



Teachers' and Students' Needs for Mathematical Literacy-Based Comics

Audiyah Shinta Bella¹, Tri Candra Wulandari^{2*}, Isbadar Nursit³, Budi Hartono⁴

^{1,2,3}Universitas Islam Malang, Malang, Indonesia

⁴Sekolah Dasar Rajawali, Kalimantan Selatan, Indonesia

Received : June 30, 2026
Revised : July 31, 2026
Accepted : August 8, 2026

Abstract

This study aims to analyze the need for developing mathematical comics as a visual learning medium to improve fifth-grade students' mathematical literacy skills on fraction operations. The study used a Research and Development (R&D) approach with a (4-D) model, focused on the define stage. The research subjects consisted of 8 homeroom teachers and 1 principal, as well as 29 students at Rajawali Elementary School, Tanah Bumbu Regency. Data were collected through questionnaires and interviews, then analyzed descriptively quantitatively and qualitatively. The results of the analysis indicate that learning is still dominated by textbooks, so students have difficulty understanding and interpreting story problems. Teachers and students showed high support for print-based visual media that can be accessed offline. All students expressed a need and interest in mathematical comics to improve mathematical literacy. These findings emphasize the urgency of developing contextual and adaptive print-based mathematical comics to strengthen elementary school students' mathematical literacy skills.

Keywords:

Comics, Mathematics, Literacy, Numeracy

(*) Corresponding Author: fikri.chan@unisma.ac.id

How to Cite: Bella, A. S., Wulandari, T. C., Nursit, I., & Hartono, B. (2026). Teachers' and Students' Needs for Mathematical Literacy-Based Comics. *JTP - Jurnal Teknologi Pendidikan*, 28(2), 563-575. <https://doi.org/10.21009/jtp.v28i2.71049>

INTRODUCTION

Mathematical literacy is a fundamental competency that students need to master to consider and solve problems related to various important issues in their lives. This ability is not only related to the ability to perform calculations but also includes the ability to formulate, apply, and interpret mathematical concepts in real-life contexts (PISA 2022 Assessment and Analytical Framework, 2023). Through this ability, students can recognize the role of mathematics as a means of logical and evidence-based thinking in decision-making (Masfufah & Afriansyah, 2021). Various studies have shown that mathematical literacy is an important predictor of academic success and work readiness in the 21st century (Muhaimin et al., 2024; Rizki & Priatna, 2019). This refers to the ability to use, understand, and interpret mathematics in real-life contexts that are highly relevant to facing the challenges of the workplace and further education. Furthermore, mathematical literacy skills not only predict mathematics achievement but also positively impact academic achievement in non-mathematics fields such as literacy and science (Holenstein et al., 2021). Thus, mathematics learning is no longer oriented solely on mastering formulas, but rather on a meaningful and contextual learning process.

Recognizing the importance of these skills, mathematical literacy has become a serious concern in efforts to improve the quality of education in Indonesia (Astripin Jeane Surupanggil et al., 2025). Various efforts have been made by the government, as evidenced



by the emergence of innovative changes to the independent curriculum (Hidayah et al., 2024) as part of the educational transformation effort. The government introduced the Independent Curriculum, which emphasizes character development, 21st-century skills such as creativity, critical thinking, collaboration, and communication (4Cs), and basic competencies such as literacy and numeracy (R. Lawson & Harper, 2025; Utari & Muadin, 2023).

The low level of mathematical literacy skills is also evidenced by observations conducted by researchers at Rajawali Elementary School, Mentewe District, South Kalimantan, specifically in grade V. When students are given mathematical story problems that require mathematical literacy skills, they experience difficulty in connecting the story to the application of mathematical concepts. Most students do not yet understand mathematical concepts in depth, but rather tend to memorize formulas. As a result, when students are faced with different problems, they experience difficulty and confusion in determining the correct solution (Farida et al. 2024). This condition also indicates the need for teacher professional development (teacher development) in designing and implementing more contextual and innovative visual media-based instructional strategies. Contextual and realistic learning connects mathematical concepts to students' real-life experiences, allowing them to experience the application and meaning of the learning (Badriyah, 2025). As an effort to meet the needs of Rajawali Elementary School, math comics, as a form of narrative visual media, have high potential to bridge the gap between formal mathematical symbols and real-life contexts through stories, illustrations, and dialogue, making mathematics feel more meaningful and realistic for students (Arliani and Khabibah 2022; Guntur et al. 2023; Sipayung et al. 2020). Recent research shows that after using educational comics in mathematics learning, students can understand literacy problems and reduce boredom (Hasibuan et al. 2022).

