019). Consequently, strengthening numeracy literacy has become one of the primary goals of mathematics education, as reflected in various national and international assessments. However, evidence from large-scale assessments indicates that Indonesian elementary school students continue to experience difficulties in solving contextual mathematical problems, interpreting numerical information, and applying mathematical concepts in everyday situations. These findings suggest the need for learning approaches and instructional media that can facilitate meaningful mathematical understanding and support the development of numeracy literacy.

One approach that has been widely recognized for addressing this issue is Realistic Mathematics Education (RME). RME emphasizes learning through authentic contexts, mathematization processes, model development, discussion, and reflection (Putri et al., 2025; Putri et al., 2025). Through these principles, students are encouraged to construct mathematical concepts progressively by connecting real-world situations with formal mathematical ideas (Suyono et al., 2023). Previous studies have reported

that RME contributes positively to students' conceptual understanding, problem-solving skills, and numeracy literacy (Yuliana et al., 2022). Nevertheless, the effectiveness of RME largely depends on the availability of instructional media that can represent contextual situations clearly and support students' mathematization processes. Therefore, the development of appropriate learning media remains an important issue in the implementation of RME at the elementary school level.

Several studies have attempted to address this need through the development of comic-based mathematics learning media. Hayati et al. (2024) developed mathematics comics based on the RME approach and reported positive effects on students' understanding of multiplication concepts. Hayati et al. (2025) developed mathematics comics incorporating local cultural contexts and problem-based learning to enhance student engagement. These studies demonstrate that comics have the potential to make mathematics learning more meaningful and engaging through visual narratives and contextual storylines (Agus & Wardhani, 2023). However, the visual representations employed in these studies primarily functioned as supporting illustrations and were not specifically designed to facilitate students' mathematical reasoning processes through simplified visual modeling.

In a different context, studies on doodle art have highlighted its potential as a visual medium that can enhance students' creativity, learning interest, and engagement. Sa'adah and Giyartini (2022) found that doodle art supports students' creative expression through simple and communicative visual forms. Despite these benefits, previous

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

doodle art studies have generally focused on creativity and aesthetic aspects rather than mathematics learning outcomes. More importantly, they have not examined the role of doodle art in supporting numeracy literacy or facilitating students' understanding of mathematical concepts through contextual problem solving (Hayati, 2026).

Research on digital mathematics learning media has also expanded considerably in recent years. Zuraini et al. (2024) reported that digital-based mathematics learning environments can improve students' learning experiences and engagement. Nevertheless, many digital learning media focus primarily on technological features and content presentation without systematically integrating key RME principles such as mathematization, model-of, and model-for processes (Wati et al., 2026). Consequently, students may benefit from attractive media presentations but still experience difficulties in transforming contextual situations into mathematical representations and formal reasoning.

Based on the synthesis of previous studies, three important gaps can be identified. First, mathematics comics have been developed to support contextual learning, yet they have not incorporated doodle art as a pedagogically meaningful visual representation. Second, doodle art has been explored as a creative learning medium, but its potential contribution to numeracy literacy development remains largely unexplored.

Third, previous instructional media have rarely integrated doodle art with the core principles of Realistic Mathematics Education, particularly mathematization, model-of, and model-for processes that support the transition

from contextual understanding to formal mathematical reasoning. As a result, there remains a lack of instructional media specifically designed to combine contextual learning, simplified visual representation, and numeracy literacy development within a single framework.

To address these gaps, this study develops a Doodle Art comic based on Realistic Mathematics Education (RME) for elementary school mathematics learning. The developed comic integrates authentic contexts, doodle art visual representations, and progressive mathematization processes to support students in understanding mathematical concepts more meaningfully. Unlike previous studies, the comic is specifically designed to function not only as an attractive learning medium but also as a pedagogical tool that facilitates model-of and model-for transitions in accordance with RME principles. Therefore, the novelty of this study lies in the integration of doodle art, comics, and Realistic Mathematics Education within a single instructional medium aimed at strengthening elementary school students' numeracy literacy. The objective of this study is to develop the RME-based Doodle Art comic and examine its validity, practicality, and potential effectiveness in improving students' numeracy literacy.

METHOD

1. Research Design and Development Stages

This study is a Research and Development (R&D) study aimed at producing a product in the form of doodle art comics based on Realistic Mathematics Education (RME) as contextual learning media to support elementary school students' numeracy literacy. The development model employed is ADDIE, which consists of five operational stages: analysis, design,

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

development, implementation, and evaluation.