Several studies have demonstrated that math comics are effective in improving students' mathematical literacy skills (Fitriyani et al., 2021; Hasibuan et al., 2022; Indah Pristy Yenzi et al., 2023; Ningrum et al., 2023; Saraswati et al., 2024). However, no research has specifically examined the needs of teachers and students for mathematical literacy-based comics in rural elementary schools with limited digital infrastructure as a basis for media development. This research gap underlies the need for a systematic needs analysis study before product development begins. Therefore, this study aims to analyze the needs for developing mathematical literacy-based comic media for fraction operations in elementary schools located in rural oil palm plantation areas. This study is the first part of a series of 4-D model research and development (R&D) models, which specifically focuses on the define stage to ensure that the developed product is truly responsive to real needs in the field. The findings of this define stage are expected to provide empirical contributions for learning media developers in designing contextual, adaptive comic teaching materials that are oriented towards strengthening mathematical literacy in elementary schools with rural characteristics.

METHODS

This research employed the Research and Development (R&D) method with the 4D Model. The 4D Model is designed as a systematic procedure for developing learning tools through four main stages: Define, Design, Develop, and Disseminate (Thiagarajan et al., 1974) (see Figure 1). The 4D Model was chosen because it has systematic, structured stages, and is oriented toward developing valid, practical, and effective educational products. Furthermore, this model provides a clear development path, from needs identification to product dissemination, making it widely used in research on the

development of learning tools such as teaching modules, student worksheets (LKPD), learning media, e-modules, and assessment instruments.

This research was conducted at Rajawali Elementary School, Tanah Bumbu Regency, South Kalimantan Province, from December 2025 to January 2026. The subjects consisted of 29 fifth-grade students who had studied fraction operations, eight homeroom teachers, and the principal of Rajawali Elementary School. Of these eight homeroom teachers, only three directly teach mathematics. The teacher needs questionnaire (Table 4) was therefore completed only by these three mathematics teachers, while the remaining teachers and the principal participated in the interview but not in this specific questionnaire.



Figure 1. Development stages using the Four-D model (Source: Thiagarajan et al., 1974)

This research focuses on the initial development stage, namely define, with the aim of identifying challenges, gaps, required learning media, and teacher expectations to ensure the final product developed is able to improve elementary school students' mathematical literacy skills. In the define stage, the research carried out five steps: front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives, as presented in Figure 2.

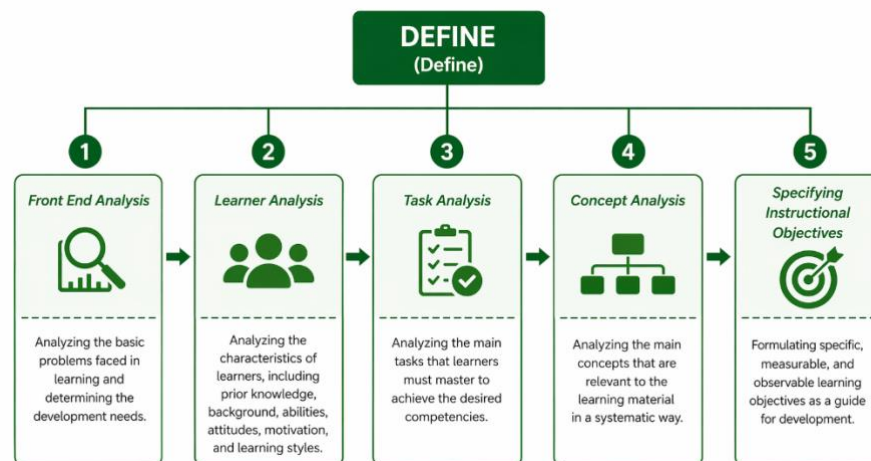


Figure 2. Define Stage

Based on Figure 2, there First, front-end analysis, where researchers analyzed the basic problems faced by teachers and students in the learning process that requires mathematical literacy skills. Second, learner analysis, which analyzes student characteristics to ensure media design and development are relevant to their needs. At this stage, researchers analyzed students' initial competencies, backgrounds, general attitudes toward the learning topic, and the desired media, format, and language. Third, task analysis, which identifies the core skills students must master and breaks these skills down into more specific sub-skills. Fourth, concept analysis, which systematically analyzes the concepts to be presented in the math comic learning media. At this stage, the concept of fractions is identified and organized step by step to avoid misconceptions, and relevant examples are identified. Fifth, specifying instructional objectives, which formulates learning objectives based on the results of task analysis and concept analysis into clear, measurable, and observable objectives.