The analysis stage was conducted to identify the needs of numeracy learning, student characteristics, curriculum alignment, and problems encountered in mathematics learning at the elementary school level. Operationally, this stage involved classroom observations, interviews with teachers, analysis of students' numeracy difficulties, and the review of teaching materials and learning media used in schools. In addition, an analysis of students' everyday life contexts was conducted to determine contextual situations relevant to the development of the comic content.

The design stage involved developing the comic storyline, creating doodle art sketches, designing learning activities, and mapping the principles of Realistic Mathematics Education (RME) into the comic content. The development stage involved product creation, expert validation, and product revision based on suggestions from mathematics education experts and learning media experts. Revisions were conducted iteratively until the developed product met the established validity criteria, including content feasibility, alignment with Realistic Mathematics Education (RME) principles, visual design quality, and readability. The product was considered valid when it achieved a minimum average validation score within the feasible category. Once the validity criteria were fulfilled, the revised product was deemed suitable for use in the implementation stage to examine its practicality and potential effectiveness in improving students' numeracy literacy.

The implementation stage was conducted through a limited field testing involving 28 fourth-grade

elementary school students. This stage aimed to evaluate the practicality and potential effectiveness of the developed RME-based doodle art comic before broader implementation. The limited field testing was designed to obtain initial empirical evidence regarding the usability of the media, students' responses, and its potential contribution to strengthening numeracy literacy. During this stage, the developed comic was used in numeracy learning activities to examine its practicality and potential effectiveness. Data were collected through classroom observations, teacher and student response questionnaires, interviews, and numeracy literacy tests administered before and after the implementation.

Meanwhile, the evaluation stage aimed to assess the overall quality, practicality, and usefulness of the product based on quantitative and qualitative findings obtained throughout the development and implementation process.

2. Research Subjects, Location, Time, and Materials

The subjects of this study were 28 fourth-grade students of UPTD SD 4 Bireuen, selected using purposive sampling. The selection was based on the consideration that fourth-grade students already possess adequate reading skills and begin to encounter contextual numeracy content. The study was conducted at a public elementary school in Bireuen Regency, Aceh. In addition to students, supporting research subjects included. The subjects consisted of 28 fourth-grade students, one classroom teacher, and two expert validators. The materials developed in the comics focused on numbers and contextual problem solving, aligned

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

with the elementary school curriculum and students' everyday life contexts.

3. Research Instruments and Data Collection Techniques

The research instruments included: (1) expert validation sheets to assess content feasibility, visual design, and alignment with RME principles; (2) teacher and student response questionnaires to measure the practicality and attractiveness of the media; (3) numeracy literacy tests to examine the potential impact of media use; and (4) observation sheets and interviews to obtain supporting qualitative data. Data were collected through expert validation, questionnaires administered after media use, pretests and posttests, and classroom observations during the learning process. Before the implementation stage, all research instruments were validated to ensure their appropriateness in measuring the intended constructs. The instruments consisted of expert validation sheets, teacher response questionnaires, student response questionnaires, and a numeracy literacy test developed based on the research indicators and the learning objectives to be achieved.

Content validity was established through expert judgment involving mathematics education experts and instructional media experts. The validation process focused on the relevance, clarity, representativeness, and appropriateness of each indicator in relation to the research objectives and the principles of Realistic Mathematics Education (RME). The experts evaluated each instrument item using a five-point rating scale ranging from 1 (very inappropriate) to 5 (very appropriate). The results of the expert assessments were then analyzed using Aiken's V

coefficient to determine the content validity of each instrument item.

In addition to content validity, instrument reliability was examined to determine the consistency of the instruments in measuring the same constructs. Reliability testing was conducted through a pilot study involving participants with characteristics similar to those of the research sample. Internal consistency was analyzed using Cronbach's Alpha coefficient. Further-more, interrater agreement was calculated to determine the consistency of the evaluations provided by the experts during the validation process.

Data Analysis Techniques

Data analysis in this study employed both quantitative and qualitative descriptive techniques. Quantitative data were obtained from expert validation sheets, teacher and student response questionnaires, and numeracy literacy tests, while qualitative data were obtained from observations and interviews. The feasibility and practicality of the developed media were analyzed by calculating the mean score using the following formula:

$$\text{Mean Score} = \frac{\sum X}{N} \quad (1)$$

where Mean Score is the average score, $\sum X$ is the total score obtained, and N is the number of assessment indicators. The resulting mean scores were interpreted using the feasibility and practicality criteria presented in Table 1.