Scores were obtained from respondents' answers to each statement, while the maximum score was obtained by multiplying the number of respondents by the highest score, which was 4. Before collecting data, the instrument was validated by at least two experts. The instrument was validated by two experts using a validation sheet rated on a scale of 1–4 (1 = not appropriate, 2 = less appropriate, 3 = appropriate, 4 = very appropriate) covering five aspects: content feasibility, goal attainment, format, language, and graphic design. Content validity was calculated using Aiken's V formula. The results showed that the teacher needs questionnaire obtained a mean V of 0.962 (range 0.833–1.000) and the student needs questionnaire obtained a mean V of 0.833 (range 0.667–1.000), both of which fall into the very high category ($V \geq 0.80$), indicating that the instruments were valid for data collection (see Table 1). Result of validate from expert served in Table 1.

Table 1. Content Validity Results of the Instruments (Aiken's V)

Instrument	Items	Validators	Mean V	Range of V	Category
Teacher Needs Questionnaire	13	2	0.962	0.833–1.000	Very high
Student Needs Questionnaire	13	2	0.833	0.667–1.000	Very high

After validated, list of questions in the teacher needs questionnaire is presented in Table 2. The instrument used in the study was validated by experts to ensure its content aligned with the research objectives. The data obtained will be analyzed descriptively (Harahap et al., 2024). The questionnaire design for analyzing teacher and student needs regarding math comics refers to Tables 2 and 3.

Table 2. Teacher Needs Analysis Questionnaire

No	Indicator	Description
1.	Use of learning media in schools	1. Responses regarding the learning media used 2. Responses regarding the need for learning media to improve literacy skills 3. Responses regarding the need for learning media available at schools
2.	Openness to innovative media	1. Response to the use of other learning media. 2. Responses to the use of visual learning media in print form
3.	The need for comic media to improve mathematical literacy skills	1. Response to the need for visual learning media 2. Response to flexible learning media tailored to school conditions 3. Response to comics to support mathematical literacy skills 4. Response to the desire to use math comics

Table 3. Student Needs Analysis Questionnaire

No	Indicator	Description
1.	Media Usage Experience	Respondents' responses to learning media that have been used in schools.
2.	Difficulty understanding contextual problems	Responses to solving problems difficulties.
3.	The need for visual or digital-based learning media.	Responses regarding learning media that can help improve contextual problem-solving skills..
4.	Media access needs	Responses to flexible visual learning media tailored to school conditions.
5.	Interest in math comics	Responses to the needs and desires of math comic learning media.

RESULTS & DISCUSSION

The results obtained by researchers at the define stage included front-end analysis, learner analysis, task analysis, concept analysis, and the formulation of learning objectives using a quantitative descriptive approach. The questionnaire results served as an initial needs analysis at the define stage.

Front-End Analysis: Teacher Perspective

The results of the front-end analysis from the teacher perspective are presented in Table 4.

Table 4. Teacher Perspective

No	Description	Question	Responses (%)			
			SS	S	TS	STS
1.	Use of learning media in schools	• Learning media used in class are school textbooks	33,3	66,7		
		• Teacher use learning media other than textbooks	33,3	66,7		
		• The use of learning media available at school needs to be improved to support students' mathematical literacy skills	66,7	33,3		
2.	Openness to innovative media	• Teacher support the use of learning media other than those provided by the school	100			
		• Teacher support the use of printed media (such as comic books, posters, or illustrated worksheets) as aids to help students	100			
3.	The need for visual-based learning media.	• Teacher need visual learning media to support mathematics learning activities in the classroom.	33,3	66,7		
		• Teacher need printed visual learning media that is easy to share and read without digital devices, such as colored physical books.	33,3	66,7		
		• Teacher need visual learning media using comics to improve mathematical literacy skills in fifth-grade students.	33,3	66,7		
		• Teacher want to use comics in mathematics learning activities.	33,3	66,7		

Note: percentages in this table are calculated out of n=3, reflecting the three mathematics teachers who completed this questionnaire (see clarification in the Method section), not all eight homeroom teachers.

Based on Table 4, in the indicator of learning media use, all teachers (100%) stated that textbooks were the main learning resource. In addition to textbooks, teachers also utilized concrete media such as fraction blocks and tangrams as supporting materials. The use of these manipulative media indicates an effort to help students understand abstract concepts through direct experience, which aligns with Bruner's (1966, cited in Mutaqin et al., 2021) representation theory through three stages: enactive, iconic, and symbolic. Therefore, learning cannot simply rely on text and procedural exercises, but requires media that can provide context, visualization, and a more meaningful learning experience.