Table 1. Criteria for Feasibility and Practicality

Mean Score	Category
4.21–5.00	Very Feasible / Very Practical
3.41–4.20	Feasible / Practical
2.61–3.40	Fair
1.81–2.60	Less Feasible
1.00–1.80	Not Feasible

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

To examine the effectiveness of the RME-based Doodle Art comic in improving students' numeracy literacy, pretest and posttest scores were analyzed using the normalized gain (N-Gain) formula. The N-Gain values were then interpreted according to the criteria presented in Table 2.

Table 2. N-Gain Interpretation Criteria

Criteria	Category
$N - \text{Gain} \geq 0,70$	High
$0,30 \leq N - \text{Gain} < 0,70$	Moderate
$N - \text{Gain} < 0,30$	Low

Prior to inferential statistical analysis, the normality of the pretest and posttest data was examined using the Shapiro–Wilk test. If the data were normally distributed ($p > 0.05$), a Paired Sample t-test was conducted to determine whether there was a statistically significant difference between students' pretest and posttest scores. Conversely, if the data were not normally distributed ($p \leq 0.05$), the Wilcoxon Signed Rank Test was employed as a non-parametric alternative.

Furthermore, effect size analysis was conducted to determine the magnitude of the treatment effect. Cohen's d was calculated when the Paired Sample t-test was used, whereas the effect size r was calculated when the Wilcoxon Signed Rank Test was applied. The effect size values were interpreted according to conventional criteria: small (0.20), medium (0.50), and large (0.80). Qualitative data obtained from observations and interviews were analyzed descriptively through data reduction, data display, and conclusion drawing to support and enrich the quantitative findings.

RESULTS AND DISCUSSION

1. Design Stage

At the design stage, doodle art comics were systematically developed

with a strong emphasis on the integration of storyline, visuals, and the principles of Realistic Mathematics Education (RME). The comic storyline was constructed based on contextual situations closely related to elementary school students' everyday lives, serving as a starting point for the mathematization process (Sastrawati et al., 2025). The doodle art sketches were designed to be simple, communicative, and functional, enabling students to visualize numeracy problems without imposing excessive cognitive load. Furthermore, RME principles were explicitly mapped into the comic content, including the use of real-life contexts, the development of visual models, facilitation of discussion, and mathematical reflection. This mapping ensured that each component of the comic was not merely narrative or illustrative but also supported the gradual and meaningful development of students' conceptual understanding of numeracy.

2. The Development Stage Involved Product Creation and Expert Validation

The development stage focused on producing the RME-based doodle art comic and evaluating its feasibility through expert validation. At this stage, the comic was developed based on the design that had been prepared previously, including the integration of contextual storylines, doodle art illustrations, and the principles of Realistic Mathematics Education (RME). The developed product consisted of contextual numeracy materials presented through simple visual narratives that were adjusted to elementary school students' characteristics. An overview of the developed comic product can be seen in Figure 1.



Figure 1. Comic Product

Media Feasibility Based on Expert Validation

The results of expert validation indicate that the RME-based doodle art comics are categorized as feasible to highly feasible for use in numeracy learning. Mathematics education experts assessed that the content aligns with the learning outcomes and supports the development of numeracy literacy through meaningful contexts. Furthermore, the structure of problem presentation was considered consistent with the characteristics of Realistic Mathematics Education, particularly in encouraging students to construct conceptual understanding progressively. Learning media experts noted that the use of simple doodle art effectively clarifies visual information without imposing excessive cognitive load. These findings

confirm that the integration of doodle art and RME has strong pedagogical validity. Conceptually, these results reinforce previous findings on the role of visual representations in contextual mathematics learning (Gravemeijer et al., 2013).

Based on Table 3, the results of expert validation indicate that the doodle art comics based on Realistic Mathematics Education demonstrate a high level of feasibility, with an overall average score of 4.41 or 88.20%, which falls into the highly feasible category. In terms of content feasibility, the validators assessed that the numeracy content aligns with the learning outcomes and is presented through contexts that are meaningful for elementary school students. The aspect of alignment with RME also received high scores,

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

particularly on indicators related to the use of real-life contexts and support for progressive mathematization, indicating that the media were designed in accordance with the fundamental principles of RME.

Meanwhile, in terms of media feasibility, the doodle art illustrations were considered effective in clarifying visual information and helping students understand numeracy problems without imposing excessive cognitive load. This finding suggests that visual simplicity functions as a reinforcement of conceptual understanding. Overall, the validation results indicate that the integration of doodle art and RME possesses strong pedagogical validity.

Practicality and User Responses
The practicality of the media is demonstrated through positive responses from both teachers and students regarding the

use of the comics in learning activities. Teachers reported that the comics are easy to implement, relevant to the learning context, and helpful in explaining numeracy concepts in a more concrete manner. Students showed high interest in the doodle art illustrations and the presented storylines, which led to increased engagement in discussions and problem-solving activities. Observation results indicate that students were more active in expressing ideas and problem-solving strategies compared to conventional instruction. These findings suggest that the developed media are practical and functional in real classroom contexts. Empirically, these results align with studies emphasizing that visual narrative-based media can enhance participation and learning motivation among elementary school students (Hosler & Boomer, 2019).

Table 3. Expert Validation Results of RME-Based Doodle Art Comics

Assessed Aspects	Indicator	Mean Score	Category
Content	Alignment with learning outcomes	4,50	Very Feasible
Feasibility	Accuracy of numeracy concepts	4,40	Very Feasible
	Meaningfulness of the context	4,35	Very Feasible
Alignment with RME	Use of real-life contexts	4,45	Very Feasible
	Support for progressive mathematization	4,30	Very Feasible
	Facilitation of discussion and reflection	4,25	Feasible
Media	Clarity of doodle art illustrations	4,55	Very Feasible
Feasibility	Readability of text and visuals	4,50	Very Feasible
	Suitability of the design to student characteristic	4,40	Very Feasible
Overall Average		4,41	Very Feasible

Based on Table 4, the results of the teacher questionnaire indicate that the RME-based doodle art comic demonstrates a very high level of practicality, with an average score of 4.54 or 90.80%. Teachers assessed the media as easy to use, relevant to numeracy learning, and helpful in delivering mathematical concepts in a more concrete and contextual manner. This finding indicates that the media

can be implemented without adding administrative or technical burdens to the learning process.

Meanwhile, based on Table 5, students' responses fall into the *very good* category, with an average score of 4.50 or 90.00%. The visual attractiveness aspect received the highest score, which had a positive impact on student engagement in discussions and problem-solving activities. Observatio-

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

nal data further support these findings by showing an increase in students' active participation compared to conventional learning.

Table 4. Results of the Teacher Questionnaire on Media Practicality

Assessed Aspects	Indicator	Mean Score	Category
Ease of Use	Easy to use in the learning process	4,60	Very Practical
	Does not require complex additional tools	4,50	Very Practical
Learning Alignment	Relevant to numeracy content	4,55	Very Practical
	Supports the explanation of contextual concepts	4,65	Very Practical
Time Efficiency	Helps manage learning time effectively	4,40	Very Practical
Overall Average		4,54	Very Practical

Table 5. Students' Responses to the RME-Based Doodle Art Comics

Assessed Aspects	Indicator	Mean Score	Category
Visual	The doodle art illustrations are engaging	4,70	Very Good
Attractiveness	The colors and images are easy to understand	4,60	Very Good
Learning Engagement	Actively participate in discussions during learning	4,45	Good
	Motivated to solve problems	4,50	Very Good
Conceptual Understanding	Helps in understanding word problems	4,40	Good
	Facilitates identifying solution strategies	4,35	Good
Overall Average		4,50	Very Good

3.The implementation stage was conducted through a limited trial.

The analysis of numeracy literacy test results shows a tendency toward improvement in students' abilities after use of the RME-based doodle art comic. Students demonstrated better skills in understanding problem contexts, connecting numerical information, and communicating mathematical reasoning logically. Qualitative data from interviews reinforce these findings, as students stated that the learning activities felt closer to their everyday experiences and were easier to understand. This improvement indicates that the media not only supports procedural understanding but also strengthens conceptual meaning. These findings are consistent with the theoretical framework of Realistic Mathematics Education (RME), which emphasizes the role of authentic

contexts in developing mathematical literacy. Therefore, the RME-based doodle art comic has strong potential as an effective instructional medium to support numeracy literacy among elementary school students.

Based on Table 6, the average numeracy literacy score increased from 61.10 in the pretest to 76.18 in the posttest, resulting in a score difference of 15.08 points. The N-Gain value of 0.39 falls within the moderate category, indicating that the implementation of the RME-based doodle art comic contributed to a meaningful improvement in students' numeracy literacy. This finding suggests that the developed learning media was effective in helping students understand contextual mathematical problems, connect numerical information, and apply appropriate problem-solving strategies. The mode-

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

rate N-Gain score (Table 7) also indicates that the learning intervention provided a positive impact on students'

learning outcomes and numeracy development.