Regarding learning innovation, all teachers (100%) expressed openness to the use of alternative media, including illustrated print media such as comics, posters, and visual worksheets. This support demonstrates teachers' readiness to adopt a more varied and communicative learning approach. Based on responses to open-ended questions, most teachers emphasized the importance of having media available in both print and offline formats. This consideration was based on limited internet access in oil palm plantation areas, which means not all students have a stable network. According to respondent G2, "I want comic learning media to be available in both online and offline formats. Not all students have stable internet access. By having an offline version (for example, in the form of an application without internet or a printed book), learning can still run smoothly without network constraints." Meanwhile, G1 proposed that media also be available in digital format to increase learning flexibility and accessibility. According to the respondent, "Utilize technology such as learning applications, both online and offline, to maintain learning accessibility and flexibility."

Conceptually, these differing emphases do not represent a contradiction, but rather reinforce the need for flexible learning design. This means that learning media must be designed to adapt to technological developments while still considering the school's infrastructure (Agustina et al., 2025). In this context, developing printed math comics is seen as the primary solution most suited to real-world school conditions, while developing digital versions can be a further strategy to expand access to learning. This approach aligns with the principle of equity in education, which emphasizes that all students should have equal learning opportunities without being constrained by technical barriers (Wu, 2024). Furthermore, the concept of flexible learning design supports the need for media that adapts to students' conditions and needs (Katsaris & Vidakis, 2021).

Regarding the visual-based media needs indicator, all statements indicate that teachers need flexible and adaptive printed visual media. Conceptually, the difference in emphasis between print and digital does not represent a contradiction, but rather reinforces the need for flexible learning design (Agustina et al., 2025). This approach aligns with the principle of equity in education and the concept of flexible learning design (Katsaris & Vidakis, 2021). The integration of visuals and narrative text in comics can help students build more structured cognitive connections than text-only presentations (Fauzi et al., 2025). Thus, comics not only complement the use of existing textbooks and concrete media but also strengthen the continuity of the learning representation stage to improve students' mathematical literacy skills. Overall, these findings emphasize the urgency of developing print-based visual learning media that are contextual, adaptive, and oriented toward strengthening mathematical literacy, particularly in educational units with limited digital infrastructure.

Front-End Analysis: Student Perspective

The results of the analysis of student experiences using learning media are presented in Table 5.

Table 5. Student Experiences Using Learning Media

No	Description	Question	Responses (%)			
			SS	S	TS	STS
1.	Use of learning media in schools	Use of Mathematics learning media using a whiteboard/blackboard	58	42		
		Learning at school still uses modules/books from the school	78	22		
		My teacher has used learning media (such as: comics, illustration videos from YouTube) in addition to textbooks from the school in mathematics learning activities in class.		58	42	
2.	Difficulty understanding story problems	I don't really understand how to solve math story problems if I only study using school textbooks.	59	41		
3.	Media can help understand mathematical concepts	Learning media helps me understand mathematical concepts in story problems.	40	22	38	

Based on Table 5, students' experiences in using learning media indicate that classroom learning uses a blackboard and school modules. 58% of students strongly agreed, and 42% agreed that textbooks are still used in learning. All students also agreed that teachers use supporting learning media during classroom learning. In an unstructured interview, one student stated that teachers use PowerPoint presentations when explaining material.

Regarding conceptual understanding, 59% of students strongly agreed that they did not understand story problems if they only used textbooks, and 41% students agree if they do not understand story problems if they only used textbooks. Learning that relies solely on textbooks places students in the most abstract position, as it provides less direct or visual experience in understanding concepts (Darmuki et al., 2023). Knowledge becomes increasingly abstract if delivered solely through verbal language or lectures, and understanding concepts abstractly and solely through verbalization can lead to misunderstandings in the learning process (Asadulloh et al., 2024). Students gain more learning experiences if learning media are more concrete. Conversely, if students become more abstract in learning material, they gain fewer learning experiences. Therefore, students will feel helped in understanding story problems through interesting learning media that creates learning experiences from the abstract realm to a more concrete and meaningful realm.

Furthermore, 40% of students strongly agreed, 22% agreed that learning media can help them understand story problems, and 38% disagree it learning media can help them understand the problem. Story problems have a higher level of difficulty compared to regular math problems because the content presents real-life events (Ramadhini & Kowiyah, 2022). This situation reinforces the importance of media that can bridge real-life

contexts with understanding mathematical concepts. Contextual teaching materials help students better understand mathematical concepts, while the use of technology in mathematics learning also provides variety and increases student interest in the subject (Harahap et al., 2024).

Theoretically, this condition can be explained through Bruner's representation theory, which emphasizes the importance of the enactive, iconic, and symbolic stages in learning. In the classroom, the enactive stage has emerged through the use of manipulative media, and the symbolic stage is available in textbooks, but iconic representation as a conceptual bridge has not been optimally utilized. This gap indicates the urgency of developing contextual visual media. Based on this analysis, the development of print-based mathematical comic media is pedagogically and contextually relevant. Digital comics function as iconic representations that bridge the enactive to symbolic stages.

Learner Analysis: Student Difficulties and Needs

The results of the analysis of student difficulties and needs regarding visual-based learning media are presented in Table 6.

Table 6. Student Difficulties And Needs

No	Description	Question	Responses (%)			
			SS	S	TS	STS
1.	The need for visual learning media	Visual or digital-based learning media can help you understand math story problems.	58,6	20,7	20,7	
		Visual or digital learning media using mathematical comics in learning will make learning mathematics more fun and provide a deeper understanding of concepts.	41,4	58,6		
2.	Media access needs	I need visual or digital learning media that can be accessed without using the internet.	41,4	20,7	37,9	
3.	Interest in math comics or digital comics	I need math comics or digital comics to improve my mathematical literacy skills on fractional number operations.	100			
		I am interested in using math comics or digital comics to improve mathematical literacy skills in the material on fractional number operations.	58,6	41,4		

Based on Table 6, 79.3% of students positively perceived visual media as helpful in understanding story problems, while 20.7% did not. Visual media directly optimizes the sense of sight, shifting the learning experience from an abstract level (text-only) to a more

concrete and meaningful level (Qohar et al., 2025). Consequently, students' perceived abstraction during learning is reduced, resulting in optimal understanding.

Based on the questionnaire, 100% of students agreed that visual media creates enjoyable learning and deepens understanding, reinforcing the concept of joyful learning. Enjoyable learning is not merely entertainment, but rather an affective state that supports optimal conceptual absorption. The use of technology and media in mathematics learning provides variety and increases student interest in the subject, while contextual teaching materials help students better understand mathematical concepts (Harahap et al., 2024). This condition is also closely related to the theory of learning motivation. One factor contributing to students' difficulty understanding story problems is low learning motivation (Aryashanti & Yuli Witanto, 2025). Therefore, when visual media can create a pleasant atmosphere, it also acts as a motivational stimulus that overcomes these inhibiting factors.

Considering that the school is located in the middle of a plantation and therefore lacks internet access, 62.1% of students agreed with offline-based learning media, and 37.9% agreed with online-based learning. This finding is a crucial consideration in media selection. The school's geographical location confirms that concrete, visual, offline media is the most realistic and pedagogically effective choice. Learning media need to be designed to adapt to technological developments while still considering the school's infrastructure (Agustina et al., 2025).

Regarding interest in comics or digital comics, all students responded positively to the use of comics, using printed technology in the form of books with engaging story concepts. This indicates that students' interest in comics has not been optimally facilitated by available media. Learning media, when used wisely, can bridge the gap between direct experience and abstract concepts, making learning more concrete, engaging, and relevant (Ramadhini & Kowiyah, 2022). Comics, as a narrative-based visual medium, directly fulfill this bridging function, especially for story problems that require the ability to read context and construct mathematical models (Sipayung et al., 2020).

These findings suggest that developing print-based math comics as a contextual, enjoyable, and geographically appropriate learning solution for story problems in schools. The integration of visuals and narrative text in comics can help students build more structured cognitive connections than simply presenting text (Fauzi et al., 2025).

Task Analysis

Furthermore, the results of a task analysis conducted based on the Merdeka Curriculum and the Mathematics textbook for Grade V indicate that the learning task structure for fraction operations includes identifying known and requested information, determining the type of operation, equating denominators, performing calculations, simplifying results, and interpreting answers within the context of the problem. The analysis indicates that students' main obstacles do not lie in the calculation procedure, but rather in understanding the context of the problem and interpreting the results. This indicates that students' difficulties lie in the aspect of mathematical literacy, particularly in the formulation and interpretation processes (PISA 2022). Thus, media is needed that can systematically visualize the problem context so that students can more easily transform stories into mathematical models and reinterpret the results obtained.

Concept Analysis

In the concept analysis stage, it was identified that the fraction operations material has a hierarchical structure starting from prerequisite concepts such as the meaning of fractions, numerators and denominators, equivalent fractions, and LCM to equalize denominators, then developing into core concepts such as addition and subtraction of fractions with the same or different denominators, to advanced concepts such as

simplifying results and applying them to contextual story problems. This conceptual structure indicates that learning should progress from the concrete to the abstract in stages. However, dominant text-based learning practices tend to place students directly at the symbolic stage. Bruner's 1966 representation theory, cited in (Mutaqin et al., 2021), enactive, iconic, and symbolic transitions must occur systematically to avoid conceptual gaps. In this context, math comics are positioned as iconic representations that bridge concrete experiences to symbolic abstraction. The integration of text and illustrations in comics allows students to visually understand the problem flow while gradually building symbolic connections.