Table 6. Results of Students' Numeracy Literacy Test Before and After the Use of the Media

Numeracy Literacy Aspect	Pretest Mean Score	Posttest Mean Score	Score Difference	Improvement Category
Understanding problem context	63,20	78,50	15,30	Moderate
Connecting numerical information	61,80	76,40	14,60	Moderate
Problem-solving strategies	60,50	75,20	14,70	Moderate
Communication of mathematical reasoning	58,90	74,60	15,70	Moderate
Overall average	61,10	76,18	15,08	Moderate

Table 7. N-Gain Score

Numeracy Literacy Aspect	Pretest	Posttest	Difference	N-Gain	Category
Overall Average	61.10	76.18	15.08	0.39	Moderate

Table 8. Cohen's d Test

Analysis	Value	Category
N-Gain	0.39	Moderate
Cohen's d	0.82	Large Effect

Table 9. Wilcoxon test

Analysis	Value	Category
N-Gain	0.39	Moderate
Effect Size (r)	0.51	Large Effect

Table 10. Percentage of Students' Numeracy Literacy Mastery

Mastery Category	Pretest (%)	Posttest (%)
Mastery Achieved	35,71	78,57
Not Yet Achieved	64,29	21,43

Based on Table 10, the results of the numeracy literacy test indicate an increase in the average scores across all aspects after the use of the RME-based doodle art comic. The greatest improvement occurred in the aspects of mathematical reasoning communication and understanding the context of problems, which are key indicators of contextual numeracy literacy. The overall mean score increased from 61.10 on the pretest to 76.18 on the posttest, with a

difference of 15.08 points, which falls into the moderate improvement category. These findings indicate that the media not only assists students in solving problems procedurally but also strengthens conceptual understanding and mathematical reasoning skills.

Furthermore, Table 5 shows a significant increase in the percentage of learning mastery, from 35.71% on the pretest to 78.57% on the posttest. This improvement suggests that the majority of students were able to achieve the mastery criteria after participating in learning activities using the RME-based doodle art comic. Theoretically, these results are consistent with the principles of Realistic Mathematics Education (RME), which position authentic contexts as the foundation for the development of mathematical literacy. Therefore, the RME-based doodle art comic has strong potential as an effective instructional medium for numeracy learning in elementary schools.

4. Evaluation Stage

The evaluation stage in this study was not conducted as a separate final

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

stage, but rather was integrated into each phase of the ADDIE development model. Evaluation was carried out continuously to ensure that the developed product was aligned with learning needs, student characteristics, and the objectives of strengthening numeracy literacy.

At the analysis and design stages, evaluation was conducted through self-evaluation by the researchers by reviewing the results of the needs analysis, the suitability of the learning materials, the comic storyline, the doodle art design, and the integration of Realistic Mathematics Education (RME) principles into the developed media. This process aimed to ensure that the initial product design was appropriate for elementary school students' characteristics and the needs of contextual numeracy learning.

At the development stage, evaluation was conducted through expert validation and practicality testing. Expert validation involved mathematics education experts and learning media experts who assessed the content feasibility, visual design, readability, and alignment of the media with RME principles. Furthermore, practicality testing was conducted through teacher and student response questionnaires to examine the ease of use, attractiveness, and usefulness of the media in classroom learning.

Meanwhile, at the implementation stage, evaluation was carried out through a limited effectiveness test to examine the potential of the RME-based doodle art comic in improving students' numeracy literacy. The improvement observed in students' numeracy literacy can be explained by the role of doodle art as a simple and meaningful visual representation that helps students understand contextual mathematical

situations. The visual elements presented through doodle art reduce cognitive load by transforming abstract mathematical information into concrete and easily recognizable illustrations. As a result, students are better able to identify relevant information, interpret problem contexts, and connect numerical concepts with real-life situations. Furthermore, when integrated with the principles of Realistic Mathematics Education (RME), doodle art functions not merely as an attractive illustration but as a visual model that supports the mathematization process, enabling students to gradually move from contextual understanding to formal mathematical reasoning. This process contributes to the development of key components of numeracy literacy, including interpreting quantitative information, selecting problem-solving strategies, and communicating mathematical reasoning. Evaluation at this stage included the analysis of pretest and posttest results, classroom observations of students' learning activities, and interviews to obtain information regarding students' learning experiences and challenges during the implementation process.

Therefore, the evaluation stage in this study functioned as a reflective and continuous improvement process throughout all stages of development, ensuring that the resulting product was not only theoretically feasible but also practical and potentially effective for use in elementary school numeracy learning.

The findings of this study indicate that the RME-based doodle art comic meets the criteria of validity, practicality, and effectiveness as a learning medium for strengthening elementary school students' numeracy literacy. The expert validation results yielded an

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

average score of 4.41 (88.20%), which falls into the highly feasible category. These results indicate that the content, visual design, and integration of Realistic Mathematics Education (RME) principles were appropriately implemented. The high scores obtained in the aspects of content feasibility and alignment with RME suggest that the developed comic successfully integrates contextual situations, progressive mathematization, and opportunities for discussion and reflection. These findings support the view that instructional media should not merely function as a means of delivering information but also as a facilitator of meaningful mathematical thinking processes.

The feasibility of the developed comic is closely related to the integration of contextual storylines and simple visual representations. The contextual situations presented in the comic, such as purchasing goods, comparing quantities, and sharing objects, serve as entry points for students to connect mathematical concepts with their real-life experiences. In accordance with the principles of RME, mathematics learning becomes more meaningful when mathematical ideas emerge from situations that are familiar to students. The high validation scores on indicators related to real-life contexts and support for progressive mathematization demonstrate that the developed media successfully translates these theoretical principles into practical learning activities.

The practicality results further strengthen the feasibility of the developed media. The teacher response questionnaire obtained an average score of 4.54 (90.80%), categorized as very practical, while students' responses achieved an average score of 4.50 (90.00%), categorized as very good.

These findings indicate that both teachers and students perceived the comic as easy to use, relevant to learning objectives, and engaging in classroom instruction. Teachers reported that the comic helped explain numeracy concepts in a more concrete and contextual manner, while students expressed high interest in the doodle art illustrations and storylines. This finding suggests that the simplicity of the visual design contributes positively to student engagement. Unlike visually complex media that may increase cognitive load, doodle art illustrations present essential information clearly, allowing students to focus on mathematical reasoning rather than decorative elements.

The effectiveness of the developed comic is reflected in the improvement of students' numeracy literacy after its implementation. The average score increased from 61.10 on the pretest to 76.18 on the posttest, resulting in a gain of 15.08 points. In addition, the N-Gain value of 0.39 falls within the moderate category. Although classified as moderate, this result demonstrates that the learning intervention successfully enhanced students' abilities to understand problem contexts, connect numerical information, develop problem solving strategies, and communicate mathematical reasoning. The increase in learning mastery from 35.71% to 78.57% further confirms the positive contribution of the developed media to numeracy learning.

Furthermore, the effect size analysis revealed a Cohen's *d* value of 0.82 (Table 8) and Effect Size (*r*) 0.51 (Table 9), which falls within the large effect category. This finding indicates that the observed improvement was not only meaningful in terms of learning outcomes but also educationally substantial. While the N-Gain score

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

reflects the level of improvement achieved by students, Cohen's d indicates the magnitude of the media's influence on the development of numeracy literacy. Therefore, the effectiveness of the RME-based doodle art comic should not be interpreted solely through the moderate N-Gain score but also through its substantial educational impact. The combination of a moderate N-Gain and a large effect size suggests that the developed media provides meaningful learning experiences and contributes significantly to students' numeracy development and conceptual understanding.

The improvement in numeracy literacy can be explained through the mathematization process facilitated by the comic. At the beginning of the learning activities, students are exposed to contextual situations that represent horizontal mathematization. During this stage, students identify relevant numerical information and interpret real-world situations using informal mathematical ideas. The doodle art illustrations help students visualize problem contexts and reduce cognitive barriers to understanding. Subsequently, students are guided toward vertical mathematization through the use of numerical operations, tables, diagrams, and mathematical symbols to solve problems. This progression from contextual understanding to formal mathematical reasoning represents a fundamental characteristic of the RME approach.

The role of doodle art in this study extends beyond visual attractiveness. The illustrations function as cognitive tools that support the transition from model-of to model-for. Through simple yet meaningful visual representations, students are able to organize information, recognize mathematical relation-

ships, and construct conceptual understanding more systematically. These findings suggest that visual simplicity can enhance the quality of mathematics learning when intentionally aligned with pedagogical objectives. Therefore, doodle art should be viewed not merely as an artistic element but also as an instructional strategy that supports the development of students' numeracy literacy.

The findings of this study are consistent with previous research emphasizing the effectiveness of Realistic Mathematics Education in improving mathematical literacy and conceptual understanding (Apriyanti et al., 2023; Sutarni et al., 2024). The results also support studies indicating that instructional comics can increase students' motivation, engagement, and participation in learning activities (Setiyadi et al., 2025). However, this study extends previous findings by demonstrating that the integration of doodle art into the stages of RME can serve as an effective mechanism for supporting progressive mathematization (Pujiastuti et al., 2025). Unlike earlier studies that predominantly focused on digital comics or visually complex illustrations, this study highlights the pedagogical value of simple visual representations specifically designed to support students' mathematical thinking processes.