Specifying Instructional Objectives

Based on the overall analysis results, the objectives of media development were formulated to facilitate students in identifying information in story problems, modeling problems in mathematical form, performing fraction operations correctly, and interpreting results in real-life contexts. These objectives align with the learning outcomes of the Independent Curriculum, which emphasizes conceptual understanding, reasoning, and contextual problem-solving.

Overall, the define stage showed that: (1) learning was still dominated by text-based media, with a textbook usage score reaching 100%; (2) students experienced difficulty understanding fraction story problems, as reflected in a score of 58.6% on the difficulty indicator; (3) teachers and students demonstrated high openness to innovative visual media, with a teacher openness score of 100.0%; and (4) there was a need for contextual media that could be accessed offline. These findings underscore the urgency of developing comics as a print-based and also as digital, which visual learning medium that is contextual, adaptive, and oriented toward strengthening the mathematical literacy of fifth-grade elementary school students, particularly in educational institutions with limited digital infrastructure.

CONCLUSION

Based on the analysis of the define stage of the Four-D (4-D) model, it can be concluded that fifth-grade mathematics instruction at Rajawali Elementary School is still dominated by textbooks and text-based approaches, with a textbook usage score reaching 100%. This does not fully support the development of students' mathematical literacy skills. Students experience difficulties, particularly in understanding the context of story problems, formulating mathematical models, and interpreting calculation results in fraction operations. This is reflected in the 58.6% of students who stated they did not understand story problems when learning only using textbooks.

The needs analysis results indicate that teachers and students have a high level of openness to the use of innovative visual learning media. All teachers (100%) support the use of flexible, print-based visual media that can be accessed without relying on the internet, as a response to limited digital infrastructure in oil palm plantation areas. From the student perspective, 79.3% positively perceive that visual media can help understand story problems, and all students (100%) stated that visual comics would create enjoyable learning while enhancing in-depth conceptual understanding. The students' interest in math comics indicates that this interest has not been optimally facilitated by the available media. Furthermore, 62.1% of students expressed the need for media that can be accessed offline, reinforcing the relevance of developing comics in print format as the most contextual and realistic solution. Thus, there is a pedagogical and contextual urgency to develop print-based math comics designed to suit student characteristics and school conditions. This

media development is expected to position comics as iconic representations that bridge the enactive to symbolic stages, systematically visualize the context of problems, strengthen mathematical literacy skills in the formulation and interpretation process, and improve the mathematical literacy skills of fifth-grade elementary school students in the material of fractional number operations. The limited number of respondents in this study makes the findings exploratory in nature, so further studies are needed with a more representative sample in the next development stage..

ACKNOWLEDGEMENT

The authors would like to thank PT. Eagle High Plantation for their support in conducting this research. They also express their appreciation to the school, teachers, and students of Rajawali Elementary School who volunteered to participate and provided the necessary information during the data collection process. They also express their gratitude to Universitas Islam Malang (UNISMA) and CDC_LP2RP for their internship program with industry and to all parties who provided support, input, and assistance throughout the research process and the preparation of this article.

REFERENCES

- Agustina, R. H., Alfiyanto, A., Suhendri, S., Wihardjo, E., & Pranajaya, S. A. (2025). Optimizing Learning: Adaptive Technology Integration in Indonesia's Education System. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, 16(2), 304–317. <https://doi.org/10.37640/jip.v16i2.2293>
- Arliani, S. P., & Khabibah, S. (2022). Development Of Mathematical Digital Comics With Ethnomatematics Approach To Class Iii Elementary School On Weight Unit Conversion Material. *MATHEdunesa*, 11(2), 481–487. <https://doi.org/10.26740/mathedunesa.v11n2.p481-487>
- Aryashanti, N., & Yuli Witanto. (2025). Analisis Kesulitan Peserta Didik dalam Menyelesaikan Soal Cerita Matematika Ditinjau dari Kemampuan Pemahaman Konsep dan Keterampilan Matematika. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 7(2), 180–189. <https://doi.org/10.36232/jurnalpendidikandasar.v7i2.1899>
- Asadulloh, Bahtiar, R. S., & Santoso, E. (2024). Penggunaan Media Benda Konkret untuk Meningkatkan hasil Belajar Matematika Siswa Kelas 1 Sekolah Dasar. *Journal of Science and Education Research*, 3(2), 43–49. <https://doi.org/10.62759/jsr.v3i2.129>
- Astripin Jeane Surupanggil, Surya Putra Raharja, & Suhartini Sumadi. (2025). Analysis of Students' Abilities in Solving Numeracy Literacy Problems in Mathematics Learning at the Junior High School/ MTS Muhammadiyah in Sorong Regency. *Noumerico: Journal of Technology in Mathematics Education*, 3(2), 93–101. <https://doi.org/10.33367/jtme.v3i2.6531>
- Badriyah, L. (2025). Realistic mathematic education (RME) sebagai model pembelajaran. In *Maliki Interdisciplinary Journal (MIJ) eISSN* (Vol. 3). <http://urj.uin-malang.ac.id/index.php/mij/index>
- Budi Indaryanti, R., Murtiyasa, B., & Soemardjoko, B. (2025). 4D Research and Development Model: Trends, Challenges, and Opportunities Review. In *Jurnal Kajian Ilmiah* (Vol. 25, Number 1). <http://ejurnal.ubharajaya.ac.id/index.php/JKI>
- Darmuki, A., Hidayati, N. A., Tanghal, A. B., & Esteban Jr, A. M. (2023). Pengembangan dan keefektifan model buku teks mata kuliah strategi pembelajaran berbasis