Despite these positive findings, several limitations should be acknowledged. The study involved a relatively small sample and employed a limited trial without a control group, which restricts the generalizability of the findings. Therefore, future studies are recommended to employ experimental or quasi-experimental designs involving larger samples and comparison groups to obtain stronger empirical evidence

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

regarding the effectiveness of the developed media. In addition, future research may expand the application of doodle art comics to other mathematics topics and educational levels.

Overall, the findings confirm that the RME-based doodle art comic represents a pedagogical innovation that is valid, practical, and effective in strengthening elementary school students' numeracy literacy. The combination of contextual learning situations, simple visual representations, and systematic mathematization processes enables students to construct mathematical understanding in a more meaningful, engaging, and relevant manner.

CONCLUSIONS

This study concludes that the development of a doodle art comic based on Realistic Mathematics Education (RME) results in an instructional medium that is feasible, practical, and potentially effective in supporting elementary students' numeracy literacy. The integration of everyday life contexts, simple visual representations, and stages of progressive mathematization enables students to construct numeracy understanding in a more meaningful way. Expert validation results indicate that the developed media demonstrate strong pedagogical alignment and solid content substance, while teacher and student responses reflect high levels of practicality and acceptance. In addition, the findings reveal improvements in students' abilities to understand problem contexts, connect numerical information, and communicate mathematical reasoning. Theoretically, this study enriches RME scholarship by positioning doodle art as a functional visual representation rather than merely an aesthetic element in contextual numeracy learning.

Based on these findings, it is recommended that elementary school teachers utilize RME-based doodle art comics as an alternative numeracy learning medium to foster more contextual, engaging, and meaningful learning experiences. Teachers are also encouraged to adapt the story contexts to their local environments and students' characteristics to optimize the mathematization process. For future researchers, it is recommended to conduct effectiveness testing using experimental designs with control groups and to involve larger samples to strengthen the generalizability of the findings. The development of doodle art comics may also be extended to other numeracy topics or combined with interactive digital media. From a policy perspective, the results of this study may serve as a reference for the development of context-based numeracy learning media aligned with meaningful learning approaches in elementary education.

REFERENCES

- Agus, K. R., & Wardhani, K. D. (2023). Implementation of gamification in learning media to improve student activity and learning outcomes. *International Journal of Multidisciplinary Research and Growth Evaluation*, 4(2), 232–237. <https://doi.org/10.54660/ijmrge.2023.4.2.232-237>
- Apriyanti, E., Asrin, A., & Fauzi, A. (2023). Model Pembelajaran Realistic Mathematics Education Dalam Meningkatkan Pemahaman Konsep Matematika Siswa Sekolah Dasar. *Jurnal Educatio FKIP UNMA*, 9(4), 1978–1986. <https://doi.org/10.31949/educatio.v9i4.5940>
- Asyari, A., Saputra, E., Wulandari, W., Nuraina, N., & Listiana, Y. (2024).