- pendekatan kontekstual. *KEMBARA Journal of Scientific Language Literature and Teaching*, 9(1), 223–238. <https://doi.org/10.22219/kembara.v9i1.22635>
- Farida, M., Sihotang, H., & Ditasona, C. (2024). Analysis Of Students' Difficulties In Solving Algebraic Operation Problems Based On Problem-Solving Skills In Grade Vii At Smp Negeri 8 Tambun Selatan. *EduMatSains : Jurnal Pendidikan, Matematika Dan Sains*, 8(2), 228–238. <https://doi.org/10.33541/edumatsains.v8i2.5131>
- Fauzi, A., Jannah, N. U. J., & Fikri, S. (2025). Digital Comics: Media Analysis in Maharah Qiro'ah Learning. *Journal of Literacy Education*, 1(3), 107–117. <https://doi.org/10.64780/jole.v1i3.75>
- Fitriyani, Y., Eliyanti, M., & Lestari, M. A. (2021). Penerapan Media Komik Untuk Meningkatkan Kemampuan Literasi Dalam Memahami Soal Cerita Matematika Di Sekolah Dasar. *Auladuna: Jurnal Pendidikan Dasar Islam*, 8(2), 168. <https://doi.org/10.24252/auladuna.v8i2a5.2021>
- Guntur, M., Sahronih, S., & Ismuwardani, Z. (2023). Pengembangan Komik Sebagai Media Belajar Matematika Di Sekolah Dasar. *JKPD (Jurnal Kajian Pendidikan Dasar)*, 8(1), 34–44. <https://doi.org/10.26618/jkpd.v8i1.9685>
- Harahap, S. R., Lubis, Y., & Sofiyah, K. (2024). Strategi Pembelajaran Mengatasi Kesulitan Anak Sd Dalam Mengerjakan Soal Cerita. *TEACHER : Jurnal Inovasi Karya Ilmiah Guru*, 4(1), 1–8. <https://doi.org/10.51878/teacher.v4i1.3079>
- Harahap, S. W., Mardianto, M., & Salminawati, S. (2024). Pengembangan E-Modul Fikih dalam Pembelajaran Fikih untuk Madrasah Tsanawiyah di Medan. *Scaffolding: Jurnal Pendidikan Islam Dan Multikulturalisme*, 4(2), 625–642. <https://doi.org/10.37680/scaffolding.v4i2.5235>
- Hasibuan, N. H., Gusmania, Y., & Rahman, S. (2022). Efektivitas Pengembangan Media Pembelajaran Komik Berbasis Kodular untuk Kemampuan Pemahaman Literasi Matematika Siswa SDS Edustar. *Jurnal Absis: Jurnal Pendidikan Matematika Dan Matematika*, 4(2), 501–510. <https://doi.org/10.30606/absis.v4i2.1218>
- Hidayah, I. R., Sa'dijah, C., Anwar, L., Yerizon, Y., & Arnawa, I. M. (2024). Empowering students' numeracy skills: Mathematics teachers' perceptions regarding the effectiveness and challenges of Indonesian national curriculum and the programs – A mixed method study. *Infinity Journal*, 14(1), 163–188. <https://doi.org/10.22460/infinity.v14i1.p163-188>
- Holenstein, M., Bruckmaier, G., & Grob, A. (2021). Transfer effects of mathematical literacy: an integrative longitudinal study. *European Journal of Psychology of Education*, 36(3), 799–825. <https://doi.org/10.1007/s10212-020-00491-4>
- Indah Pristy Yenzi, Mujahidawati, M., & Novferma, N. (2023). Pengembangan Komik Matematika Berbasis Problem Based Learning untuk Meningkatkan Kemampuan Literasi Matematis Siswa. *JURNAL PENDIDIKAN MIPA*, 13(4), 1114–1125. <https://doi.org/10.37630/jpm.v13i4.1303>
- Katsaris, I., & Vidakis, N. (2021). Adaptive e-learning systems through learning styles: A review of the literature. *Advances in Mobile Learning Educational Research*, 1(2), 124–145. <https://doi.org/10.25082/AMLER.2021.02.007>
- Masfufah, R., & Afriansyah, E. A. (2021). *Mosharafa: Jurnal Pendidikan Matematika Analisis Kemampuan Literasi Matematis Siswa melalui Soal PISA*. 10(2). <http://journal.institutpendidikan.ac.id/index.php/mosharafa>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2020). Qualitative data analysis: A methods sourcebook (4th ed.). Sage
- Miles, M.B & A. Michael Huberman. (1994). Qualitative Data Analysis: An Expanded Sourcebook. *Journal of Environmental Psychology*, 14(4), 336–337. [https://doi.org/10.1016/S0272-4944\(05\)80231-2](https://doi.org/10.1016/S0272-4944(05)80231-2)