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

- Pengembangan soal literasi numerasi berbantuan quizizz dengan menggunakan konteks sosial budaya kota tebing tinggi. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, 7(2), 285–296.
<https://doi.org/10.22460/jpmi.v7i2.21648>
- Gravemeijer, Fauzan, A., & Plomp, T. (2013). The development of an rme-based geometry course for Indonesian primary schools. *Educational Design Research – Part B: Illustrative Cases, 2013*, 159–178.
<https://research.tue.nl/files/3900348/23590380570408.pdf>
- Hayati, R. (2026). Development of Ethnomathematics-Based Mathematics Workbooks To Improve Numeracy Literacy. *Genderang Asa: Journal of Primary Education*, 7(1), 61–71.
<https://doi.org/110.47766/jga.v7i1.7710>
- Hayati, R., Kartika, Y., Zuraini, Z., & Meilinar, F. (2024). Pelatihan Pembuatan Media Komik untuk Meningkatkan Literasi dan Kemampuan Pemecahan Masalah Siswa. *Jurnal Rambideun*, 7(3), 317–324.
<https://doi.org/10.51179/pkm.v7i3.3046>
- Hayati, R., Syahputra, E., & Surya, E. (2025). RME-Based Gamification on Students' Motivation And Learning Outcomes. *Proceedings of International Conference on Education*, 3(1), 380–386.
<https://doi.org/10.32672/pice.v3i1.3501>
- Hayati, R., Syahputra, E., & Surya, E. (2026). Realistic Mathematics Education Grounded In Deliberative Culture: Fostering Problemsolving Skills in Primary Education. *SCIENTIFIC CULTURE*, 12(1), 616–628.
<https://doi.org/10.5281/zenodo.12126119>
- Ndiung, S., Dantes, N., Ardana, I. M., & Marhaeni, A. A. I. N. (2019). Treffinger creative learning model with RME principles on creative thinking skill by considering numerical ability. *International Journal of Instruction*, 12(3).
<https://doi.org/10.29333/iji.2019.12344a>
- Pujiastuti, N. I., Prahmana, R. C. I., & Evans, B. (2025). Innovative Ethno-Realistic Mathematics-based modules: Promoting Pancasila values in Indonesian mathematics education. *Mathematics Education Journal*, 19(1), 1–22.
<https://doi.org/10.22342/jpm.v19i1.pp1-22>
- Putri, F. A. E., Febriani, D. E., & Parandrengi, R. (2025). Integrating realistic mathematics education and deep-learning approaches into an e-comic. *Primatika: Jurnal Pendidikan Matematika*, 14(2), 349–360.
<https://doi.org/10.30872/primatika.v14i2.6067>
- Putri, G. R., Novita, R., & Rahmattullah, R. (2025). Development of digital mathematics comics based on the realistic mathematics education approach. *Indonesian Journal of Science and Mathematics Education*, 8(3), 681–695.
<https://doi.org/10.24042/ij sme.v8i3.29156>
- Sa'adah, S. N., & Giyartini, R. (2022). Media Ajar Doodle Art untuk Meningkatkan Kemampuan Kreativitas Siswa Kelas V di

DOI: <https://doi.org/10.24127/ajpm.v15i2.15720>

- Sekolah Dasar.
PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar, 9(1), 83–96.
<https://doi.org/10.17509/pedadidaktika.v9i1.53048>
- Sastrawati, E., Maryono, M., Budiono, H., Destrinelli, D., & Yantoro, Y. (2025). Mathematics Comics Based on Problem-Based Learning With Illustrations of Jambi Culture. *Jurnal Eduscience*, 12(1), 217–231.
<https://doi.org/10.36987/jes.v12i1.6876>
- Setiyadi, A. C., Anhar, A., & Muttaqin, H. (2025). Utilizing Comics as a Learning Media to Improve Students' Arabic Speaking Skills. *Arabiyatuna: Jurnal Bahasa Arab*, 9(1), 43–66.
<https://doi.org/10.29240/jba.v9i1.12211>
- Setarni, S., Utama, Prayitno, H. J., Sutopo, A., & Laksmiwati, P. A. (2024). the Development of Realistic Mathematics Education-Based Student Worksheets To Enhance Higher-Order Thinking Skills and Mathematical Ability. *Infinity Journal*, 13(2), 285–300.
<https://doi.org/10.22460/infinity.v13i2.p285-300>
- Suyono, S., Minarti, M., & Wiraningsih, E. D. (2023). The Effect of Realistic Mathematics Education Approach and Learning Motivation To Improving Higher Order Thinking Skills By Controlling Students Intelligence Quotient. *Mathline : Jurnal Matematika Dan Pendidikan Matematika*, 8(3), 1021–1034.
<https://doi.org/10.31943/mathline.v8i3.459>
- Wati, N. W. E. S., Astawa, I. W. P., & Ardana, I. M. (2026). A Systematic Literature Review on Learning Media and Realistic Mathematics Education (RME): Classification of Media Types and RME Characteristics in Enhancing Mathematical Problem-Solving Skills. *EduMatSains: Jurnal Pendidikan, Matematika dan Sains*, 10(3), 385–403.
<https://doi.org/10.33541/edumatsains.v10i3.7694>
- Yuliana, Y., Usodo, B., & Riyadi, R. (2022). The New Way Improve Mathematical Literacy in Elementary School: Ethnomathematics Module with Realistic Mathematics Education. *AL-ISHLAH: Jurnal Pendidikan*, 15(1), 33–44.
<https://doi.org/10.35445/alishlah.v15i1.2591>
- Zuraini, Z., Nofriati, E., Hayati, R., & Zulhelmi, Z. (2024). Pelatihan Literasi Digital untuk Membangun Kreatifitas dalam Pembelajaran Terhadap Guru-Guru. *Community Development Journal: Jurnal Pengabdian Masyarakat*, 5(5), 9454–9459.
<https://doi.org/10.31004/cdj.v5i5.35531>