- Muhaimin, L. H., Sholikhakh, R. A., Yulianti, S., Ardani, A., Hendriyanto, A., & Sahara, S. (2024). Unlocking the secrets of students' mathematical literacy to solve mathematical problems: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(4), em2428. <https://doi.org/10.29333/ejmste/14404>
- Mutaqin, E. J., Muslihah, N. N., Hamdani, N. A., & Sasty, S. D. F. (2021). Analysis of The Application of Learning Theory of J.B. Bruner in a Counseling Study Counting Operation to Add Whole Numbers. *Social, Humanities, and Educational Studies (SHEs): Conference Series*, 4(1), 109. <https://doi.org/10.20961/shes.v4i1.48582>
- Ningrum, N. L., Basir, M. A., & Maharani, H. R. (2023). Pengembangan Komik Digital Untuk Meningkatkan Literasi Numerasi Siswa Pada Materi Statistika. *Jurnal Pendidikan Matematika (JPM)*, 9(2), 164–171. <https://doi.org/10.33474/jpm.v9i2.19761>
- PISA 2022 Assessment and Analytical Framework. (2023). OECD Publishing. <https://doi.org/10.1787/dfef0bf9c-en>
- PISA 2022 Results (Volume I). (2023). OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Qohar, Moh. A., Azizah, S. N., & Sholekka, R. (2025). Efektivitas Penggunaan Media Gambar terhadap Peningkatan Pemahaman Belajar Matematika Siswa. *Jurnal Axioma: Jurnal Matematika Dan Pembelajaran*, 10(2), 50–60. <https://doi.org/10.56013/axi.v10i2.3790>
- R. Lawson, E., & Harper, L. V. (2025). Characteristics Of Learning In The Independent Learning Curriculum In Madrasah Ibtidaiyah. *ELEMENTARY: Journal of Primary Education*, 3(1), 20–25. <https://doi.org/10.55210/elementary.v3i1.510>
- Ramadhini, D. A., & Kowiyah, K. (2022). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Matematika Materi Kecepatan Menggunakan Teori Kastolan. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(3), 2475–2488. <https://doi.org/10.31004/cendekia.v6i3.1581>
- Rizki, L. M., & Priatna, N. (2019). Mathematical literacy as the 21st century skill. *Journal of Physics: Conference Series*, 1157, 042088. <https://doi.org/10.1088/1742-6596/1157/4/042088>
- Saraswati, L., Zaenal, R. M., & Yusritawati, I. (2024). Pengembangan Media Pembelajaran Komik Matematika (KOMKA) untuk Meningkatkan Kemampuan Numerasi Siswa Sekolah Dasar. *Indo-MathEdu Intellectuals Journal*, 5(4), 4463–4475. <https://doi.org/10.54373/imeij.v5i4.1597>
- Sipayung, T. N., Simanjuntak, S. D., Wijaya, A., & Sugiman, S. (2020). The effect of comic-based realistic mathematics approach on students' learning motivation and conceptual understanding. *Journal of Physics: Conference Series*, 1538(1), 012111. <https://doi.org/10.1088/1742-6596/1538/1/012111>
- Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). Instructional development for training teachers of exceptional children: A sourcebook. Leadership Training Institute/Special Education, University of Minnesota.
- Utari, D., & Muadin, A. (2023). Peranan Pembelajaran Abad-21 Di Sekolah Dasar Dalam Mencapai Target Dan Tujuan Kurikulum Merdeka. *JURNAL PENDIDIKAN ISLAM AL-ILMI*, 6(1), 116. <https://doi.org/10.32529/al-ilm.v6i1.2493>
- Wu, Y. (2024). Study on Educational Equity and Resource Allocation from an International Comparative Education Perspective. *Journal of Education, Humanities and Social Sciences*, 44, 42–47. <https://doi.org/10.54097/we9x1g23>